54th ISOCARP CONGRESS 2018

1-5 Oct. Bodø, Norway

COOL PLANNING:

CHANGING CLIMATE & OUR URBAN FUTURE

Proceedings

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Cool planning: changing climate & our urban future
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Knowledge for Better Cities

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INTRODUCTION

Dushko Bogunovich
General Rapporteur

Dushko Bogunovich is Professor of Urban Design and Planning, and Dean of the Faculty of the Built Environment, Arts and Science at BA ISAGO University in Botswana. He now lives in Gaborone. His permanent residence is in Auckland. There, Dushko was Associate Professor of Urban Design at Departments of Architecture, and Landscape Architecture, at New Zealand's largest polytechnic, Unitec Institute of Technology. He taught under- and post-graduate courses, and conducted research and consulting in: urban planning, environmental policy and sustainable development. His research focus is on Auckland, Christchurch and the NZ urban system in the context of global urbanisation and the challenges posed by the acceleration of climate change. Dushko has been a member of ISOCARP since 1984.

Perhaps the year 2018 will go down in history as the year the global community finally realised that climate change is an existential and imminent threat to human presence on Earth. As the UN Secretary General, Antonio Guterres, put it at a meeting at the UN Headquarters in New York on September 10th: ***"The world risks crossing the point of no return on climate change, with disastrous consequences for people across the planet and the natural systems that sustain them."***

Strong words for a professional diplomat. But how many of the 7.3 billion people on the planet will have heard them? And grasp the dire urgency? It is more likely that the extraordinary weather events of this year's Northern summer will produce the needed awakening impact on public opinion and government action, than yet another political speech.

In the same week that Mr Guterres was raising the alarm over the paralysis of world leaders and voicing his dismay at the slow implementation of the Paris Agreement, two colossal super-storms were spinning at either side of the globe – hurricane Florence in the Atlantic, and typhoon Mangkhut in the Pacific. Tens of millions of people in the cities, towns and villages in the eastern US, The Philippines and southern China stood in the way of these two monster-storms.

The Call for Papers for this congress was written in January 2018. It contained a few bold statements. The Call announced that the congress agenda would be ***'one of the most ambitious in ISOCARP's history'*** and declared that the aim of the congress was 'nothing less than to save civilisation'. It asserted urban planners' critical role in this undertaking, arguing that ***'the future of civilisation now more than ever depended on the way we plan and manage our cities and towns'.***

The Call also introduced the host city, Bodø, describing it as ***'cool in both senses'.*** This was a dual reference to its attraction to visitors and investors as a 'cool place', and to the fact that it is a cold city, due to its location Europe's and Norway's far north, inside the Arctic circle.

However, in the meantime - as the weird Northern Hemisphere summer of 2018 would have it - Bodø became unusually warm. Along with its region, Nordland, and the rest of Arctic Norway and Sweden, Bodø experienced temperatures of around 30 degrees Celsius (the normal for July is about 15). What was even more anomalous for this region of the world, was that it had more than 50 forest wildfires, something normally associated with Mediterranean parts of Europe.

In fact, the entire Northern Hemisphere has been affected by unusually weather phenomena. Heat waves, forest fires, storms and floods were fierce and widespread all over North America, Europe, Asia and northern Africa. Heat waves in July and August affected Ireland, Wales, England, France, Spain, Portugal, Turkey, Pakistan, China, the Koreas, Canada and California. In early August, temperatures in western Spain and southern Portugal reached 47 degrees. Meanwhile, forest wildfires were raging in the United Kingdom, Sweden, Denmark, Estonia, Finland, Latvia, Malta, the Netherlands, Poland and Germany. In Greece 90 people died in one wildfire near Athens. This is almost as many as Portugal in 2017, when more than 100 people died in wildfires. In California, some 5,000 recorded wildfires killed 10 people, burned 3,000 sq km of land, destroyed over 1,000 homes and forced evacuation orders on 20,000 residents. In Asia, storms and floods battered regions of Japan, China and India.

But while the attention of the media and the public is understandably on the populated areas, the scariest harbingers of the new climate in 2018 are in the Arctic. In December and January this past winter, the area between the North Pole and the Svalbard Islands had weeks of above zero temperatures. It even rained. By the time we all gather in Bodø, we will know if the long predicted 'blue ocean event' happened, or didn't. At the time of writing this report, a completely ice-free Arctic Ocean seemed unlikely. But that is of little consequence. The fact is that the Arctic sea ice is almost gone and the ***albedo effect*** – more solar heat gain from the darker surface of an ice-free ocean – is now accelerating. This means the permafrost areas of the coastal plains and shallow seas of Siberia, Canada and Alaska are irreversibly thawing. And that means the dreaded 'methane clathrate bomb' is ever more likely to go off and change our planet forever.

So, the situation with the global climate system is indeed alarming. No more are we facing the 'prospect' of climate change – the climate HAS changed. In this new reality, what concerns our profession is that cities and towns worldwide will face the consequences in a disproportionate way. Not only because urban areas now contain more than half the human population, but also because urban inhabitants are heavily dependent on that clever human invention called 'urban infrastructure'. The trouble with urban infrastructure is that when it works, life is good and easy; but when it gets destroyed or disabled, life quickly turns to hell.

So what can Planning do? What can town, city, regional and spatial planners do to mitigate climate change processes that can still be prevented or slowed down, and to prepare us for all those that are now inevitable?

This is what this 54th Congress of ISOCARP is about. 500 planners from all over the world will gather in Bodø for five days to try to answer the two big questions of 21st century urbanism:

1) how can we make cities more ***sustainable*** and thus prevent even more global warming - given that 'cities are heat engines' (as succinctly and profoundly stated in the language of thermodynamics and its Second Law – the Law of Entropy);

2) how can we make cities more ***resilient***, so that they can withstand the shocks and crises that seem inevitable regardless of how soon we take drastic action to curb our carbon emissions.

However, there is an even harder question, implied in these two, which we intend to put in front of delegates towards the end of the congress. Which of these two agendas - sustainability or resilience - has (or should have) priority for your planning department or consultancy? Or for your mayor and your city council? Or in the opinion of your citizens?

We do not expect a clear cut and definitive answer. Nor are we asking because we think somebody knows the exact answer. We are asking because we think this is the most important question for governments – central and local - and the planning profession to consider at this moment in history.

The Congress delegates are coming from 53 nations and some 160 cities and towns. Contributions will come in the form of papers, case studies and special sessions.

The plenary sessions will be addressed by the Norwegian and ISOCARP dignitaries, as well as by three extraordinarily qualified, internationally renowned keynote speakers:

• ***Jeremy Rifkin,*** globally acknowledged economist, futurologist and expert on technology, cities and industrial revolutions, author of several seminal books;

• ***Peter Newman,*** professor and author from Australia, leading world expert on sustainable cities, and transport and technology policy;

• ***Herbert Girardet,*** author and educator, from the UK, and world's leading expert on urban ecology and the imperative of 'regenerative urbanism'.

But of course, the engine room of any conference are the presentation sessions. These will be delivered in six concurrent tracks, each one a sequence of between five and seven sessions. Each track will be monitored by a pair of rapporteurs chosen from different corners of the world.

• ***Track One*** is about the ***Global View*** – comprised of papers which are not rooted in a particular city or town or region, but are global in scale and consequence. They aim to interrogate the general question of impacts of climate change on urban areas and these areas' generic capacity for sustainability/mitigation and resilience/adaptation.

Tracks Two, Three, Four and Five are about climate and specific cities and towns - their issues and projects, and the main strands of their climate response:

• ***T2 - Spotlight Cities*** – as defined by their somewhat specific locations and geographies (coastal; mountainous, remote; Arctic; tropical…);

• ***T3 - Climate-proof Cities*** – defined as urban areas where the basics such as food, water, energy and shelter are deemed vital in readiness for future extreme weather events;

• ***T4 - Technology and Infrastructure*** – is focused on engineering and how the design concepts of 'clean', 'green' and 'smart' can support the objective of being a resilient and sustainable city;

• ***T5 - Social Networks*** – is about the human factor and politics; it interrogates models of citizen participation, urban governance and cultural transformation required for transition to sustainability and resilience.

Track Six is about examples of ***Contemporary Planning Practice*** worldwide which are not necessarily focused on the climate/global warming issue. It offers insights into the diversity of the planning profession's current issues, methods and solutions worldwide.

There will also be several special sessions, including on:

• ***UN's Sustainable Development Goals in Norwegian Planning;***

• ***Strategic Research and Innovation Agenda;***

• ***The Next City (an ISOCARP seminar); and***

• ***Global Resilience Networks.***

Finally, thanks to our hosts, the City of Bodø, there will be a stream of session open the public – at the ***ByLab*** venue. ***ByLab*** will cover topics like:

Planners for Climate Action (an UN initiative); New Generation of Planners (an ISOCARP initiative); Reframing Citizen Participation for Sustainability Transition; Planning for Diversity; and Legitimacy of Urban Governance.

Does this look promising? Will this congress ***'save the world'***?

As clearly stated in the Call for Papers, ***'the root cause of, and the solution to the global climate crisis, are fundamentally urban'.*** In plain language: cities will determine the fate of the world. Their rampant metabolism is powerful enough to throw the entire biosphere into a death spiral - and this may happen well before 2100. But their extraordinary concentration of human intelligence (planners included!) offers the hope that we'll figure out how to save ourselves before breachingw of which the UN General Secretary warned us on 10th September.

We are coming to the realisation that Cool Cities are a historical imperative. Either our cities get Cooler, or our planet gets Warmer.

This imperative will not happen by itself. It is a task which must be planned. This makes urban planning the coolest profession on the planet.

Short outlines

Papers

Track 1. The global view: climate change impacts, sustainability and resilience

Track 2. Spotlight cities: planning for coastal cities, remote towns and high north cities

Track 3. Climate-proof cities: planning for weather, water, food and energy

Track 4. Technology and infrastructure: clean, green, smart and resilient

Track 5. Social networks: citizen participation, urban governance and cultural transformation

Track 6. Contemporary planning practice: projects and paradigms

Authors are responsible for the content of the short outlines and the full papers which are listed in the order of their presentations in each track.

Track 1: The Global View: Climate Change Impacts, Sustainability and Resilience

Location: Scandic Havet – Storhavet 1

by Kate Holmquist and Evren Ulker Kacar

Track 1 takes a global look at climate change, exploring how urban and rural areas worldwide are tackling challenges regionally, and how solutions can be applied globally. Presentations from five continents will approach the conference theme of climate change holistically, acknowledging the scale of this phenomenon, and the global collaboration necessary to comprehensively and effectively respond. Participants will be introduced to the impacts of climate change affecting communities, and challenged to think globally about strategies for sharing knowledge, scaling up solutions, and addressing issues of equity that disproportionately affect some populations over others. Sessions will explore planning approaches being employed to mitigate climate change and plan for more resilient cities and communities at different scales and levels of government, in parts of the world where planning for climate change is well underway to countries still striving to raise awareness on the impacts of climate change.

Congress Abstracts: Assessment/ Commentary

The Global View Track looks at the big picture. We expect lively discussions as diverse view points highlight important challenges, disparity, and fragmented approaches – and offer a global forum for understanding a global issue, and identifying opportunities to strategically reduce the effects of climate change through collaboration, idea sharing and coordination. Diverse case studies will offer valuable lessons in what has worked and what hasn't; and practitioners and academics across a range of organizations will evaluate and discuss the potential of spatial planning, land use management, and technologies for risk assessment to inform policy and practice – from different perspectives.

What can we expect at the congress

The Global View Track will feature over 30 speakers, organized into six sessions that explore the impacts and assessment of climate change, policy challenges at the national level in the context of global climate goals and agendas, and present planning methodologies for and case studies in sustainability and resilience.

Session 1: Global Goals & National Planning Policy – Part I

How are governments responding to global climate agendas and sustainability goals? Two sessions will explore challenges of national, state and local coordination on policy and planning to ensure action and progress. Part I will focus on intergovernmental coordination and the hurdles to implementation, and actionable policy to address energy efficiency and production, green-house gas emissions, sea level rise, and achieving Zero Carbon cities.

Session 2: Cultural Impact of Climate Change: Norway multi-dwelling lifestyle.

Researchers from the Norwegian University of Life Sciences will present on shifting cultural patterns in homeownership, and the link to climate change. More than one out of five households in Norway own a vacation home in addition to their primary homes. Case studies in this session will focus on mobility and housing consumption patterns including the effects of climate change on travel modes and future land use patters.

Session 3: Global Idea Sharing – Case Studies in Sustainability & Resilience

In the spirit of the 54th Congress we will create a global forum for idea sharing, presenting a variety of case studies that take a critical look at what works and what doesn't in planning for sustainability and resilience.

We will hear about successful spatial planning approaches for reducing greenhouse gas emissions in three developed nations, the role of spatial planning and land use management in Africa, and the effects of changing weather patterns and rapid glacier retreat on water availability in Andean Cities, and New York City, Doha, Qatar will discuss their strategies for a resilient future.

Session 4: Planning Methodologies for climate adaptation & resilience

Presenters and participants are invited to take a high-level look at the planning profession and rethink methodologies for climate adaptation and resilience. We will hear from topical experts about environmental planning, spatial planning, and land use management approaches, such as endogenous resilience, volcanic river basin management and the use of indigenous knowledge as a tool for water resource management. This session will look at methodologies ranging from place-based solutions to systems level planning strategies, illuminating a natural tension between contextual approach and the need for scalable solutions.

Session 5: Global Goals & National Planning Policy – Part II

How are strategies measuring up in meeting national and global climate targets? Part II will dive into coordination of climate action and planning policies across borders and political boundaries. Presentations will look at spatial planning and regulation at the local level in African and Asian cities, to understand their effectiveness in addressing national climate policies.

Session 6: Assessment & understanding the Impacts of Climate Change

World-wide, the impacts of climate change vary widely and are experienced differently. For planners to address climate change holistically and strategically, the assessment of regional effects of climate change and the data to project future impacts are critical. Session 6 explores efforts by government agencies, NGOs, and academic institutions to measure and understand the problem to make data-driven solutions possible.

Session 1: Global goals & national planning policy - *Part I*

2 October (Tuesday), 11:00 - 12:30

TK *Chris Gossop, National Energy Foundation (NEF), Milton Keynes, United Kingdom*
London and climate change - a zero carbon city for 2050 - achievable or just hot air?
The new London Plan sets the target of London becoming a zero carbon city by 2050. The paper explores the realism of this - will the prescriptions of the plan and the likely results on the ground suffice to meet that target?

Mooza Al-kuwari; Khonokze Rahaman, Doha, Qatar
Climate change strategy for the urban planning and development sector in Qatar
The Ministry of Municipality and Environment has developed a Climate Change Strategy for the Urban Planning Sector for the State of Qatar that will regulate developments in the country.

Serena E. Alexander, San Jose State University, San Jose, USA
Harnessing the opportunities and understanding the limits of America's state-level climate action plans
This research is an evaluation of America's current state-level climate action plans focusing on their emissions reduction outcomes as well as their development procedure and foundations; goal setting, policy coverage and regional coordination; implementation provisions and conditions; and implementation mechanisms and monitoring results.

Sisi Liang, Tsinghua University, Beijing, China
From green to resiliency: A review of evolution, experiences and implementations of American Climate Change Action Plan
Through a deep review of city-level climate action plans in the United States, this paper discusses the evolution, implementation, and performance of green efforts cities made during the past decade. It calls for a transformation of policy from green development toward improvement on resiliency.

Olga Chepelianskaia, Uniciti, Toulouse, France
Climate resilience through land use regulations in Asian CIties
Climate resilience is a critical imperative for Asian cities and it needs to be mainstreamed into land use regulations to achieve a durable and cost-effective result. The presentation outlines how to put this approach in place in a context of developing Asian cities' political, institutional, economic and societal challenges.

Session 2: Cultural impact of climate change: Norway multi-dwelling life-style

2 October (Tuesday), 13:00 - 15:00

TK *Jin Xue; Petter Næss; Rasmus Steffansen; Harpa Stefansdottir; Tim Richardson, Norwegian University of Life Sciences, ÅS, Norway*
Multi-dwelling home lifestyle and climate change
Drawing on the concept of multi-dwelling home lifestyle, the paper aims to analyze the associated mobility pattern, housing consumption pattern and the impacts on climate change.

Rasmus Steffansen; Jing Xue; Harpa Stefansdottir; Petter Næss; Tim Richardson, Ås, Norway
Vacation home planning, perceptions of nature and climate change
This study focuses on perceptions of nature and climate change in relation to Norwegian vacation home planning, ownership and use. The data (qualitative/quantitative) largely reveals an anthropocentric outlook from both the planning side and the user side, resulting in a neglecting of nature and climate changes related impacts and effects.

Petter Næss; Jin Xue; Rasmus Steffansen; Harpa Stefansdfottir; Tim Richardson, Norwegian University of Life Sciences, Ås, Norway
Travel modes for visits to non-primary dwellings: considerations and justifications
Based on qualitative interviews of Norwegian users of non-primary dwellings, supported by a questionnaire survey among a larger sample, this paper addresses travel modes when visiting non-primary dwellings and the reasons stated for choosing the relevant modes of transportation.

Harpa Stefansdottir; Jin Xue; Petter Næss; Rasmus Steffansen; Tim Richardson, Norwegian University of Life Sciences, Ås, Norway
The impact of climate change on potential use of vacation homes
The aim of the study is to lay out how changing climate may affect the future use pattern of three selected vacation home areas in Norway. This study is mainly based on eleven qualitative in depth interviews with vacation home owners in Trysil, Oppdal and Kragerø.

Session 3: Global idea sharing - Case studies in sustainability and resilence

2 October (Tuesday), 15:30 - 17:00

TK *Deborah Heinen, Hafencity University, Hamburg, Germany*
The role of regional planning in the US, Canada and Germany in spatial climate mitigation actions
Land use and transportation patterns are significant factors impacting greenhouse gas emissions. They are also factors that are governed differently in nations across the globe. Therefore this paper seeks to compare the regional capacities to govern land use and transportation in Hamburg (Germany), Seattle (USA) and Vancouver (Canada).

Rolf Schuett, Systemarchi, Nochowo, Poland
Climate change impact in Andean cities in Bolivia: the Tiquipaya case and a community led New Urban Agenda for resilient planning
This paper discusses how it may be possible to implement important impulses of the New Urban Agenda in communal collaboration strategies. It suggests as well how low tech landscape and urban design can improve resilience and community involvement.

K. Emmanuel Letebele, EThekwini Municipality, Durban, South Africa
The impact of climate change on spatial planning, the case of Durban, eThekwini Municipality
The Municipality developed the Spatial Development Framework underpinned by New Urban Agenda, Sustainable Development Goals, and the Paris Agreement. It also has climate change responses such as the Durban Climate Change Strategy and Climate Resilience Implementation Plan. The paper will explore coordination, main streaming and implementation of climate change.

Sagwata Manyike, South African National Biodiversity Institute, Pretoria, South Africa
Incorporating climate change resilience into spatial development tools in South Africa
The Biodiversity and Land Use Project, which is funded by the Global Environmental Facility through the United Nations Development Programme is piloting various ways in which South African Cities can become more resilient towards climate change through interventions in their spatial planning and land use management systems.

Track 1

Tjark Gall, Urban Framework, Germany

A methodological approach to measure interrelations between urban form and flood-related risks in Kampala, Uganda

This paper aims to develop a method to examine the relationship of spatial characteristics to the often-unjust distribution of climate change risk exposure and test it in the case of Kampala, Uganda. The research intends to increase the understanding of spatial injustice to support better-informed policy and spatial intervention strategies.

Ali A. Alraouf; Jomaa A. Marzouq, Urban Planning Doha, Doha, Qatar

Revisiting the concept of resilient cities: the case of Doha, Qatar

Using the case of Doha, the paper illustrates a new conceptual understanding of cities' resilience. The paper analyses the contemporary evolution in Doha and highlights the milestones in structuring the new vison for Doha's development as a resilient city holistically.

Ingrid Young, New York City Mayor's Office, New York, United States of America

New York City- environmental review and planning for a sustainable future

NYC Planning and Environmental Review- Creating a more Sustainable and Resilient City. How rethinking one major city's regulatory framework can better shape sustainable growth over the next century.

Session 4: Planning methodologies for climate adaption and resilience

3 October (Wednesday), 13:30 - 15:00

TK *Alexei Trundle, The University of Melbourne, Parkville, Australia*

Endogenous resilience: integrating urban informality with climate change planning in Pacific Small Island Developing States

This paper demonstrates pathways for building on the resources, networks, and latent capacities of urban informality to enhance the climate resilience of urban systems. Post-disaster case study research from two Pacific Small Island Developing States is used to illustrate conceptual and practical opportunities for urban planning to complement endogenous resilience.

Vicky Ariyanti; Jurian Edelenbos; Peter Scholten, Erasmus University Rotterdam/ IHS, Rotterdam, Netherlands

Future direction for a volcanic basin planning

Governing water in an active volcanic basin requires inter-faceted views and integration of water, lahar (volcanic debris flow) and volcano management. This paper addresses these issues simultaneously using a case of Opak Sub-Basin in Mt. Merapi region, Indonesia.

Guri Venvik, Geological Survey of Norway, Trondheim, Norway

The ground beneath our cities

The subsurface is important for cities. Cities not only expand outward and upward, but also downward. The more use we make of subsurface space, the more surface space we free for the one function that cannot do without daylight and fresh air: living

Willemien Van Niekerk; Amy Pieterse; CSIR, Pretoria, South Africa; Jacques Du Toit, University of Pretoria, Pretoria, South Africa

Place-based adaptation solutions for South African settlements

This paper explores how climate change adaptation was mainstreamed into South African local government planning instruments by comparing two case studies. One drove integration internally while the other received support from national government to enable and drive integration. The challenges and opportunities for mainstreaming are discussed.

Ehsan Ranjbar, Tarbiat Modares University, Tehran, Iran; Najmeh Motalaei, Iran

Climate change and the effects on urban planning and design in Iranian cities

Iran is one of the countries that touch the effects of climate change. This article is trying to elaborate the challenges resulting from climate change in Iranian cities, assess the consequences and effects on everyday life of cities and introduce new policies in urban planning and design.

Nasim Iranmanesh, Islamic Azad University East Tehran branch; Kouros Etaati, Jarf Sanat, Tehran, Iran

Indigenous knowledge as solution against drought in cities of Iran (case study: Qazvin city)

This paper will review the indigenous knowledge in harvesting and supplement water in historical cities of Iran to get to know some sustainable solutions to challenge the drought which is the result of global warming of the earth.

Session 5: Global goals & national planning policy - *Part II*

3 October (Wednesday), 15:30 - 17:00

TK *Anneloes van Noordt, Environment Department Flanders, Brussels, Belgium*

The role of spatial development in the energy and climate transition

This paper is centered on how spatial development can contribute to the energy and climate targets. Focus points will be defined to indicate the role spatial development can play and a research by design exercise will be discussed. To conclude, policy recommendations in general and specifically for Flanders are formulated.

Bilge Aydin; Azime Tezer, Istanbul Technical University, Istanbul, Turkey; J. Joerg Knieling, HafenCity University, Hamburg, Germany

How to combine resilience theory with regional policies? A network based methodology

The aim of this study is to develop a new, network-based methodology for regional resilience analysis in order to analyze interconnected risk factors in a complex world. There has been explained, how system approaches can be combined with network theory to evaluate regional resilience with a multi-dimensional, multi-scale and multi-temporal perspective.

Nada Tandoh, Land Use and Spatial Planning Authority, Accra, Ghana

The effect of climate change in Ghana's cities

Ghana is not isolated from the changes in climate the world over. Impacts of climate changes include floods, drought, heat waves etc. Policies and strategies have been developed, and also mainstreamed into governance to ensure implementation. This paper reviews Ghana's perspective of climate change impacts, sustainability and resilience.

Patrick Apraku, Land Use and Spatial Planning Authority, Accra, Ghana

Governance, management, administration and planning systems in Ghana

The Government of Ghana has demonstrated commitment to mainstreaming climate change into key planning processes at the national, regional and local level. Ghana's resolve to mainstream climate change into the development agenda is through the Ghana Shared Growth Development Agenda I&II (2010-2017) attest to this commitment.

Ana Maria Fernandez Maldonado, Delft University of Technology, Delft, Netherlands

Addressing climate change in European spatial planning

The study investigates how climate change related issues have modified European spatial planning in two ways: how spatial planning systems have included climate change-related issues; and which main planning instruments are being used to achieve to tackle the risks associated with climate change. It uses data from the ESPON-COMPASS project.

Session 6: Assessment & understanding the impacts of climate change

4 October (Thursday), 11:00 - 12:30

TK *Shahadat Hossain Shakil, USAID, Dhaka, Bangladesh; Mohammed Hamidul Hasan, Bangladesh Institute of Planners, Dhaka, Bangladesh*

An assessment of effective approaches for adapting to the impacts of climate change on urban poor communities to make the urban area more resilient. - Perspective from Bangladesh

Is a bottom-up or top-down approach more effective for adaptingto the impacts of climate change on urban poor communities in the cities of global south?

Saikat Paul; Raj K., B. Bhaskar Rao; Ritu Roy, Indian Institute of Technology Kharagpur, Kharagpur, India

Application of low-rank sparse decomposition method to study urban heat island

This study establishes use of Low-Rank Sparse Decomposition Method to assess trends or patterns in Urban Heat Island (UHI) phenomenon in the metropolitan city of Kolkata. This would help in UHI mitigation and adaptation planning strategies in tropical regions.

Irina Shmeleva, Institute of Design and Urban Studies, Saint-Petersburg, Russian Federation; Stanislav Shmelev, Environment Europe, Oxford, United Kingdom

Global urban sustainability assessment: a multidimensional approach

Environment Europe database includes 90 global cities and allows to benchmark sustainability performance on 20+ social, economic, environmental and smart indicators.

Luisa Batista; Miguel Lopes; Paulo Pinho, University of Porto, Faculty of Engineering, Porto, Portugal

Metabolic Impact Assessment for strategic urban planning

This presentation intends to show the potentials of Metabolic Impact Assessment (MIA) of urban development proposals to strategic urban planning. The introduction of MIA into SEA fosters the implementation of climate change mitigation strategies.

Robert Cichowicz; Malgorzata Hanzl, Technical University of Lodz, Lodz, Poland

Measuring CO2 emissions - implications for spatial development

Air pollution measurements and analyses indicate the relationship between built form and urban development and the presence of concentrations of CO2 and other pollutants. The current study examines these relationships in quest of the recommendations how to transform urban development and users behaviour to decrease CO2 emissions.

Track 2: Spotlight Cities: Planning for Coastal Cities, Remote Towns, and High North Cities

Mumbai, India
Photo by Marjam Ahmadi


Location: Scandic Havet – Storhavet 2

by Kevin King and Sofia Morgado

What is the track about?
The Spotlight Cities track takes a careful look at some of the most vulnerable cities in the world. The track examines the main risks and the associated adaptive strategies for coastal, remote, and Arctic cities.

The authors have collectively assembled insights, analysis, and techniques for responding to climatic events and mitigating against future risks.

What has been the response?
Adaptive strategies for vulnerable waterfronts are described through the lens of both policy and design. Spatial strategies that take into account the complexity of the city are evaluated with consideration for both urban and natural systems.

Papers and workshops in this track address a diversity of geographic locations and city scales. New York City, the Gold Coast of Australia, the severe cold regions of China, Buenos Aires, Delhi select European cities, Doha, Jakarta, Lagos, Sjøgata, and others all provide examples that will shape our understanding of resiliency.

Through the papers in this track, we consider strategies for urban infrastructure that will mitigate against risk associated with climate change. These strategies may address street design, drainage systems, regional greenway networks, or flood protection. Alternatively, these strategies may be driven more by land-use strategies or policy approaches and discuss the city from macro-level development patterns.

The track also presents an emerging palette of methodologies – sometimes driven by technological innovations – that better enable practitioners to understand current conditions and advocate for effective change. Papers include information on computer simulated models that aid in the site selection process. Other topics include a description of how public spaces or social solutions play a role in effective strategies for adaptation.

How do you deem / assess the response?

A diversified set of perspectives, methodologies, geographical conditions, and case studies indicate a very positive reaction to the challenge casted by the Congress call. The breadth of the contributions resulted in a rich array of possible Session formats – a remarkable outcome indeed.

With the Sessions finally outlined, lively debates are expected to develop between presentations. Questions, related to either research or practice, may give rise to future collaborations and partnerships. Content drawn by presenters and contributions from the audience will be pivotal to creating a shared set of conclusions at the closing of the Congress.

What can we expect at the congress?
The congress will engage participants through workshops, presentations, debates, and discussion. In particular, the Spotlight Cities Track will contribute to the lively interaction between delegates with different backgrounds and cross-cutting topics within each of the 5 different Sessions.

Session 1 will provide an opportunity for up to 30 participants to meet 'underground' for an exploratory workshop for potential underground uses in Bodø. This workshop will be preceded by knowledge sharing on popular uses and possibilities to repurpose underground spaces.

Session 2 dives into matters related to resiliency along vulnerable waterfronts. Recent and significant weather events have highlighted the inherent challenges and risks associated with urban development along the waterfront. Residents' vulnerability and resilience to flooding in Lagos, Nigeria is examined through a lens of adaptive governance. A Recovery and Rehabilitation Plan for Tacloban City in the Philippines following the destruction of the world's strongest typhoon to make landfall is evaluated. Storm impacts and flooding controls in Hong Kong and NYC are analysed.

Session 3 focuses on urban infrastructure, the built environment, and landscape in the face of climate change. Street design in the Gold Coast of Australia, drainage systems in Delhi, and the effectives of urban expansion on utility services in Akure, Nigeria are included papers. An evaluation of a demonstration city – Qi'an in China – that uses a 'sponge' greenway as an ecological buffer is provided. Lastly, climate readiness strategies from New York City and Boston are discussed.

Session 4 will discuss broad techniques and macro-scale analysis of the City. Urban form and development strategies – including ecological buffering - will shape the discussion. Emerging research, knowledge networks, and calls for citizen engagement are shaping our cities. This session will highlight potential solutions to working within the rapidly changing contexts of our urban environments.

Lastly, **Session 5** is directly related to cold cities and cities of the north. The series of papers in this session explore unique aspects associated with designing for climate change that these cities, towns, and villages face.

Session Proposal
Making the most of underground spaces

2 October (Tuesday), 11:00 - 12:30

This event will take place at a short walking distance from the congress venues in a former underground shelter, last used as the 'G Nattklubb'. The address is 'Sjøgata 16B'. Please allow yourself some time to walk over to this location.

Moderators: Han Admiraal (ITACUS/Enprodes), Netherlands; Antonia Cornaro (ITACUS/ISOCARP Swiss ND/Amberg); Elizabeth Reynolds (URBEN/Think Deep UK)

Cities are more and more being challenged by lack of space whilst at the same time having to cope with the reality of climate change. In this session we will ask ourselves how to make the most of underground spaces through repurposing.

How can we repurpose existing underground spaces in such a way that they regain a new life and become beneficial again for a city? In this session, we will look for inspiration at the many bunkers that Bodø has and analyse and discuss what new uses they could serve.

After introductions/input statements by the moderators we will hold an interactive workshop with the audience as well as with local representatives. These will be from the local municipality, the real estate department of the Ministry of Defence, the local aviation museum; and the airport authority. Together, we will look at possibilities to repurpose these underground spaces. The outcome will be a report to be presented to the local representatives at a later date. Also, the event will be the kick-off of a new ISOCARP group on underground urbanism.

Session 2: Rising tides: resiliency and the waterfront in the face of extreme climatic conditions

2 October (Tuesday), 13:30 - 15:00

TK *Gitte Schreurs; Kris Scheerlinck; Erik Van Daele; David Burney, KU Leuven, Ghent, Belgium*

Countering the current paradoxical redevelopment of New York City's vulnerable waterfronts

The research aims to develop novel spatial strategies for the reconfiguration of vulnerable industrial waterfronts, defined by climate change and economic decline. The paper aims to counter the current 'tabula rasa' developments in New York City, by taking into account climate change and the waterfront's existing spatial qualities and fragilities.

Olusola Olufemi; Olufisayo Ogunmodede; Pinremola Olufemi; Oluwabukola Somoye, Independent, Oakville, Canada

A resilient coastal mega city, a resilient people: Flooding as a climate change threat in Lagos, Nigeria

From affluent neighbourhoods to impoverished communities, flooding resulting from climate change remains an existential threat in Lagos. Planners have a major role in facilitating resilience thinking and collaborating with various stakeholders to build resilience against flooding and other environmental disasters by developing capacity to learn, adapt, self-organize, and transform.

Gerald Paragas, Municipal Government of Sta. Barbara, Pangasinan, Philippines

Challenges and lessons learned after Supertyphoon Haiyan in Tacloban City, Philippines

The report follows the experiences, challenges, successes and lessons of Tacloban City in the Philippines as the coastal city moved from humanitarian response to the recovery and development phases after the Supertyphoon Haiyan.

Chui Ying Tracy Wong, University of Cambridge, Cmbridge, United Kingdom

Climate change adaptation in Hong Kong from urban planning perspective: flood zoning as control mechanism

Flood zoning is suggested to be a better solution than engineering-led measures to cope with risks of sea level rise and storm surge under climate change for the planning of coastal communities in Hong Kong.

Naniek Widayati Priyomarsono; Rudy Surya; Ninawati Ninawati; Theresia Budi Jayanti, Universitas Tarumanagara , Jakarta, Indonesia

The development of Juwana Settlement as a Northern Java coastal city in Indonesia has the potential to support global maritime axis

Juwana is strategic city in the northern Java coastal area. It has many resources, linier settlement alongside Gonggo river, and radial settlement in the outback. This city can be a prototype of a coastal city to create an economy networking. It has the potential to support Indonesia to be the global maritime axis.

Ali Alraouf; Mubarak AL Nuaimi, Urban Planning, Doha, Qatar

Cool waterfronts and coastal cities: how Qatar's peninsula develops a resilient future?

This paper illustrates a shift in contemporary urban development in Qatar. The shift stems from a deeper understanding of the vulnerability of Qatar as a peninsula facing the consequences of climate change in an inevitable manner. It sheds light on planning approaches which characterize the new waterfronts development paradigm.

Session 3: Cold Cities: Challenges and strategies for cities of the North

2 October (Tuesday), 15:30 - 17:00

TK *Han Li; Benchen Fu, Harbin Institute of Technology, Harbin, China*

Study on renovation planning and residential design of the resilient village in forest areas of severe cold region in China

Based on resilience concepts, this paper carries out an in-depth study and demonstration on resilient renovation strategies of village planning and residence design in forest areas of severe cold regions of China, from theoretical and practical perspectives, in order to deal with climate change and reduce regional energy consumption.the future challenges.

Hong Leng; Cunyan Jiang, Harbin, China

Study on the relationship between urban climate change and urban development construction in severe cold areas

Based on the particularity of climate environment in severe cold areas, the paper discusses the relationship between urban climate change and urban development construction, advancing some urban planning strategies and suggestions.

Artem Nikolaev; Sergei Kudinov, ITMO, Saint-Petersburg, Russian Federation

Development of recommendations on the planning structure and street design in the cities with cold climate

This paper is aimed to make an analysis of Russian regulatory documents for city planning and to find ways how to improve them from the aspect of planning in a cold climate.

Ida Marie Granmo, Vefsn Municipality, Mosjøen, Norway

Between fjords and mountains: Climate changes vs. cultural heritage sites in northern Norway – an example from Mosjøen in Nordland county

The new weather conditions in northern Norway are threatening local cultural heritage sites. Urban planners in Mosjøen are now trying to develop a zoning plan for the cultural heritage site Sjøgata, that both functions as a protection plan and as an adaptive strategy to climate change.

Track 2

Piotr Lorens, Gdansk University of Technology, Gdansk, Poland
Planning for the north-European waterfront cities – issues and strategies
Redeveloping urban waterfronts is subject of common practice globally. Although, as one of the major driving forces in this process is tourism development, climate issues play an important role in design and functioning of these structures. Therefore, waterfront cities located in less climate-privileged parts of the world, require alternative design strategies.

Viktoria Khokhlova
The case of Teriberka. Arctic present
Once experienced the thinning of the overbuilt physical structure, Teriberka shall turn back to the dynamic lifestyle. Unlike the settle towns with constantly increasing demands, Teriberka is in need of the principles and structures capable to vary in scale or to be moved whenever needed - intellectually and physically.

Session 4: Form and technique: City and region shaping through analysis and technology

3 October (Wednesday), 13:30 - 15:00

TK *Pedro Ressano Garcia; Ana Claudia Oliveira, LEAU Lisbon, Portugal*
S.O.S. - sustainable open solutions to climate waterfront
S.O.S. Sustainable Open Solutions to climate waterfront mission is to develop affordable research environment and efficient operational tools to schools of Architecture, Entities to interact directly with the market. The aim is to make use of the existing strategic network to face the future challenges.

Xin Li, Tianjin University, Beijing, China
Using Computer Simulation to Plan and Design Traditional Dong Towns & Villages in Mountainous Areas of Tongdao, Hunan, China
We will present an automated computer planning and design simulation of Dong nationality's towns & villages. Our bottom-up planning and design simulation program can characterize cultural customs, community structures, and spatial features of traditional Dong towns & villages. It is significant for protecting traditions and landscapes in rural-urbanization.

Chengcheng Liu, Tianjin Urban Planning & Design Institute, Tianjin, China
Research on potential disaster risk & countermeasures in China's coastal rapid urbanization area
The urban planning strategy of China's action plan for urban adaptation to climate change has been actively practiced in the China's coastal rapid urbanization area. This paper analyzes the potential disaster risk in these areas and the specific measures in three aspects of urban planning.

Simbarashe Chitapi, Aurecon, Tshwane, South Africa
A comparison of the utility of urban strategies for small towns: The Cases of Lobatse and Arandis
This paper compares the regeneration strategies put forward by two small towns in decline. Each town, although somewhat remote is within 100km of a significantly larger town. The paper assesses and scores the plans' resilience and sustainability response, its utility and implementatibility and proposes improvements for future plans.

Mirela Thaise Malta Purim; Fernando Domingues Caetano; Jeronimo Paulo Cunha Pimentel de Meira, Paranacidade, Curitiba, Brazil
The annulment of urban perimeter as a technical tool for urban planning: the unsustainability of the cities in the Brazilian state of Paraná
This paper analyses the urban perimeter legislation annulment as a planning instrument in the cities of the State of Parana – Brazil. This annulment results in urban perimeter oversizing, reinforcing widespread occupation and the conversion of rural land into urban land, leading to unsustainable settlements.

Jennifer Ailen Choi; Laura Corbalan Viero; Mitchell de Sousa; Rocio Di Corrado Analia Fernandez, University of Buenos Aires, Ciudad Autónoma de Buenos Aires, Argentina
Perception, territory and urban planning: perceptive studies over the south border of the city of Buenos Aires, Argentina
The development of the city throughout Riachuelo left traces on the territory that cannot be read by traditional cartography, there is a halo in the collective memory reflected by different perceptions through time that cannot be mapped traditionally. New representation methods are required for these dynamic, complex and fragmented borders.

Session 5: Urban works: Infrastructure, the built environment, and landscape in the face of climate change

3 October (Wednesday), 15:30 - 17:00

TK *Mario Shllaku, Hassell, Brisbane, Australia*
Planning for cooler streets; functions and elements for cooler coastal cities, the case of gold coast, Australia
The paper presents the case of Nerang Street in Gold Coast, Australia, as an example where the application of urban canopy and urban biome concepts along with the adequate urban planning and design strategies aims at dropping the temperatures by 5 degree Celsius.

Lucia Ilieva, CSDCS, Sofia, Bulgaria
Adaptive strategies for mobility planning in remote and coastal cities and towns - "LAST MILE" project case
Mobility and Accessibility are vital elements for sustainable urbanisation with a direct impact on climate change. The INTERREG Europe Project "LAST MILE" is presented with its focus on developing adaptive strategies providing user oriented services for the travel chain's last segment in remote tourism destinations and coastal cities and towns.

Mahak Agrawal, New Delhi, India
Climate risks and urban drainage: a case of National Capital Territory of Delhi
Urban Development blind to natural drainage for decades, aggravates natural climate variability of Delhi. Multiplier effect is profound on vulnerable population with least adaptive capacity-villages located within the flood plains. Need for adaptive strategies is realized to make the city and its population resilient to climate risks of floods.

Opeyemi Aladekoyi, University of Medical Sciences Ondo, Ondo, Nigeria; Micheal Oyinloye, Federal University of Technology, Akure, Nigeria
Effects of urban land use change on selected public utilities for sustainable development in Akure, Nigeria
One of main driving forces of global environmental change is urban expansion, which is central to the sustainable development debate. This research aims at examining the impact of urban expansion on utility services in Akure Nigeria, with a view to improve strategies to protect these utilities for sustainable development.

Track 3: Climate-Proof Cities: Planning for Weather, Water, Food and Energy

Photo by iau-idf


Location: Radisson Blu, Room 1
by Eric Huybrechts and Lena Niel

Cities are facing new challenges, related to social and demographic changes, innovations, the effect of finance on the economy and - climate changes. Seventy percent of the world population will live in cities by 2050, mostly in large metropolises. The urban population will double, of which 50% will be living in unplanned areas. Financialisation of the economy will produce more empty cities for speculation purpose and increase social and spatial exclusion. Smart cities and artificial intelligence will change the job distribution with the emergence of new skills and new ways to manage cities. But climate change – or climate 'shift', as some scientists now warn about due to acceleration of dangerous trends – appears to be the biggest threat. It will increase natural hazards, making large populated coastal areas and cities particularly vulnerable. The effects will be extreme in sensitive areas due to heavy rains, storms, water shortage, landslides, drought, heat waves, and sea level rise - as already observed in New York, Paris, Dacca, Cairo, Shanghai, Cape Town or Chennai.

How can urban planning propose new management models for the cities facing these challenges? How should planners change their practice in order to reduce vulnerability of human settlements, better manage crisis periods and mitigate cities' natural resource over-consumption and GHS emissions? What is a 'climate-proof' city and how do we plan for it?

We believe that we, as urban planners and designers of future cities, have to change our way of looking at the city. The city is not a collection of buildings, open spaces, technical networks and people anymore. We must adopt the perspective of a 'living urbanism': the city is an ecosystem. As derived from biological ideas, an ecosystem exists of many dynamic and static flows. All of them count. The city should be analysed from different perspectives, before one can make truly resilient cities. People, biota, water, food, energy, information - should all be understood before making an urban plan. But also transportation infrastructure, waste and material resources like sand, gravel and other building material – they are all part of our profession. By analysing the entire system, one can understand how flows run through a city or a territory and where, and in what way, they should be altered in order to achieve a resilient urban ecosystem. Only by following this approach we can create cities that will remain liveable when climate change becomes worse.

The idea of the city as an urban ecosystem and its urban metabolism is not new. It originated in the Chicago School of urban sociology (E.W. Burgess) in the early 20th century, was further developed in the 1960s (A. Wolman), and then, in practice, got applied by Richard Forman, Ian Mc Harg and other practitioners and academics in landscape and urban planning. But the idea didn't survive the era of economic changes (liberalisation, financialisation) and comprehensive or strategic planning. Now is the time to shed a new light on this philosophy. Not only because we can give a new, deeper, layer to our profession as urban planners, but because we have to change our view on city and regional planning in the face of climate challenge, new economy and socio-demographic changes. We have to make our cities climate-proof. We should even strive to enable our cities to restore the climate!

Overview of the abstracts

We have received a large amount of abstracts on climate-proofing cities. This demonstrates how many urban planners and designers realise that we have to change our current way of approaching the city. The main themes that have been addressed are the flows of energy and biota. Regarding energy, the main questions are: how are we going to provide sufficient sustainable energy to our growing cities? What will be the impact of this energy production and consumption on the carrying capacity of our planet? With regards to biota, the topic of Urban Nature-based solutions is the main theme. Since this topic is becoming very popular amongst landscape architects, urban planners and designers, but also policy makers and governments, most abstracts are giving a literature overview of the definitions that are being used. Also, questions regarding the application of Urban Nature-based solutions in cities seem relevant amongst our profession from a global perspective.

With regards to representation, it seems that the topic of climate-proofing cities is a relevant topic world-wide. We have received a lot of submissions from China, Europe, South America and North America, but also from India (where the bigger cities are very much involved in Urban Nature-based solutions and sustainable energy production). Only a few submissions came from the African continent and Australia.

Our view on the accepted abstracts and our ideas

This track is looking at how to make cities climate-proof. The abstracts that have been submitted are very good examples of cities that are busy implementing the themes of energy production/consumption and greening the cities. As stated as a problem in our introduction, we note that most abstracts are only stressing one specific flow of the urban ecosystem. To make a truly resilient city, it is important to link the specific flow of energy and biota towards other flows and generally pursue a holistic view of the city. How are people going to live in the city? E.g. how will Urban Nature-based solutions make a better living space for people? How will it affect the urban heat island is a positive manner? It might be that we do not have enough qualitative information on the effects of the flows on our cities. It is necessary to develop these as soon as possible, to enable urban planners to make cities climate-proof in the future.

Few contributions are dealing with the management of crises: how to secure human settlements during natural events. There are questions to be discussed on the capacities of cities and region to implement institutional coordination, the efficiency of this coordination between administrations (civil security, telecommunication, health…), the effectiveness of the alert systems, the robustness of the strategic infrastructures are crucial to save life and reduce vulnerability of human settlements during natural events. The increase size of city-regions due to demographic changes (metropolization + population growth) makes the coordination more complex and less efficient, and increases the vulnerability.

Expectation for the Congress

With about 40 contributions and a large diversity of subjects and approaches, Track 3 will be very rich for debates, analysis and solutions for climate-proofing cities. More than just a platform for presenting case studies, Track 3 will enable important discussions. Delegates will be encouraged to go further, to stress common points on the diagnosis and solutions and to create a dynamic discourse between planners. However, while these debates will be interesting, they will have a limited positive impact if there is no follow up. The Congress is a key moment to mobilize collective intelligence to launch initiatives, to forge networks around a question and to empower urban professionals with key messages to deliver to UN-Habitat, UNEP, OECD, Habitat Professional Forum, ICLEI and other multilateral organizations. Many international initiatives and programmes already exist - such as Resilient Cities, Climate Action… - but this ISOCARP Congress should open the opportunity to give direct access to our planners to the entire international debate on proofing cities facing climate change.

The cities that are expected to grow the most are located in Africa and South Asia. As International Planning Society, we must strive to collaborate with these continents and large regions as much as possible, to design climate-proof cities where the vulnerability is the highest.

Authors are responsible for
the content of their work

TK track keynotes

Session 1: Green infrastructure and urban design

2 October (Tuesday), 11:00 - 12:30

TK *Juan A. Demerutis-Arenas; Jesús A. Escobosa-Burgara, University of Guadalajara, Guadalajara, Mexico*

Green infrastructure for metropolitan areas in Mexico

The paper defines main features of green infrastructure for metropolitan cities.

Xin Feng; Jin Yunfeng, Tongji University, Shanghai, China

Case Study: urban green belt planning in Foshan City, China

How do Chinese planners plan green belt in order to make cities resilient to adapt to climate change? - especially in the Chinese context, where accelerated urbanization has generated continuous rapid growth creating a series of environmental problems.

Rune Skeie, Asplan Viak AS, Oslo, Norway

Urban Ecology – Achieving sustainable urban development through multifunctional blue and green infrastructure

Through urban projects on different scales, from development of districts (XXL) to blue and green roofs (S) Skeie shows that a key to achieve sustainable urban development may be to consider the city as an ecosystem.

Karolina Czyzewska, Zabrze, Poland

Green Warsaw - the future of green vegetation

Green balconies, green roofs and green walls as a solution for: reducing stress of habitants; reducing air pollution in the city; solving the problem of urban heat islands.

Abdelwehab Alwehab; Firas Alrawi; Falah Almosawi, University of Baghdad, Baghdad, Iraq

Localizing Imperatives of Sustainable Neighborhood Models: Iraqi Cities as a Case Study

Green buildings design models offered new opportunities to augment the paradigm of sustainable urbanism. The research incorporates local physical and environmental elements and attempts to extract significant indicators within models intended to improve urban environmental quality at the microscale and identify confluence areas to advance sustainable urbanism objectives.

Session 2: Green infrastructure and habitats

2 October (Tuesday), 13:30 - 15:00

TK *Claudia De Luca; Elisa Conticelli; Simona Tondelli, University of Bologna, Bologna, Italy*

Nature-based solution, green infrastructure and ecosystem services: a framework for understanding and creating resilient urban ecosystems

Climate-proof cities rely on nature-based solutions, green infrastructures, ecosystem-based adaptation and ecosystem services to create resilient urban ecosystems. Nevertheless, the relation among these concepts is still fuzzy. This paper provides a better understanding of these concepts and their integration into planning instruments to support cities embedding those within their plans

Han Admiraal; Antonia Cornaro, ITACUS & Enprodes Management Consultancy, Delft, Netherlands

The contribution of urban underground space to climate-proof and resilient cities

Integrating underground space into the urban fabric is a necessity as part of climate proofing our cities. We need to develop an underground urbanism to ensure the peculiarities and advantages of underground space are appreciated. In that way, cities can become resilient and climate-proof within their area constraints.

Song Liu; Song Yao Huai; Hongting Pan, Tongji University, Landscape Architecture Department, Shanghai, China

Construction of Green Infrastructure Based on Water Ecological Security Pattern, A case study of Songtao River Catchment in Guizhou Province, China

Based on an evaluation of the regional water ecological security pattern, green infrastructure is constructed to achieve Songtao river catchment ecological security.

Xin Lian; Jun Zhou, Planning Institute of China Center for Urban Development, Beijing, China

Towards a sustainable and eco-civilized era: a national-wide project of pairing Ecological Restoration with Urban Repair (ERUR) in China

A Chinese national-wide project called "Ecological Restoration and Urban Repair (ERUR)" creatively pairs the traditional ecological restoration with efforts to tackle with urban habitats issues, which is a pilot step for Chinese cities to restore urban ecological system challenged by both the massive urbanization as well as global climate change.

Meltem Delibas, Delft University of Technology/ Istanbul Technical University, DELFT, Netherlands; Azime Tezer, Istanbul Technical University, Istanbul, Turkey; Taneha Kuzniecow Bacchin, Delft, Netherlands

Soil Ecosystem Services (SoES) in urban planning

Soil as the foundation of all terrestrial ecosystems on Earth gives urban planners wise advises for a sustainable future.

Anna Starzewska-Sikorska, Institute for Ecology of Industrial Areas, Katowice, Poland

LUMAT project – integrated environmental management of land resources as contribution to enhancement of urban areas resilience to climate change

Project LUMAT is concerning integrated environmental management of land resources in functional urban areas. Cases of the LUMAT project functional urban areas in 7 countries present solutions of integrated environmental management which can be considered as activities contributing to the enhancement of urban resilience to climate change.

Session 3: Food & Heat

2 October (Tuesday), 15:30 - 17:00

TK *Olusola Olufemi, Independent, Oakville, Canada*

Cascading threats of climate change on the food system in Nigeria: an overview

Integration of the food system and food planning within the Green and Brown agenda through participatory governance, collaboration and authentic dialogue provides an eco-efficient approach to minimising the ecological footprint and foodprint. A secure ecological foundation guarantees food planning within a complex, cascading and interconnected threats of climate change.

George Thomas Kapelos, Ryerson University, Toronto, Canada

"Heat!" – testing design approaches to mitigate excessive heat exposure for vulnerable populations in Toronto apartment buildings

With climate change, excessive summer heat will impact Torontonians, especially residents in older, high-rise buildings, not designed to anticipate extreme heat. Researchers documented the issues on film. They presented data to students who designed prototypes for outdoor cooling centres. Community members provided feedback on proposed designs.

Teresa Marat-Mendes, Lisbon University Institute ISCTE-IUL, Lisboa, Portugal

Planning for Change: The Forms and Flows of Lisbon Metropolitan Area Food System

Integrating food within urban planning, from a metabolic perspective, is critical to catalyze an urban sustainability transition. This presentation discusses the theoretical and methodological framework of SPLACH Project to approach the food system, while dissecting the urban forms and social-economic flows that affect the metabolic function of the urban realm.

Jakob Schackmar, University of Kaiserslautern, Kaiserslautern, Germany

Substitute industries and economic change as a chance for cities to become more sustainable

Urban farming, as bio-economy, can be a sustainable approach to revitalize cities effected by structural economic changes and transform them into future oriented and livable places.

Pierre Renault, Independant consultant, Paris, France

Past knowledge and new strategies: Are Iranian cities ready for climate change?

Iran cities used to adapt to arid climate with old technical knowledge as Qanats or Badgir. The river restoration program could be an opportunity to solve urban heat island issues in Tehran.

Xin Li, Beijing Forestry University, Beijing, China

Construction of resilience in urban fringe based on sponge city: an example of green space planning of Shahe in Beijing, China

Based on the rainfall characteristics of northern China, the elastic design of water is used to give space for the river within the embankment, to provide site for the storm-water outside the embankment, and to create an elastic landscape in the urban periphery.

Session 4: Energy

3 October (Wednesday), 13:30 - 15:00

TK *Pengjun Zhao, Department of Urban and Regional Planning, Peking University, Beijing, China*

Reduce residents' transport energy use in China: Comparing the impacts of land use planning, public transit improvements, and low-carbon-city initiatives

The paper is about how to reduce residents' transport energy use in China.

Gema Hernández Moral; Victor Serna González; Giulia Massa; César Valdemaseda Tranque, Fundación CARTIF, Valladolid, Spain

ENERGIS: tool for demand characterisation in urban settings to support energy planning at different scales.

Only with adequate knowledge on the energy status in the city (in particular of the residential sector, main contributor to CO2 emissions in cities) it is possible to plan for a low carbon environment. The ENERGIS tool will support planners by mapping energy demand information of cities at different scales.

Hong Leng; Xi Chen; Zhe Diao, Harbin Institute of Technology, School of Architecture, Harbin, China

Evaluation of the impact of the urban morphology on building energy consumption in cold region cities - take the office building in Harbin, China as an example

The aim of this work is to quantitatively analyze the impact of urban morphology on building energy consumption in cold region cities. The results can provide a theoretical reference for the energy-saving oriented urban planning strategies in cold region cities, and are of significance for the mitigation of climate change.

Martin Tzou; François Courtot; Jingbo Guo; Sijie Liu; Yili Xiong; Jiashuo Xiu, EDF China, China; Shu Du, China Center for Urban Development, China

District cooling in Sanya Haitang Bay: energy integration in urban planning from theory to practice

Climate change initiatives undertaken in the city Sanya in China reveal the importance and the challenges of integrating energy issues at the urban planning stage, considering the significant contribution of district energy systems in reducing cooling demand and carbon emissions in hot and humid cities.

Adriano Bisello; Silvia Tomasi; Daniele Vettorato, EURAC research, Bolzano, Italy

Sustainable and smart energy transition in cross-border territories. Insights from the European Alpine macro-region

This paper discusses the results of an ongoing research on energy strategies in the European Alpine macro-region (EUSALP). It suggests the steps to set up an effective planning and monitoring system for the strategies implementation that is replicable in cross-border regions promoting a sustainable and smart energy transition

Session 5: Water

3 October (Wednesday), 15:30 - 17:00

TK *Yann Leclercq, MRTPI, London, United Kingdom*

Mitigating the effects of climate change in strategic development: The Ibadan City Masterplan

Nigeria's third largest city, Ibadan, is anticipated to grow from 6 to over 13 million by 2036. One of the impacts of the city's sprawling growth is increasing flooding. Upon the initiative of the Oyo State Government, Dar was commissioned in 2016 to the city's first masterplan.

Daniela Baer; Edvard Sivertsen; Nathalie Labonnote, Rebecka Snefuglli Sondell, Sintef; Terje Skjeggedal, NTNU; Trondheim, Norway

Planners' information need in adaptation to climate-induced floods

This study investigates urban planners' need for information to adapt to climate change. Interviews with planners in Trondheim and Stavanger disclose gaps in the provision of data and needed tools. A newly developed GIS-based tool for estimating flood damage costs as part of city planning is presented.

Lulu Chen; Su'ning Xu; Xiaohe Hou; Binxia Xue, Harbin Institute of Technology University, Harbin, China

Study on the framework of environment layers in the urban layer system

This paper proposes the concept of 'urban layer', and studies urban environment layers in the urban layer system and builds the structure of it. It applies the study on environment layers to the project of Comprehensive Urban Design of Waterfront Areas of Beijing, especially the water layer and climate layer.

Willemien Van Niekerk; Amy Pieterse, L. Louiza Duncker; Kea Maditse; CSIR, Pretoria; Claire Davis, Natural Resources and Environment, Pretoria, South Africa

Water sensitive urban design as adaptation strategy

Cities in areas getting hotter and drier have to find alternative approaches to manage the increased demand for water versus the shrinking supply, while also climate proofing their cities. Water sensitive urban design as an adaptation strategy integrates the management of urban water resources with urban planning.

Hong Geng; Yue Li, Wuhan, China

A climate-adaptation based study on the comprehensive planning strategy of urban water systems

When it comes to improving urban climate adaptability, it is of vital importance to conduct researches on both how to adapt to and how to mitigate the impacts of climate change upon urban water systems.

Peilun Li; Zhiqing Zhao; Lu Zhang, School of Architecture, Harbin Institute of Technology, Harbin, China

Urban new districts' toughness development under the sponge infrastructure project: The case of Jinan, China

As a response to urban rainwater disasters, the paper summarizes the three themes; urban flood control, drainaige pollution control and rain resources utilization touching upon technical, organizational, economic and societal challenges of the themes. New district of Jinan city project is discussed as the case study together with the challenges of the sponge infrastructure.

Session 6: Data and modelling

4 October (Wednesday), 11:00 - 12:30

TK *Geraud Bonhomme, Perspective.brussels - Brussels Planning Agency, Brussels, Belgium*

Usquare.brussels a resilient planning approach

Usquare.brussels is an innovative project to convert former urban barracks with a remarkable heritage into an international university resilient district. The site, property from the Brussels Region since 2018, will be a pilot operation linking a new spatial planning tool with the principles of the Regional Plan for Circular Economy.

Xiang Liu; Jian Zeng; Yanan Fang, Tianjin, China

Study on the microclimate of seaweed houses in Jiaodong - the case of Dongchudao Village

Seaweed house is a very ecological dwelling in Shandong peninsula, China. This paper uses data measurement, numerical simulation and other means to study the microclimate environment of seaweed house.

Ge Sun, Shanghai Tongji Urban Planning& Design Institute, Shanghai, China

A study of human ecology and resources network

The case will demonstrate a biological self-organize algorithm, which is based on the new human ecology, makes an effective contribution to help with the existing resource oriented network urban morphology. It gives design proposals of Liwa Oasis, UAE, which is a future optimized network plan of resource distribution.

Fujun Xia, Shanghai Tongji Urban Planning &Design Institute, Shanghai, China

Study on the performance of sponge city construction based on land use planning - Cases of Canghai new area in Wuzhou

In order to solve the problems of the deterioration of water environment in China and frequent waterlogging disaster, the methods of performance evaluation in the planning stage of land use planning is explored in this paper, and some strategies to improve the performance of sponge city construction are put forward.

Silja Tillner, Architects Tillner & Willinger, Vienna, Austria

Downtown Cairo urban regeneration - a model for future urban regeneration plans with energy efficiency interventions

The Implementation Plan is intended as a future prototype to explore new models for urban regeneration in historic zones that integrate energy-efficiency into the plans, thereby linking planning and urban design measures for the improvement of mobility and the public realm with public and private investments in energy-efficient buildings.

Croce Silvia; Daniele Vettorato, EURAC Research, Bolzano, Italy

Urban surface use optimization for climate resilience improvement

The optimization of the urban surface use is very relevant for the maximization of urban resilience to climate change. The paper proposes a method to optimize the urban surface use in order to improve the climate resilience capacity of cities.

Session 7: Governance and economics

4 October (Thursday), 13:30 - 15:00

TK *Ningjing Xu, School of Architecture, Tsinghua University, P.R.China, Beijing, China*

Investigation of regional coordinated development based on watershed comprehensive management for Greater Beijing Municipality Area

This paper is to provide a feasible plan for the ecological and economic coordinated development of the Greater Beijing region in the predictable future by comprehensive management in ecological watershed units.

Roman Pomazan, Urban Sustain Architecture design group; Alexandr Khvan, Frame Art Ltd; Pavlo Ostapenko, Geography department of Kyiv State University, Kyiv, Ukrain

Shymkent City

Shymkent City is a project of the new urban district of the third million city of Kazakhstan. Shymkent is the fastest growing city of Kazakhstan, that has large amount of urban issues to be solved. Shymkent City was envisioned as the key urban driver of the most young-populated megalopolis of Shymkent. This new neighborhood is going to represent new comfortable urban environment that should became the specimen for urban transformations of Shymkent in the future.

Karin Hiltgartner, TU Wien, Vienna, Austria

Climate protection and environmental Impact assessment: could climate protection be seen as an 'overall public interest'?

This contribution analyses how differently Austrian courts valued climate protection within the Environmental Impact Assessment on the enlargement of Vienna's Airport. While the court of second instance rejected the project due to international obligations on climate protection, the Constitutional Court found that these were not to be taken into consideration.

Alexander Marful; Elom Ayeke; Rexford Assasie Oppong, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

Strategies for making peri-urban coastal communities resilient in sub-saharan Africa: the case of Ningo-Prampram

This paper focuses on Prampram, a Peri Urban community found in the Ningo Prampram district. The research investigated necessary interventions required in developing a resilient coastal Peri-urban community in Ghana, amidst the vast infrastructural deficit usually found in Sub-Saharan African countries.

S. Mohsen Hosseinifarhangi; Margherita Turnavi; Gerrit J. Carsjens; Arnold van der Valk, Università iuav di Venezia, Hummelo, Netherlands

Actor-network analysis of transition towards urban hi-tech horticulture. A comparative study of development and adoption of urban high-tech horticultural practices in Shanghai and Amsterdam

This paper firstly studies the development trajectories of technological novelties and secondly, analyzes the process of adaptation and preparation of niches for adoption in urban practices. It tries to find the gaps between these development trajectories and their adoption in urban practices.

Amarjeet Kumar; Saikat Kumar Paul, Indian Institute of Technology, Kharagpur, India

A framework to identify risk level of areas for the formation of evacuation zones during cyclones

The paper proposes a framework for formation of evacuation zones during disasters.

Session Proposal
Cool Planner: The role of urban planning and design within global resilience frameworks

4 October (Thursday), 13:30 - 15:00

Location: Radisson Blu, Room 2

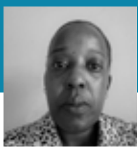
Moderators: Milena Ivkovic, Vice President ISOCARP and Director Blok74 Rotterdam, Netherlands, and Lena Niel, urban and landscape designer, Deltares, Delft, Netherlands

Speakers: Christine Auclair, Climate Change Planning Officer, Urban Planning and Design Branch UN-HABITAT; **Jon Kher Kaw**, Senior Urban Development Specialist at The World Bank; **Irina Shmeleva**, Institute of Design and Urban Studies, ITMO University, Saint Petersburg & Director of Institute of Sustainable Development Strategies (NGO), Saint Petersburg, Russia; **Bernardus Van Heerden**, Strategic Development Manager at eThekwini Municipality, Durban, South Africa

Cities are facing new types of challenges, because of the effects of climate change and densification in cities. The Sendai Framework, Sustainable development goals and The New Urban Agenda are trying to address these challenges for cities. Cities have to become inclusive, climate-proof and economic hubs. Hence, the city is approached as an urban ecosystem instead of a blue print that exists of different layers and flows. Only a truly resilient and inclusive city could be achieved if one understands the functioning of this system. This shift of planning and design also asks for a new type of urban planner and designer. But what is exactly this new role of urban planning and design to achieve these climate-proof cities in line with these frameworks?

As a preparation of this session, the ISOCARP Dutch National Delegation, ISOCARP Europe and Deltares Nederland organized an expert workshop on the 3rd of July 2018, under the title: Cool Planners and the Global Climate Change Resilience Networks. At the end of this expert meeting, several statements about the role of urban planning in the climate change were formulated. These statements will be used as a kick-off for the session.

Track 4: Technology and Infrastructure: Clean, Green, Smart and Resilient


Location: Radisson Blu, Room 2
by Adriano Bisello, Wanjiku Macharia, and Ana María Fernández-Maldonado

After two decades of discussion about smart cities, a globally shared definition of smart urban development and the identification of the most effective approach to urban sustainability and climate resilience are still missing. Undoubtedly, the traditional smart city approach is strongly rooted in an ICT-driven approach, but urban sustainability requires many more components. Above all the human one, as latest interpretations show. The future, smartness and resilience of our cities and their infrastructures are calling for citizen-oriented adaptable and accessible solutions. Only by enabling new behavioural and business models will our cities finally shift focus from adaptation and mitigation costs to smart low carbon development opportunities.

Discussing technologies and infrastructures may appear somewhat "out of topic" in an urban and regional planning congress, bearing in mind the complexity and specifics each system, solution or even single component deserves. However, it is not. Infrastructures are even more interconnected thanks to ICTs platforms and IoT; technologies turn-over is fast; disruptive solutions may lead to great leaps forward; private-public partnership are asking for bankable investments; communities are willing to be part of the decision-making process; the sharing economy is calling for new value models; energy utilities are suspicious of energy prosumers; infrastructure endowments are ageing quickly; green areas are now understood as ecosystem services providers. These and many other factors affect how urban planners should think innovatively about technologies and next-generation infrastructures, looking more at "soft", adaptable and citizen-centered solutions rather than "hard", monolithic and preconceived tools to solve standardized problems.

Cities aspiring towards resilience must make an important cultural shift to a model of urban planning which empowers the citizens. This is also an opportunity for city managers to develop leadership by developing a deeper understanding of its citizenry. Through collaboration and sharing, cities can propagate clean, green and smart infrastructure and technologies right until the neighbourhood level, thus creating and supporting successful, climate-resilient communities.

Overview and Assessment of the abstracts

Research findings and innovative approaches contributing to Track 4 come from all over the world, offering a broad perspective on these topics and contributing to shedding light on cross-cutting issues.

The following topics and research questions were suggested by the call for contributions:

• How does the 'urban technology nexus' affect urban metabolism?

• Infrastructure systems: how do we reinvent the concept and the configurations?

• ICT and the 'smart city'; 'sentient city; 'wise city'; 'green intelligence'

• Disaster preparedness and 'smart resilience'

• The future of transport technology and infrastructure

• The future of energy technology and infrastructure

• The future of building and construction technology

• Urban form, urban flows and the design for smart, adaptable spaces

• What are the economic opportunities in technological innovation for sustainability and resilience?

As a reaction to that, Track 4 presents the use of smart technologies and how next-generation infrastructures will affect urban ecosystems - both their form and flows – thus helping cities become cleaner, greener, smarter and more resilient to climate change.

The first session on planning next-generation infrastructures for innovative solutions highlights some illustrative examples. There is a study that aims at linking infrastructure designs, ecology, water and soil cycles for the development of adaptive, transformative designs and strategies in public works. In addition, the session has a paper that illustrates the role of landscape planning in managing flood response. There is a proposal to validate regulations for wind energy generation in Russian Federation focusing on wind farm planning, design, construction, operation and remediation. Next, an evaluation of the built greenway network using big data analysis and strategies for improvement will be presented. Finally, we will hear a proposal that reviews and addresses the equity and fairness dimensions for policy makers to consider when integrating green infrastructure in spatial planning to maintain a balance between economic and environmental goals.

The session on planning next-generation infrastructures for adaptation, mitigation and disaster preparedness highlights innovative solutions to adapt to and mitigate against climate change. There is a research that posits that Geographic Information Systems (GIS) and Remote Sensing Technology allow urban planners and policymakers model for flood risks to gain critical insights on the real impacts of climate change and adopt sustainable resilient and smart solutions, providing examples from South Africa. There are also two case studies from China. One demonstrates how the cooling effect of green space can be improved by controlling the green area perimeter, shape and community structure of the tree species. The other examines a city's symbiotic relationship with its rivers and the management of flood response through landscape planning including reclamation and restoration of an urban riverfront.

The session on shaping urban form and flows in smart cities design highlights some illustrative examples of different concepts to consider. There is a paper that builds the case for Transport Oriented Development (TOD) as a climate adaptation strategy, the challenges and proposed solutions to mainstream TOD at policy, fiscal and operational levels. Another research presents the main challenges when planning for Zero Emission Neighbourhoods. Looking at examples from Norwegian cities, it observes that to successfully plan, the project developers must consider not only energy and emissions, but incorporate the interests and ideas of a broad range of "new" stakeholders at the early planning stage, such as utility companies. There is a paper that explores what the urban structure looks like when individuals' mobility are aggregated into spatial analysis units using large-scale cell phone data to emphasise the dynamic relationship between human mobility and urban structure, which is key to planning housing, community development and transportation. Another research suggests to develop a Land Suitability Evaluation model focusing on the quality of infrastructure and ecosystems that protect, provide and connect people. The aim is for the model to support resilient urban planning providing decision makers with a comprehensive picture of the urban infrastructure and ecosystems in order to make better informed decisions to deliver cooler cities. To get further insight into urban flows, a study evaluates a Shared Farm model looking at the operating mechanism, core features that facilitate urban-rural reciprocal flow that is circumvented by China's binary urban-rural structure, which hinders the free-flow by a separated property right systems.

The session on turning technological innovation in urban and community values highlights some illustrative examples of planning for and leveraging meaningful technological innovations in the city and the community. There is a proposal to develop a methodology which identifies local windows of opportunity from a spatial and economical perspective, to systematically identify where smart city solutions could be applied within the current urban fabric while planning its management and maintenance to ensure a transformation urban project rather than a transient novelty. There is a paper that llustrates how disruptive technology for urban governance and decision-making offers major opportunities for engaging multi-disciplinary partners and integrating evidence based decision-making into the governance process. There is also a proposal to explore the challenges and potential of new technologies and their application in an urban setting by surveying urban innovation units and living labs to determine the effect of new technologies on city planning and its users.

In addition, this paper analyses the set of key principles that define the concept of living labs. Then there is a presentation on how disruptive technology applications for urban governance and decision-making offer major opportunities for engaging multi-disciplinary partners and stakeholders, and integrating evidence based decision-making in governance process addressing societal challenge. An exploratory research to investigate whether the transformation that comes with the IoT and smart cities could serve as a catalyst for promoting culture and reducing marginalization will be presented. A study also examines the development of technology application for tourism activities that disseminate information and facilitate the appropriation of the urban space, analysing some of the new challenges to urban planning and city management, created by tourist activity at the local level which is not ready for it.

Finally, a presentation on planning and designing outdoor spaces in Qatar to be running-friendly in response to weather conditions.

Track 4 will feature two supplemental Sessions:

1. How to develop a new public service based on the "Smarticipate Platform".

2. Urban mobility in transition: perspectives and challanges on urban living and public space in china

Session 1: Planning next generation infrastructures for innovative solutions

2 October (Tuesday), 11:00 - 12:30

TK *Taneha Kuzniecow Bacchin; Filippo La Fleur,Delft University of Technology, Delft, Netherlands; Richard Ashley, University of Sheffield, Department of Civil and Structural Engineering, Sheffield, United Kingdom*

Next generation infrastructure design under conditions of extremes

Design and programming of next generation hybrid green/blue/grey infrastructures for the adaptation and/or transformation of urban areas and (metropolitan) regions to extreme climate change (e.g. sea level rise, river peak discharge and intensive rainfall patterns).

Dmitry Boyko; Valeriya Patueva, GeoClever, Volgograd, Russian Federation

Planning issues of wind farm siting in the Russian Federation

The paper will show main planning regulations and approaches of wind farms in Russia.

Li Tan, Beijing Forestry University, Beijing, China

Evaluation of built greenway network in Beijing based on big data analysis

This paper evaluates the built greenway network in Beijing based on two types of big data: travel trace data from bike-sharing applications and the point of interest data from Micro-blog. Core problems and strategies are summarized for a better plan and design of greenway network responding to climate change.

Ifeoma Ukonze; Donald Okeke, Department of Urban and Regional Planning, University of Nigeria Nsukka, Enugu, Nigeria; Collins Nnamani, Department of Estate Management University of Nigeria Nsukka, Enugu, Nigeria / presented by Mahak Agrawal, New Delhi, India

Integration of green infrastructure into transportation planning in African cities

This study gives a review of the integration of the concept of green infrastructure into the transportation policy framework which could serve as a tool for achieving sustainable transport development. It will also help show an alignment between the socio-economic and environment gains of this concept in African cities.

Zhejing Cao, Tsinghua University, Beijing, China

Resilient slow traffic system planning based on traffic survey data and comparative study: evidence from Wenyu River area in Beijing

This paper aims at taking Wenyu River area in Beijing as an example, to analyze the slow traffic demand, trip pattern, land use mode of the periphery of urban center, for proposing resilient slow traffic system planning strategies through comparative case studies.

Track 4

Session Proposal
Urban Mobility in Transition: Perspectives and Challenges on Urban Living and Public Space in China

2 October (Tuesday), 13:30 - 15:00

Moderator: Sebastien Goethals, Vice President ISOCARP

Speakers: PAN Haixiao, Tongji University; WANG Hongyang, Nanjing University, China

The current transition of urban mobility is about to transform our daily commuting habits and energy consumption modes in both urban and rural environments.

Since digital connectivity has opened new windows of opportunities for communities and commuters through the sharing economy, the way we use together and individually our streets and public spaces might be less (or more?) segmented and informal, as a result of real-time and collective decision-making.

An optimized scenario of mobility transition, integrating automation, sharing and electrification by 2050, presents a reduction from 4,600 to 700 megatons of CO2 and from 2,1 to 0,5 billion vehicles worldwide.

But only few cities are now starting to test smart mobility systems, and most of them dramatically lack of urban planning strategies in terms of integration of public transport and new mobility services and public spaces.

Chinese cities are the places where the change happens at the fastest pace. Shared and free-floating bicycles have become a popular trend in China and worldwide, but the massive amount of bicycles that recently invade the streets of Chinese cities has shown the limits of such solution.

This session proposes to identify the major coming challenges of the urban mobility revolution in China and worldwide.

During the first part of the session, Sebastien Goethals will introduce the relation between smart mobility and urban metabolism, through integrated planning and design strategies, followed by a quick introduction of the scale and speed of China's urbanization and mobility transformation.

During the second part, two Chinese major experts in urban planning and mobility, PAN Haixiao (Tongji University) and WANG Hongyang (Nanjing University) will give a presentation about their approach of the mobility transformation and its potential to improve livability in Chinese cities.

The third and last part of the session will be dedicated to a rapid visioning exercise with the public, putting in perspective the role of city planners in the technological transition of cities.

Session 3: Planning next generation infrastructures for adaptation, mitigation & disaster preparedness

2 October (Tuesday), 15:30 - 17:00

TK *Sabelo Mahlangu, University of Witwatersrand, Johannesburg, South Africa*

Planning for a changing climate: A GIS and remote sensing approach to urban flood modelling in the Gauteng City Region
A GIS and Remote Sensing approach to urban flood modelling will be presented.

Menghan Zhang; Beiijng, China

Symbiosis with rivers: the management of flood response to future climate change from the perspective of landscape planning
We should find solutions to disasters based on the idea of resilience by establishing a place that can adapt to the temporal dynamics. As means of flood management and symbiosis with rivers, in both low-urbanization areas and urban areas, two different detailed strategies of landscape planning are provided.

Binxia Xue; Xiaohe Hou; L. Lulu Chen; S. Su'ning Xu, Harbin Institute of Technology, Harbin, China

Study on the optimized strategy of resilient spatial pattern from the perspective of sponge city - Taking Garden Street Historic Block in Harbin City as example
In order to solve the most serious rainwater problem in old urban areas of China, this paper redesigns green infrastructures which are compatible with the architectural style of old city and then combined with gray infrastructures. The program optimizes space in a resilient way and builds a three-dimensional spatial pattern.

Wale Alade; Femi Adeniji, University of Lagos, Lagos, Nigeria; Mobolaji Olaseni, Yaba College of Technology, Yaba, Lagos; Olubukola Alade; Bukola Alade, Bells University of Technology; Olajuwon Olaseni, Vistaplan Consulting Nigeria

Making Lagos a cool city: a study of transport system and travel behaviour
Lagos transport system threatens peoples' survival and climate. Urgent and full implementation of the Lagos strategic transport masterplan which makes provision for multimodal transport system, transport and land use integration among others is recommended with urban planning strategies such as Transit Oriented Development for land use and travel demand management

Zhong Yujia; Tan Li, Beijing, China

Study on vegetation in Haidian District of Beijing based on heat island effect
By studying the data combined with the law of cooling effect of green space, we found that the cooling effect of green space can be improved by controlling the green area, perimeter, shape coefficient and community structure. Based on this, we will guide to improve the urban ecological green network.

Session 4: Shaping urban form and flows in the smart cities

3 October (Wednesday), 13:30 - 15:00

TK *Daniela Baer, SINTEF, Trondheim, Norway; Brita Nielsen, Norwegian University of Science and Technology, Trondheim, Norway*

Challenges and Best Practices for the planning of zero emission neighborhoods and smart energy communities – the case of seven Norwegian cities
We will present challenges which occurred when planning for Zero Emission Neighbourhoods in seven Norwegian cities as well as best practice examples how to cope with them.

Track 4

Olga Chepelianskaia, Uniciti, Toulouse, France

Climate adaptation: transit oriented development as a strategy in Asian cities

Increasing vulnerability to climate change in Asian cities has made adaptation a critical matter. While successful Transit Oriented Developments (TOD) in developed Asian cities have uncovered significant benefits, its adaptation potential is yet to be analysed. The presentation outlines the climate change adaptation role of TOD in Asian cities.

Xiyuan Ren, Tongji University, Shanghai, China

Research on urban spatial structure in Shanghai from a human mobility view based on cell phone data

Four characteristics of human mobility in spatial analysis units: flow strength, influential area, flow composition, and law of time. A dynamic urban form is then described to support the future design for smart spaces.

Xin Kai, Shanghai Tongji Urban Planning and Design Institute, Shanghai, China

Land suitability evaluation for resilient urban planning: a planning practice of Pingdingshan City, China

This paper proposes a land suitability evaluation model for resilient urban planning in the dimension of infrastructure and ecosystems. In the process of ecological strategy planning in Pingdingshan, the model used to identify the ecological valuable and sensitive areas, providing an ecological basic framework for land-use planning.

Jun Zhou; Xin Lian Beijing, China

Shared Farm: an approach to achieve urban-rural reciprocity based on sharing economy

The sharing economy, featuring the access-based consumption without the transfer of ownership, offers a perfect therapy for rural area in China to bypass the institutional obstacles of land transaction and participate in the game of market economies. Shared Farm was born based on such concept.

Session Proposal
How to develop a new public service

3 October (Wednesday), 15:30 - 17:00

Moderator and Speaker: *Larissa Guschl, urban planner based at participatory planning and design office WeLoveTheCity, Rotterdam, The Netherlands*

Citizens have plenty of ideas for the neighbourhood in which they live, work and play. Unfortunately, they don't always have access to the right information to develop their ideas into a concrete proposal. That's why Freie und Hansestadt Hamburg, Roma Capitale and The Royal Borough of Kensington and Chelsea want to share a combination of open data and expert knowledge. The smarticipate platform allows citizens, entrepreneurs, NGOs and city officials to submit their proposal for a sustainable neighbourhood and to receive immediate feedback. This means everyone can get involved, even those who have never interacted with local government before. Some citizens and entrepreneurs even want to go further and demand access to the technological core of the digital platform to plug in their own topic.

During the hands-on session you can test the smarticipate prototypes (Plant a Tree App, Urban Transformation App, 3D Planning App). Besides that, we will challenge you to think about which kind of New Public Service you would like to introduce and how the smarticipate platform could help in achieving that goal.

Session 6: Turning technological innovation in urban and community values

4 October (Thursday), 11:00 - 12:30

TK *Judith Borsboom-van Beurden, Norwegian University of Science and Technology, Trondheim, Norway*

Windows of opportunity for smart city solutions

For a real urban transition, a systematic scan of the windows of opportunity for smart city solutions is needed, not only during urban (re)development, but also in asset management in the built environment.

David Ludlow, European Smart Cities, Bristol, United Kingdom

Smart city governance – co-creating urban planning and inclusive communities

Disruptive technology applications for urban governance offer major opportunities engaging multi-disciplinary partners and stakeholders, integrating evidence based decision-making addressing societal challenge. Research questions to be addressed include the specifications for a user-defined framework of interconnected strategic policy, and how best to ensure development of a common model of urban governance?

Ozge Celik, Özhan Ertekin, Istanbul Technical University, Istanbul, Turkey

Re-thinking the city: Living Lab concepts in Turkey

The paper examines living labs in Turkey to find out cooperation between labs and local government and its influences and contributions on local planning.

Alexander Boakye Marful; Daniel Duah, Kwame Nkrumah University of Science and technology; Joseph Agyei Danquah, Building and Road Research Institute, Kumasi, Ghana

Smarting the cities: a catalyst for acculturation in Ghana?

This paper seeks to investigate whether the transformation that comes with smarting cities could serve as a catalyst for acculturation or a strategy for resilience. As an exploratory research, a mix method approach was adopted in collecting data from persons within Kumasi and a microcosm of a city in Kumasi.

Maria da Graça Moreira, Universidade de Lisboa, Lisboa, Portugal

Tourism and ICT; a new urban challenge to planners

Tourism is one of the economic activities that have developed most in urban space. The number of people who make tourism along with the changes in ICT is having a great impact on the appropriation of urban space. The APPs about climate are a value on the tourist activities.

Sławomir Ledwon, Vice President ISOCARP, Doha, Qatar; Mubarak Al-Naimi, Ministry of Municipality and Environment, Doha, Qatar

Hot climate and runnability: how climate affects outdoor running activities. A case study of Doha, Qatar

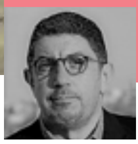
This article discusses runnability - the relation between built environment and outdoor activities of citizens, in particular running. Correlation to changing weather conditions throughout the year in hot climate is made by analysing the case study of Doha, Qatar. Examples of the latest infrastructure and its features are also presented.

Giovanni Sergi, Department Architecture and Design Genoa University, Senigallia, Italy; Paolo Rosasco, Department Architecture and Design Genoa University, Genoa, Italy

The use of Living Lab in some Italian urban settings to test the feasibility of the Smart City. Making the needs of communities compatible with applications of new technologies

Since 2007 several Italian Municipalities have tested the Smart City model. With reference to the EU Manifesto of Helsinki which outlined the Living Lab in 2006, some Municipalities have worked to check the consistency of the Smart City model with the primary role of inhabitants within such processes.

Track 5: Social Networks: Citizen Participation, Urban Governance and Cultural Transformation




Location: Stormen Concert Hall – Sinus

by Ali Alraouf and Nupur Prothi Khanna

As is clearly manifested in the call for abstracts, this track focuses on people. The main question is: how can communities and citizens be engaged in the planning process, while acting as part of a formal or non-governmental system?

This track is extremely valuable and we are anticipating that the selected papers and case studies would initiate a fresh, engaging and timely discussion underpinning the relevance of people, communities and citizens in the way cities are designed, planned and used today.

This track will also stage two session proposals.

The submitted abstracts were assessed for their relevance to the track and its subthemes, research merit, contribution to global discourse on the subject, sharing valuable local experience, comprehensively analyzed case studies and good practices. The selected papers showcase a wide spectrum of planning knowledge and experience.

Overview of abstracts

This track received the highest number of abstracts, a fitting indication that people form the core of equitable, smart and sustainable planning. The diversity of discussions ranging from theoretical analyses to good practices from across geographies, offer a well-rounded contribution to the climate change discourse. Based on particular emphasis, the sessions were organized around six themes: sustainability and local stewardship; planning places for people; inclusive cities; planning policy, governance and management; heritage in context; smart city.

Topics discussed in the different papers allowed the track team members to divide the sessions in a way which would holistically cover the interdisciplinary and interrelated nature of the contributions.

A discussion on themes and sessions

Sustainability and local stewardship forms the heart of the discussion on citizen participation in planning for 'cool cities'. The discussions centers on people engagement in diverse contexts, from mapping their natural landscape, to safeguarding their commons, to coming together in the face of natural disasters. Engagement, protection and preparedness are demonstrated in three different national contexts (Japan, China, Flanders) as part of this session.

Planning places for people puts citizens in the heart of the green initiatives in today's fast urbanising world. From designing participatory landscapes to measuring environmental benefits of open spaces, deliberations from Europe and China illustrate the relevance of people to the transformation of these spaces into places and their relevance to health and community well-being.

Inclusive cities addresses the reality of migration, changing population typologies and new and transforming communities that are beginning to dilute the political borders in our world today. Addressing concerns around segregation, this session brings forward views from the developing nations (Asia, South America, Europe, Sudan) related to the central role of women and children in sustainable practices as well as addressing the challenge of aging communities in Europe.

Planning policy, governance and management is an engaging session on the role of non-governmental actors in the diverse scales of planning and development. Ranging from master planning in West Asia, to housing concerns in Asia, to community based space management in Africa, this session focuses on public participation in policy and governance for safeguarding our urban future.

Heritage in context elicits interest amongst many papers in assessing the unfortunate loss of urban heritage in the absence of understanding its significance, imminent pressures of the fast paced development, and lack of engaging and incorporating our past in our present development. Cases from Asia (China and Istanbul) highlight the role that participatory processes are playing in re-appropriating heritage in planning and giving it a place of significance in the monochromatic urban form taking over our historic environment.

Smart City lays out possibilities around the potential of renewable energy. Innovative ways for urban planning to create cities that can prepare for a sustainable future form the core of discussions from Asia and Europe in this session.

Session proposals

01 Constructed and contested legitimacy in urban governance

Academics and practitioners from Norway will present the challenge for urban governance in facilitating sustainable cities. The negotiations around legitimacy claims from different stakeholders, planners and decision makers to enable this transformation will be the main subject of the discussions in this session.

02 Planning for Diversity

Comprising of short presentation from Norway, this session addresses the capacity of cities to live with differences, to ensure social, economic and environmental sustainability of cities. The deliberations will relate to new theories, methods and tools for planning for diversity, supported by good practices and case studies.

Way forward

Planning, like democracy is for the people, by the people and of the people. Also like democracy, the choices that we make impact us directly - as demonstrated by climate change in the recent past and in the present. Climate change is central to the future direction we need to take for planning our cities, spaces and places. The opportunities are diverse, considering indigenous knowledge systems on one end of this spectrum, down to using AI and digital media as enablers to visualize and actualize a better world. This track contributes a new perspective for the planning discipline as a facilitator to actualize this vision of a cooler, livable earth, safeguarding our future and that of the generations to follow.

TK track keynotes

Session 1: Sustainability and local stewardship

2 October (Tuesday), 11:00 - 12:30

TK *Kasumi Susaki, Ryukoku University, Kyoto City, Japan*

A study of Japanese neighborhood communities expected to work during climate change-related natural disasters - from the religious diversity perspective

In Japan, neighborhood communities are expected to work during large-scale natural disasters, and municipalities have begun to encourage their activities. Some of their activities are related to shrines or temples. Therefore, neighborhood communities should examine diversity. This paper reports the result of the examination of this issue.

Amsale Temesgen, Nord University, Bodø, Norway; Bjørn Vidar Vangelsten, Nordland Research Institute; Mònica Guillen Royo, University of Oslo, Oslo, Norway

Citizen participation for increased sustainability and quality of life in cities in Nordland County

Nordland county in Northern Norway aims to increase both attractivity and sustainability of its cities. This paper presents preliminary results from a workshop method based on Max Neef's Human Scale Development theory using citizen participation to propose policies for improved quality of life and sustainability in selected cities in Nordland.

Aase Kristine Lundberg; Mathias Reinar, Nordland Research Institute, Bodø, Norway

Urban living lab: towards more legitimate and inclusive participation in urban planning? experiences from Bodø living lab

Urban Living Labs have been promoted around the world as a desirable approach to public participation in urban planning. In this paper, Bodø Living Lab is used as a case to explore how such initiatives contribute to secure and improve the legitimacy of urban planning faced with climate change.

Ping Shen, Tongji University, Shanghai, China; Jingyu Liang, Guangzhou, China; Zhao Miaoxi, Guangzhou, China

Detecting attractive spots of hiking tourism based on geo-tagged photos: the case of northern outskirts of Guangzhou, China

Based on geo-tagged photos shared online by hikers, we detected attractive spots and obtained tags reflecting landscape features of the spots in order to provide references for planning, governance and management of hiking tourism.

Annette Kuhk, Katholieke Universiteit Leuven, Leuven, Belgium; Guy Vloebergh, Omgeving cvba, Antwerp, Belgium

How local re-commoning initiatives set a spark for global challenges

Three landed commons initiatives in Flanders (Belgium) on organic farming, social housing and slow roads illustrate how (re-) commoning practices of active land use stewards lead to a more sustainable use of scarce land and of fertile soils, and as such also to a contribution in the mitigation of climate change.

Session 2: Planning places for people

2 October (Tuesday), 13:30 - 15:00

TK *Yuting Guo, College of Architecture and Urban Planning, Tongji University, Shanghai, China*

Space production: the interaction between social network and community garden

This paper investigates urban community gardens as spaces of citizenship through a case study of the Paraquat garden in Anshan Four village to find out the interaction that urban agriculture brings to citizens' participation and the residents' lifestyle as public space.

Iris Gommers, City of Antwerp, Antwerp, Belgium

A green tool to measure the environmental and ecological benefits of green areas and to involve different stakeholders

Antwerp's "Greentool" allows urban planners to explore the potential of green to improve the living environment (heat stress, water run-off, air quality, noise perception, biodiversity, carbon sequestration) in a specific area. The application shows which nature based solutions can be used where in the city and gives the potential impact.

Longduoqi A; Hang Ma, Harbin Institute of Technology, Shenzhen, China

Evaluation of public space vitality of based-scenic villages in a subtropical climate region: Case study of Guanhu Village in Shenzhen

This study aims to establish a method to evaluate the public space vitality (PSV) of coastal villages in urban fringe through tourist preference. It has some theoretical significance to guide the self-organized development of coastal villages in urban fringe.

Lihua Li; Lingling Li, School of Architecture, Harbin Institute of Technology, Harbin, China

Adaptable planning strategies of urban sport spaces in cold regions for climate and citizens' needs: case study of Songyuan, China

Based on investigating and analyzing citizens' needs of recreation and physical activities under the influence of climate, planning strategies of urban sport spaces in China's cold regions are explored to improve the regional and climate adaptability.

Session 3: Inclusive Cities

2 October (Tuesday), 15:30 - 17:00

TK *Paola Rizzi, University of L'Aquila, L'AQUILA, Italy, Pongpisit Huyakorn, UDDI, Thammasat University, Bangkok, Thailand*

Gaming simulation as a policy planning tool in a racially diverse neighborhood: a case study of Lardproaw district, Bangkok

The researcher implemented Gaming Simulation as a method to assess the awareness toward climate change and the perception regarding the collaboration for local policy development from different local racial groups which include Thais, South East Asians, Europeans, etc. Ultimately, we recommend the progressive approach for elevated local community-based planning.

Mitchell de Sousa, University of Buenos Aires, Ciudad Autónoma De Buenos Aires, Argentina

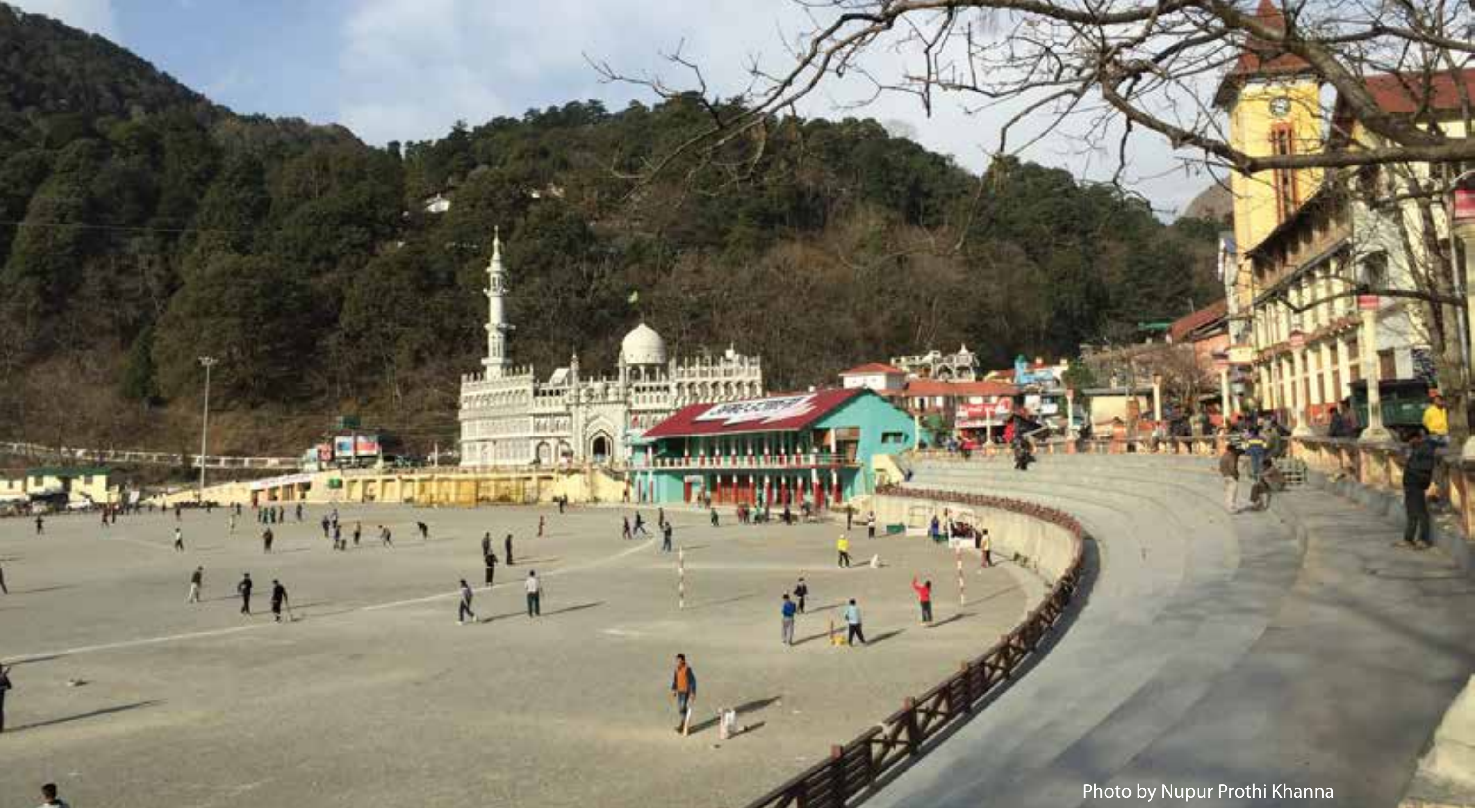
Beyond urban seggregation: social reproductions and territorial frames of popular sectors in middle-sized towns of Latin America: the case of the neighborhood "Planta De Gas" in the Patagonian-Argentine city of Trelew

This work studies the characteristics and the specific themes that are located between the dynamics of the popular sector and the socio-spatial process. The main objective is to identify the transformations of the territorial organization on informal settlements in middle-sized towns on the Latin American context.

Lekshmy Hirandas, School of Planning and Architecture, New Delhi, New Delhi, India

Child in the City: Understanding the role of children in community engagement, Case of Chara Mandi, New Delhi

The case study will introduce an understanding of the role of children in Participatory Planning. It is a well-established fact that children are much more perceptive to their environments than adults.



Maria da Graça Moreira, Universidade de Lisboa, Lisboa, Portugal
Associations of active aging; a potential tool for local development
This paper presents a research on the role that 'senior universities' can play as tools for the preservation of tangible and intangible heritage in some urban or rural areas.

Session 4: Planning, policy, governance and management

3 October (Wednesday), 13:30 - 15:00

TK *Piotr Lorens, Gdansk University of Technology, Gdansk, Poland*
Civilizing the public participation practice in post-transition countries
Public participation is nowadays commonly understood as the key issue in contemporary planning theory and practice. It can be noted that in post-transition countries the local communities are much more demanding in this respect, and – in result – new tools and approaches to this are being developed.

Mahesti Okitasari, UN University Institute for the Advanced Study of Sustainability, Tokyo, Japan
Spaces of non-state actors in the urban development process: Rethinking the community-based planning in the housing sector
This paper examines how community-based planning in Indonesia changes with the shifting roles of non-State actors in the development process, particularly in urban settlement, and the introduction of international urban development agenda and approaches in the last two decades (1999-2017).

Nagy El Gritly; Noora Al Suwaidy, Ministry of Municipality and Environment, Doha, Qatar
Towards setting up a contemporary planning system that adopts a participatory planning approach, enhances good governance, and delivers cool planning for Qatar urban future
The paper will show the importance of the role of Consultation and Community Engagement with all concerned stakeholders during the preparation of urban development projects. Such findings would represent a fundamental and decisive progress in the development and consolidation of Qatar's emerging Planning System.

Ekaterina Maleeva, Project Director at Strelka KB, Moscow, Russia
Standards for the integrated development of territories
The Integral Guidelines for Urban Development is designed to make 1114 Russian cities modern, resilient, and responsive to the needs of residents. This is the first such document in Russian practice. The guidelines combine a flexible approach to regulation, while at the same time integrating existing norms and rules and set the bar for high quality development of the urban environment.

Session Proposal
Planning for diversity

(Session Proposal as part of track 5)
3 October (Wednesday), 15:30 - 17:00
Location: Stormen Library – Bodø ByLab
(see page 39)

Session 5: Heritage in context

3 October (Wednesday), 15:30 - 17:00

TK *Serin Geambazu, Ion Mincu University, Bucharest, Romania*
Local identities on change- urban waterfront regeneration within the global city Istanbul
The study reveals the dimensions of an urban waterfront regeneration project in which the rights of the future users of the space are lost behind a fight between the government and strong opposition parties gaining ground of governance landscape, motivated by their stake in the development.

Zihan Cai; Ming Lu, Harbin Institute of Technology, Harbin, China
Research on sustainable design of historical blocks based on inhabitant social integration measurement: a case study of Harbin in China
In order to solve the conflict between inhabitant life and commercial tourism in the renewal of Chinese historical blocks, this paper uses the confirmatory factor analysis to construct an evaluation model of inhabitant social integration measurement and proposes a sustainable design strategy for historical blocks from the perspective of inhabitant social integration.

Track 5

Cunai Yan; Chenchen Ren; Huiyi Xia, Shanghai Tongji Urban Planning & Design Institute, Shanghai, China

Applied research on public participation in urban renewal planning based on the 'Fanchang Model'

This research tries to improve the original planning process of the urban renewal projects through enhancing public participation and public opinion survey process so as to form a framework of PIEA (Participation + Investigation + Evaluation + Action) for urban renewal projects.

Jianqiang Yang, Southeast University, Nanjing, China

Study on endogenous and inclusive development of old residential area

In the principles of resident participation, equal cooperation, progressive regeneration and inclusive development, the paper studies the substantial connotation, realistic meaning, fundamental principles, community organization, and regeneration measures. It proposes workable measures for endogenous urban regeneration, and establishes a holistic route in which collective intelligence should be brought into play.

Xinyue Gan, Tsinghua University, Beijing, China

Urban Beautification in Beijing's old city from the 1990s to the present: Taking housing regeneration in Beijing old city as the case

From 'housing demolition' in 1990s and early 2000s, to 'housing vacation' at present in Beijing old city, how does the mechanism of housing regeneration transform? At present, whether the living conditions of the local residents have been improved in the process of 'housing vacation'?

Huiyi Xia; Renzan Qian; Cunai Yan; Nankai Xia, Shanghai Tongji Urban Planning & Design Institute, Shanghai, China

Multi-dimension urban planning in renewal of the old city - a case study of an urban renewal project in QuYang, Shangahi, China

It is mainly based on community governance, adding data platform services and data analysis, using the Internet to provide residents or users with more effective and comprehensive public supporting services, and providing management with data control and big data analysis in the background.

Session 6: Smart City

4 October (Thursday), 11:00 - 12:30

TK *Miguel Fernández-Maroto; Juan Luis De las Rivas Sanz; Sergio Cantero Celada; Ángel María Marinero Peral, University of Valladolid, Valladolid, Spain*

INTENSSS-PA: a governance approach for integrating energy and spatial planning - its results in Castilla y León (Spain)

The INTENSSS-PA project aims to develop and implement an institutional capacity building approach related to energy and spatial planning, addressed to public authorities and societal stakeholders in order to support them to enter in a new era of holistic planning through a participatory, multi-level, interdisciplinary decision-making process.

Evgenii Aleksandrov; Elena Dybtsyna; Anatoli Bourmistrov; Giuseppe Grossi, Nord University Business School, High North Center for Business and Governance, Bodø, Norway

Opening Smart City 'fairy tale' to Critical Scrutiny: insights from dialogic accounting literature

Smart City idea becomes a 'fairy tale' with smart IT-solutions, smart people and smart collaboration for sustainable future. However, it is still unclear how to develop Smart City management which somehow should balance between interests of financial sustainability, citizens, environment and business or/and political elites.

Anniken Førde, Tromsø, Norway

Enhancing urban encounters - the transformative powers of creative integration initiatives

This paper explores innovative integration initiatives in cities in the north, emphasizing how new forms of engagement and responsibility might be engendered. The cities are seen as sites of experiments, where new relations across difference are developed.

Guoqiang Wang; Liu Songfu; Shen Yu, Faculty of Architecture, Harbin Institute of Technology, Harbin, Heilongjiang Province, China

The framework research on sustainable conservation of urban building heritage from the collaborative visioning for the future based on the complexity theory

This paper highlights how heritage sustainable conservation becomes important for dynamic innovation in the urban evolutionary process in the coming anthropogenic era, during which decision-making and human behaviour is becoming the dominant influence.

Angela Santangelo; Simona Tondelli, University of Bologna, Bologna, Italy

Embedding energy user's behaviour into multi-criteria analysis: Providing scenarios to policy-makers to design effective renovation strategies of the housing stock

The paper aims at contributing to the discussion about promoting urban regeneration through energy-related policies able to incorporate user behaviour. The outcomes shall support policy-makers to design and implement energy policy instruments to regenerate the existing built environment, to increase urban resilience, quality of urban spaces and quality of life.

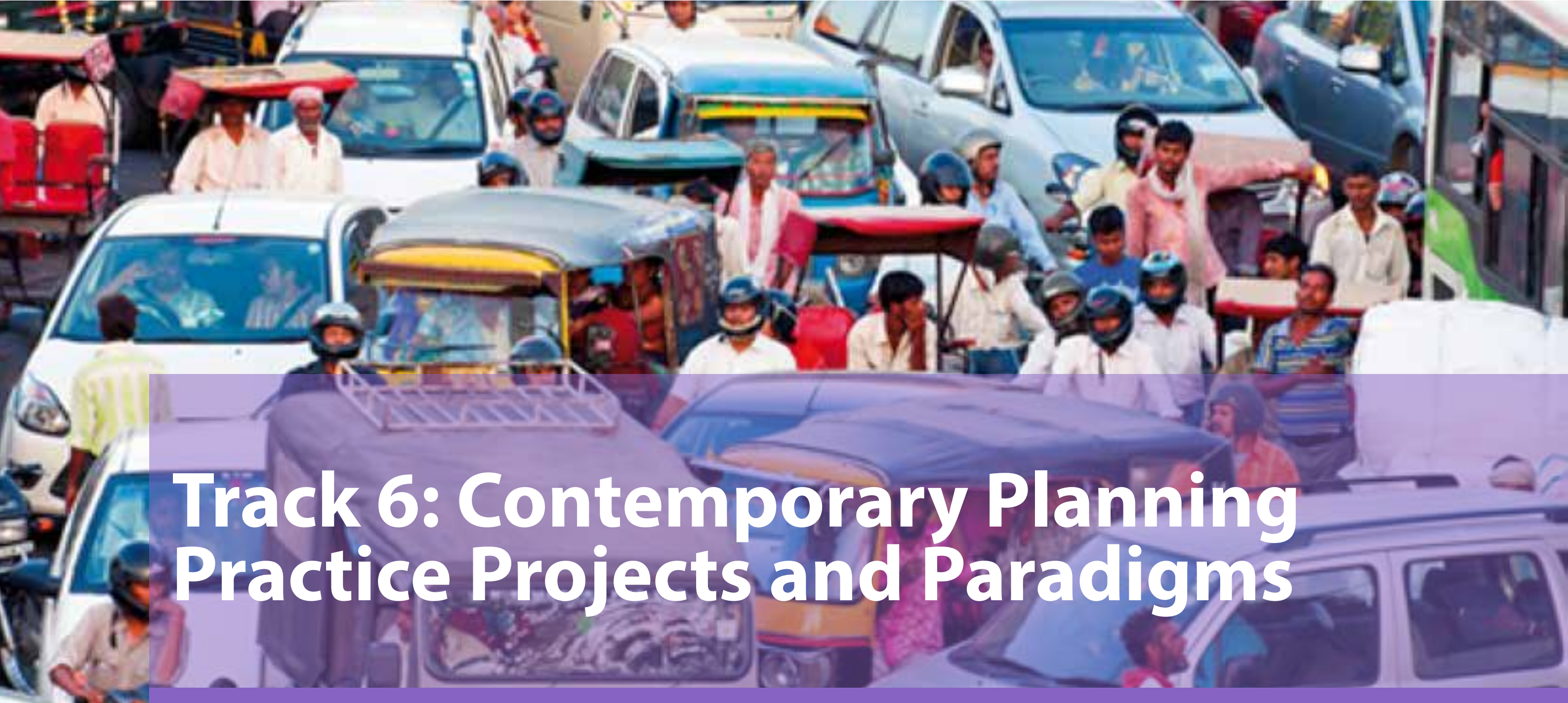
Constructed and contested legitimacy in urban governance

(Session Proposal as part of track 5)

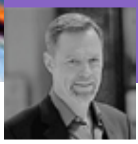
4 October (Thursday), 13:30 - 15:00

Location: Stormen Library – Bodø ByLab

(see page 40)



Track 6: Contemporary Planning Practice Projects and Paradigms




Location: Stormen Library – Litterature Hall
by Frank D'hondt and Andreas Schneider

This track reflects the diversity of 'less-climate-related' planning issues that drive contemporary planning researchers and practitioners. Weaving common threads is not easy, let alone a pattern or paradigm in contemporary planning. There are recurrent topics such as preserving cultural and natural heritage, the need for quality over quantity, (real) public space making, TOD-planning, etc. But there are also some newer fields such as 'UniverCity'/School Planning, Entrepreneurial Planning, Mobile-data-based Activity Planning, Community Life Cycle Planning, Sponge City-Planning, Urban Eco-Planning, Dual Planning System approach and …the 'Periodic Table of Urbanism'. In other words, if eclectic 'diverCity' is your thing and climate change is not necessarily the primary focus of your work and research - this track is yours!

Session 1: Urban Innovation 1
The lead paper explores the transformation in the urban planning approach of Kolkata/India based on a timeline of historical events since its inception as an Indian colonial port city, to today's IT-driven city. The paper confers that the prevailing hegemony of the dominant neoliberal urbanism is neglecting the place-making characteristics of the public realm of Kolkata, leading eventually to erosion of the cultural fabric of Kolkata neighbourhoods. The authors strongly opine the redevelopment of the public realm to reinvigorate the fading cultural patina of the neighbourhoods and enhance the neighbourhood cohesion. Other papers in this session struggle with the same consequences of urban transformation driven by neoliberalism and authoritarianism. Papers exploring eco-neighbourhoods and UniverCity complete this first session.

Discussion could be centred around following keywords: urban communities, urban transformation, neoliberalism, eco-neighbourhoods, UniverCities and public space.

Session 2: Urban Innovation 2
The lead paper analyses working, living and leisure activities in metropolitan Wuhan/China and identify their spatial relations between the old city and the East Lake new town. It then proposes optimizing suggestions for the current spatial plan of the new town in view'of a more people-centred approach to planning and urban development. Other papers advocate the idea of neighbourhood schools in India; people-centred entrepreneurial planning is Israel; the impact of large-scale urban interventions on contemporary city centers, with the Polish harbour city Gdansk as the case; and the concept of 'community-life-cycle in urban planning, with Ningbo Eastern new town development as case-study.

Discussion could be centred around following keywords: mobile-data mining, activity-planning, new town development, people-oriented/entrepreneurial planning and urban redevelopment.

Session 3: Eco-Planning System
The lead paper, taking Shanghai as an example, introduces the theory and praxis of Water-based Planning within the context of the Chinese Sponge-City Programme. Other papers argue for a global dual planning system, addressing both urbanized and non-urbanized territories; for a paradigm shift towards Urban Ecological Planning as tested in Pune/India; for centralized leadership to implement major projects that can jump-start local development, as demonstrated in the case of Dateng Valley Redevelopment in rural Wu-Xuan/China; and for an urban morphology optimization model to address the Urban Heat Island effects, with Hangzhou/China as the case.

Discussion could be centred around following keywords: water-based planning, planning system assessment and reform, urban ecological planning and urban island heat mitigation.

Session 4: Heritage Planning
The lead paper presents research on win-win strategies for ecological heritage protection and eco-tourism development along trans-regional mega linear projects of China, resulting in new guidelines for the planning, construction, ecological restoration, tourism development and management of them. Others papers are dealing with sustainability planning for small border mountain towns entering the global tourism market, with case studies in Georgia and Vietnam; with Landscape as a cultural ecosystem service and guiding administrations and professionals in incorporating landscape management into the different stages of regional and local planning and design; with Landscape planning in Russia; and with the challenges of urban rehabilitation of heritage districts under heavy touristic pressure, such as the Bairro Alto and Bica neighbourhoods in Lisbon/Portugal.

Discussion could be centred around following keywords: urban and ecological heritage, eco-tourism, landscape planning and ecosystem services, urban rehabilitation and gentrification.

Session 5: Landuse & Planning Systems
The lead paper presents issues and challenges in delivering compact development and densification in Auckland/New Zealand. It suggests that the land use planning should be accompanied by a more thorough discussion and review of planning tasks and goals, and a deeper understanding on the role of plan regulation and its actual implementation under a market-driven planning system. Other papers are presenting land-use suitability assessment criteria for South Africa, carried out on land before any developments are implemented; the practical limitations of mixed land use as a sustainable development model which promotes the compact and efficient use of spatial resources, comparing Chinese and American practices; the 'periodic table of urbanism', providing a comprehensive framework for describing the "general reign of order" in our towns and cities, whereby planners and related professions are able to reach a fuller understanding of cities – and thereby plan them better, with Palermo/Italy as the case study; and the case of a Railway hub area development in Arth-Goldau/Switzerland, with innovative participatory methods on Stakeholder Process and Urban Design.

Discussion could be centred around following keywords: compact development, land-use suitability assessment, mixed land-use, planning system rethinking and smart/participatory TOD.

Authors are responsible for the content of their work

TK track keynotes

Session 1: Urban innovation part 1

2 October (Tuesday), 11:00 - 12:30

TK *Sudeshna Kumar; Haimanti Banerji, Indian Institute of Technology Kharagpur, Kharagpur, India*

Analysis of transformation of urban planning practice by mapping changes in economic, social, cultural and built environment of the Neighborhood Level Urban Communities (NLUC): Case study of Kolkata, India

The study analyses the transformation of urban planning practice through mapping changes in economic, social, cultural and built environment of the selected NLUCs. The study then explores how entrepreneurial urbanism and neoliberalism has dominated planning practice leading to erosion of the cultural patina of Kolkata.

Xiaoping Zhang; Fengying Yan; Haiyan Lei, Tianjin University, Tianjin, China

The planning methods of Chenjia Town international ecological community in Shanghai based on ecological security

With the planning of ecological community from the theoretical discussion into practical exploration, the paper takes the Chenjia Town international ecological community in Shanghai as an example to explore the planning methods of residential areas based on the ecological security, so as to provide reference for the construction of an ecological community.

Wenjing Luo; Haijun Li, Wuhan Planning & Design Institute, Wuhan, China; Han Zou, Hubei University of Technology, China

How do universities react with cities: the case study of Wuhan, China

Cities and universities have been reacting with each other in a complex, conflicting way not only in urban morphology but also in economic, social and cultural networks. This paper takes Wuhan as an example to explore the spatial relationship between universities and cities.

Dicle Kizildere, Istanbul Technical University, Istanbul, Turkey

Emerging forms of neoliberal governance on public space: an informal business improvement district in Istanbul

This paper investigates the birth and evolution of a Business Improvement District (BID) in Talimhane, Istanbul, which is the first case of the use of this instrument of neoliberal governance in the city.

Session 2: Urban innovation part 2

2 October (Tuesday), 13:30 - 15:00

TK *Wenjing Luo; Wei Xiong, Wuhan Planning & Design Institute, Wuhan, China; Han Zou, Southeast University, Wuhan, China*

Analysis on the working-living-entertaining spatial relations of new towns based on mobile location data: the case of the national independent innovation zone of East Lake in China

By using mobile location data, we proposed a people-centred planning model which does not only describe the current human activities and interpret the reasons underneath, but also analyzes whether the current model of space use is sustainable and the future model of space supply is necessary to be changed.

Swechcha Roy; Saikat Kumar Paul; Vivek Agnihotri, Indian Institute of Technology Kharagpur, Kharagpur, India

Developing a conceptual framework for geo-spatial planning of location-allocation of schools in Indian cities

The current trends of school siting, theories about school effectiveness and approaches for meeting the social infrastructure requirement of a community is reviewed and inferred that the neighborhood school is very effective but has own limitations. The study proposes to include consumer choice in the concept of neighborhood schools.

Ronit Davidovici Marton, D.M.R Planning & Development, Tel-Aviv, Israel

The hybrid urban renewal model - Entrepreneurship, income, employment, innovation everywhere

Urbanism requires the development of economic infrastructure that places the person and a todays lifestyle as a leading asset for the city renewal. Therefore, the major goal of renewal planning is to encourage entrepreneurship, innovation, employment - everyone and everywhere. Bat Yam renewal plan is a modelling case.

Piotr Lorens; Michal Habier, Gdansk University of Technology, Gdansk, Poland

Impact of large-scale urban interventions on contemporary city centers

Large scale urban interventions have become a common development practice in contemporary cities, allowing achieving rapid changes in their urban structure. The main aim of this paper is to discuss this issue in the wider context, taking into account also social, legal, economic and infrastructural consequences of their development.

Yuan Lu; Xiangyi Wang, Urbanspace Planning And Architectural Design Co.Ltd(Shenzhen), Shanghai, China

Research on the planning of community life circle in new town based on an evaluation approach - A Case Study of Ningbo Eastern New Town in China

A research explores the evaluation and construction of community life circle, which reflects the interaction of people's daily life and space.

Reframing citizen participation for a sustainable city transition – the case of Bodø ByLab

(Session Proposal)

2 October (Tuesday), 15:30 - 17:00

Location: Stormen Library – Bodø ByLab

(see page 38)

Session 3: Eco-planning

2 October (Tuesday), 15:30 - 17:00

TK *Dan Ye, Blue Town Urban Planning Co. Ltd, Shanghai; Xiji Jiang; Yidong Yu, Shanghai Tongji planning and design institute, Shanghai*

Planning and construction practice for Sponge City in Shanghai: experience and reference

Shanghai has carried out a series of "Sponge City" planning work, including the specific planning of overall urban level, compilation of technical guidelines, special planning of pilot areas, and the implementation of the concept and technology of sponge city. This paper systematically introduces its concrete practices and useful experiences.

Frank D'hondt, Territorial Capital Institute, Glyfada, Greece

Better planning systems for cooler countries and cities

International research made clear that most if not all spatial planning systems are not (longer) fit for the purpose of a more sustainable urban and territorial development. Based on the UN Urban Agenda and UN-Habitat's Planning Guidelines, a new method will be presented to review and reform Spatial Planning Systems.

Marcin Sliwa; Aranya Rolee; Refstie Hlilde, Norwegian University of Science and Technology, Trondheim, Norway

Urban ecological planning: principles, value positions and application in practice

The paper presents the principles of Urban Ecological Planning - an approach of urban practice that challenges and supplements outdated technocratic urban planning methodologies that are still dominant in many developing countries. The value positions of this paradigm are illustrated with examples from an extensive fieldwork in Pune, India.

Track 6

Jinbai Wang; Da Xiao; Shanghai Tongji Urban Planning and Design Institute, Shanghai, China; Chen Chen, Tongji University, Department of Urban and Rural Planning, Shanghai, China

Towards world-class lakeshore city from edge county seat: Wu xuan's over-taking development strategy accompanying the construction of Dateng Valley Reservoir

Promoting regional development by means of major projects is a developing path that China frequently adopts and should shed light on the over-taking development strategy in less developed regions or economies.

YI Zheng; Junyan Yang, Southeast University, Nanjing, China

How Urban Morphology Can Be Optimized? Research on Interactive Mechanism Between Urban Morphology and Urban

Micro Climate

This paper focusses on analysing the mechanism and effect relationship between urban micro climate and urban morphology under a global climate change background. Through an urban design project to explain the interaction between urban mirco climate and urban morphology, and how urban physical environment can be improved by optimizing urban morphology.

Session 4: Heritage planning

3 October (Wednesday), 13:30 - 15:00

TK *Renzan Qian; Huiyi Xia; Cunai Yan; Nankai Xia, Shanghai Tongji Urban Planning & Design Institute, Shanghai, China*

Research on the scopes of eco-tourism development of areas along transregional mega linear projects of China – a practice study of Yin Jiang Ji Huai Project

This paper attempts to explore an operational route and theoretical model for delimitating the scopes of the eco-tourism development of the areas along trans-regional mega linear projects, for providing significant reference to planning, construction, ecological restoration, tourism development and management of such kind of projects in China.

Renard Teipelke, Independent Consultant, Gera, Germany

Sustainability planning for small border mountain towns entering the global tourism market

This case study of sustainability planning in Mestia (Georgia) and Ha Giang (Vietnam) will reflect on the opportunities and challenges of small border towns in remote mountainous areas that are trying to enter the global tourism market as a driver for their economic development.

Xinxin Zhang; Jingsheng Li, Shanghai, China

Chinese rural area natural resource oriented town and village cool planning practice

The research discusses the rural area's 'refrigerator' role to the urban area. Two real Chinese town and village planning practices are chosen which are both natural resource oriented, but have different methods and strategies.

Sara Maldina, University of Bologna, Bologna, Italy

Landscape as a service. The potentials of integrating different approaches

The categories of "Cultural Landscape" and "Cultural Ecosystem Services" represent the leading edges of a reconceptualization process of landscape, tending to combine the environmental approach and the cultural one. Through bibliographic and comparative analyses, the contribution aims at demonstrating the potentials of an integrated approach in landscape assessment and management.

Olga Maximova, University of Rome La Sapienza, Roma, Italy/ Burundi

Values for planning

The paper presents the results of the PhD research of the author supported by the Erasmus Mundus Action 2 Programme of the European Union. The PhD research is dedicated to: The Landscape: comparison between Italy and Russia - general values for legislative and planning instrumentation.

Sofia Morgado; Pedro George; Jorge Nunes; Cármen Coelho, CIAUD/ Murbs, Faculdade de Arquitetura, Universidade de Lisboa, Lisbon, Portugal

Urban rehabilitation: realities and paradoxes in Bairro alto and Bica, Lisbon

The paper discusses the current urban reality in Bairro Alto and Bic and under the scope of the of the next Urban Rehabilitation Plan for, as part of a contribute to the Urban Planning Department of Lisbon. Critical aspects, from the research part of the work are to be presented.

Session 5: Landuse & planning systems

3 October (Wednesday), 15:30 - 17:00

TK *Wen Liu; Lee Beattie; Errol Haarhoff; Shaoyao Tang, Auckland, New Zealand*

Plan making in delivering intensification in Auckland, New Zealand: issues and challenges Drawing on Auckland experience and practice, this article investigates on the efficacy of urban planning systems to deliver outcomes well aligned with the goals of urban growth management strategies, with particular attention to delivering residential intensification and higher density housing policy outcomes.

Mthobisi Masinga; Peter Njenga; Brian Mubiwa; Maartin Friedrich, KENA Consult (Pty) Ltd., Pretoria, South Africa

Development of land-use suitability assessment criteria for South Africa

Land as a resource is limited in nature and its use is not only determined by the user but also by the capability of that land to sustain productive activities. This has led to the development of a Land Use Suitability Criteria for more appropriate and sustainable use of land.

Yuwei Huang; Hualan Design & Consulting Group Nanning, China; Cheng Yu; Xiaoting Yan, Nanning, China

The practical limitations and the reference of key technology of mixed land use

By comparing with the practice in America and considering the practice in China, there are three keys to overcome the limitations of mixed use of land.

E. Stephen Goldie, Abu Dhabi Department of Urban Planning and Municipalities, Wembley Downs, Australia

The periodic table of urbanism

Just as the Periodic Table of Chemistry identifies the physical components of our universe and is able to predict the relationships between them, a Periodic Table of Urbanism is proposed to provide a comprehensive framework for describing the "general reign of order" in our towns and cities.

Nicole Wirz, Raumplan wirz gmbh, Basel, Switzerland; Andreas Schneider, HSR University of Applied Sciences Rapperswil, Rapperswil, Switzerland

Railway hub area development in Arth-Goldau (Switzerland)

Arth-Goldau is a railway hub with a lot of development potential. To activate this a participatory approach was necessary. For the first time, a Stakeholder Process methodology was applied for the masterplanning. This double case study will report about the experiences from the project manager's and the urban planner's perspective.

Track 1

THE GLOBAL VIEW:
Climate Change Impacts, Sustainability and Resilience

Harnessing the Opportunities and Understanding the Limits of America's State Level Climate Action Plans

Serena E. ALEXANDER, San Jose State University, the United States of America

Synopsis: This paper is an evaluation of America's state-level climate action plans focusing on their emissions reduction outcomes as well as their development procedures and foundations; goal setting, policy coverage and regional coordination; implementation provisions and conditions; and implementation mechanisms and monitoring results.

1. Introduction

Climate change is one of the most daunting problems of our time requiring innovative responses to its causes and consequences. In the United States, the long absence of strong federal leadership along with growing public awareness of the problem created a fertile ground for state-level climate action planning. To date, 34 states have adopted Climate Action Plans (CAPs). The question that this paper addresses is: Does state-level climate action have the potential to reduce carbon emissions significantly? This question was examined by assessing the relationships between CAPs, emissions reduction targets, plan implementation and emissions mitigation.

Evaluation of state level CAPs is important and interesting as it: 1) highlights the potentials and constraints of sub-national level action as laboratories of democracy and incubators of innovation; and 2) provides an opportunity for the planning profession to realize its new role of making global impacts while acting innovatively at local and regional levels. Moreover, evaluation of state CAPs will identify areas of strength and weakness in sub-national climate action. This can help to design a more effective federal level policy. By focusing on CAP implementation, this evaluation can also provide lessons for sub-national entities about implementing such plans and policies.

This paper is the first evaluation of the current generation of state level CAPs that focuses on implementation and actual reductions in GHG emissions. Wheeler (2008) systematically reviewed the first generation of state-level CAPs in terms of their goals, their basic strength and weaknesses, included or left out measures, and ultimately issues and problems likely to impact implementation. Yet, Wheeler's study did not assess the relationship between CAPs and actual GHG emissions reductions. Drummond (2010) compared states with and without CAPs, asking the question of whether or not these plans have been successful in reducing GHG emissions significantly. While Drummond (2010) identified some of the elements within CAPs that are associated with the greatest reductions, the author did not assess the relationship between implementation and GHG emissions mitigation. Drummond (2010) also focused on CO_2 energy emissions generated for use in the residential, commercial, and transportation sectors, and excluded the industrial sector of the economy—which is among the most controversial. The scholarly literature does not provide an assessment of possible relationships between variations in climate action plans across the nation, implementation of state CAPs and their effectiveness in reducing GHG emissions, which is one of the goals of this paper.

This paper is part of a two-pronged evaluation of state CAPs with two major components: 1) an assessment of CAP implementation and GHG mitigation potential through a content analysis of plan documents and available information about planning processes; and 2) a panel regression model depicting and assessing the relationships between CAP types based on the stringency of targets, rigor of implementation, and reductions in energy related carbon dioxide emissions from all end-use sectors (i.e. transportation, residential, commercial, industrial, and electric power). The general hypothesis that this phase sets out to investigate is: CAPs result in GHG emissions mitigation beyond the trend.

2. Research Methods

2.1 Phase 1: Content Analysis of State-level Climate Action Plans

The goal of this phase was to systematically assess implementation and GHG emissions mitigation potential of state-level CAPs through a content analysis of plan documents and publically available information about planning and implementation processes on state websites. Broadly speaking, the content analysis involved four major themes: 1) General information about the CAP and its development and adoption processes; 2) CAP GHG emissions mitigation potential claimed to be achievable through its goals, array of policies, mitigation targets, and adherence to any regional initiative; 3) Implementation provisions or conditions that have been suggested by the literature to be linked to successful implementation, such as identification of funding sources and agencies responsible for implementation; and 4) Implementation mechanisms, such as voluntary programs, financial incentives, carbon tax or cap-and-trade, recommended and employed by the CAP to reach goals and/or targets.

The CAP evaluation framework used for this study was developed in three steps: 1) a preliminary evaluation framework was derived from the literature on plan evaluation and principles of sub-national climate action planning; 2) the preliminary framework was then validated through three in-depth interviews with climate action planning experts; and 3) it was tested and refined through double coding four plans in two stages—double-coding two plans to test the reliability of the coding instrument and making necessary changes for the clarity of questions; immediately followed by double-coding two additional plans to assure consistency in coding throughout the coding process. The framework includes four major elements as discussed below and presented in Figure 1.

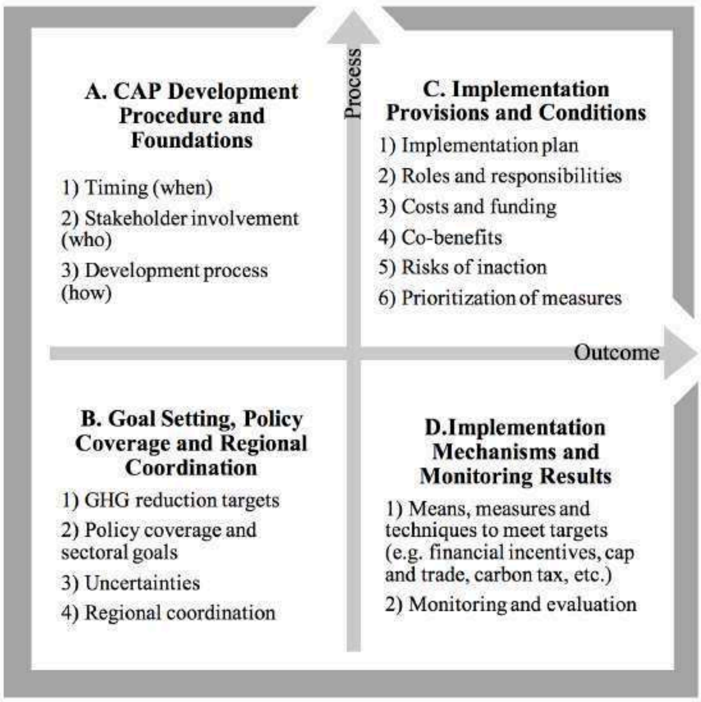


Figure 1. CAP Evaluation Framework

A. CAP Development Procedure and Foundations

The first element focuses on three main qualities of the planning process: 1) timing (when): when was the plan developed, adopted and updated; 2) stakeholder involvement (who): a) what agencies and organizations were engaged in the development of the CAP?, b) what entities provided leadership, facilitation, funding and technical support, and c) procedures through which input was received from entities representing government, industry, nongovernmental organizations, academia and the public; and 3) development process (how): what techniques were used to develop a plan and select specific policy recommendations.

B. Goal Setting, Policy Coverage and Regional Coordination
The second element deals with four key dimensions of CAPs: 1) targets: what are the nearest-term, intermediate and ultimate targets; 2) policy coverage and sectoral goals: what emission sectors have been considered, and what goals have been set for each sector; 3) uncertainties: whether uncertainties in Business as Usual (BAU) emissions and impacts of policies have been considered, and what measures or analyses have been used to take uncertainties into account; and 4) regional coordination: which of the multi-state climate initiatives (if any) has the state participated in.
C. Implementation Provisions and Conditions
The third element assesses conditions linked to implementation success, according to the evaluation literature. These provisions and conditions are: 1) implementation plan; 2) roles and responsibilities; 3) funding and cost of policy measures; 4) specification and analysis of externalities or co-benefits of each action or the entire CAP; 5) identification and analysis of risks of inaction; and 6) selection and prioritization of policy measures.
D. Implementation Mechanisms and Monitoring Results
The final element of the CAP evaluation framework is implementation mechanisms recommended or employed by the CAP to reach its goals and targets. In contrast to the previous element that solely relies on the content of the CAP to assess its implementation potential, this step also includes an analysis of other available evidence regarding the implementation of the plan. More specifically, evidence of CAP implementation or the lack thereof was found through searching the websites of governmental agencies or other organizations and entities that have either developed or published the CAP or are identified in the CAP as the responsible entity for implementation. This information was then crosschecked with state-specific data available through U.S. EPA, C2ES and the Center for Climate Strategies websites.
Implementation is defined as specific commitments made by the state to carry out policy actions recommended by the CAP, such as legislation to mitigate climate change. Implementation mechanisms are means, measures and techniques through which the state plans to reach CAP targets or goals. These include: voluntary and negotiated agreements; technical assistance, financial incentives; targeted spending (e.g., on public transportation); codes and standards; cap and trade; carbon tax; pilots and demos; information, education and outreach; research and development; emissions reporting and disclosure; and any hybrid combination of these mechanisms. In addition to implementation evidence, this step includes examining methods used to monitor and evaluate CAP implementation, such as progress reports, and plan and emissions inventory updates.
Once I completed the CAP evaluation form for each state, I then organized the collected data into four tables. The analysis of these tables revealed that while state CAPs vary in the details of their processes, components and characteristics, they can be classified into six major CAP types. These 6 types were not predefined; instead, they emerged from the analysis of collected qualitative data. The CAP types were used as an input to the regression model of the second phase. CAP categories are based on two important variables: targets and implementation. The findings section explains in detail what these categories are. There were several reasons to focus on these two variables. First, there is a gap in the literature about the relationship between targets, implementation and emissions mitigation. Second, the plan evaluation literature stresses the importance of goal-setting (i.e. targets) and implementation (see, for example, Baer, 1997; and Berke and Godschalk, 2009). Third, interviews with experts in the field indicate that targets are important as they serve as "the starting point," "the vision," "a motivational factor," "guide to achieving the objectives" and "[a] link between scientific [mitigation] requirements and planning." Implementation, on the other hand, is "extremely" important because "the plan is not the end goal, but a way to actually achieve the emissions reductions," and "[implementation is] the area that almost every place falls down on." Finally, comparing targets and implementation is realistically achievable, whereas details about the CAPs (e.g. the specific combination of policy packages) and planning processes (e.g. rigor of stakeholder engagement) cannot be practically reduced to simplified yet valid categories.

2.2 Phase 2: State-level CAPs and Energy-Related Carbon Dioxide Emissions

The second phase builds upon the data and analysis of the first phase. After assigning each state a CAP category based on the rigor of targets and stringency of implementation, I used a panel regression model to isolate and assess the impact of state level CAPs on carbon emissions. The regression coefficients, if statistically significant, show a reduction in per capita energy-related CO_2 emissions, holding all other variables constant. The specific regression model that I have used is random-effects Generalized Least Squares (GLS) regression model for panel (time-series) data. This model is appropriate when there is reason to believe that differences across entities have some influence on the dependent variable. Random-effects GLS model is suitable in this case because specific characteristics of states are most likely related to their energy-related CO_2 emissions. Another advantage of this model is that one can include time-invariant variables, such as geographic location.

The panel regression model includes 48 continental states and years 1990 to 2013, yielding a dataset of 1,104 observations. I excluded Alaska, Hawaii and Washington, DC due to lack of data for a number of independent variables and uniqueness of circumstances of these entities. Year 1990 was selected because it is the most common baseline year adopted by state level CAPs. This is because the Kyoto Protocol used 1990 as its base year, and because most states adopted the Kyoto goal or its revised versions, they also picked 1990 as their baseline year (Wheeler, 2008). Table 1 lists the dependent and independent variables as well as variable explanations, expected sign of regression, and data sources.

The dependent variable measure is derived from EIA State Energy Data System (SEDS) that is annual time-series data extending back to 1960. Emission estimates are based on energy consumption data from EIA's State Energy Consumption, Price, and Expenditure Estimates (SEDS). The dataset includes energy-related emissions for five energy-use sectors (i.e. transportation, residential, commercial, industrial, and electric power) and emissions from all sectors combined.

Several changes were made to the combined emissions to develop an appropriate dependent variable. First, I divided emissions by population to obtain per capita emissions. By doing so, I normalized emissions between small and large states and controlled for possible effect of population increase or decrease (e.g. in-migration vs. out-migration) on emissions. Second, I calculated change in emissions as a measure of progress towards emissions reductions. The change was calculated compared to most popular baseline year emissions (i.e. year 1990) because the baseline year is what plans compare their progress with. Furthermore, this controls for the effect of historic dependency on coal for producing electricity (coal-fired power plants). If I were to use emissions as opposed to change in emissions, I would have to control for differences in initial energy endowments (e.g. coal-fired power plants, hydroelectric power, and nuclear power).

The model involves a number of independent variables to explain part of changes in emissions. I am particularly interested in the potential impacts of climate action plans, their targets and implementation on emission changes. I treated state level CAPs--categorized into 6 groups--as a nominal variable. Thus, the model compares each category to a No-CAP alternative. I assigned the appropriate CAP category to each state the year the plan was adopted. Therefore, the model also compares each state before and after the adoption of the plan.

Another independent variable that attracts planners' interest is urban compactness as opposed to sprawled development. There is considerable evidence in the planning literature that sprawl is linked to higher levels of emissions when compared to a more compact development pattern (see for example, Ewing, Bartholomew, Winkelman, Walters, & Chen, 2008, pp. 107–111; Ewing & Rong, 2008; Glaeser & Kahn, 2008; and Randolph & Masters, 2008, among others). My compactness variable is derived from a multi-factor sprawl index published by the Metropolitan Research Center at the University of Utah in April 2014 and later in the year by Smart Growth America. This research is an update and refinement of a sprawl measure released in 2002. Using the refined method of 2014, sprawl indices are calculated for years 2000 and 2010. The average compactness score is 100, and greater values indicate that an area is more compact. I used the county-level sprawl indices to compute average state-level compactness for years 2000 and 2010. I interpolated sprawl indices for the missing years. Because sprawl indices changed slightly between 2000 and 2010 (with the same most compact, most sprawled or average areas in both years), linear interpolation is an appropriate method.

Variable	**Explanation**	**Expected Sign of Regression Coefficient**	**Source & Date Downloaded**
Change in emissions per million persons (DV)	Energy CO_2 emissions for current year minus same for 1990	Not applicable	U.S. Energy Information Administration
Climate action planning (CAP Types)	Categorical variable for state climate action planning efforts	Negative, since climate action planning is meant to reduce emissions through a wide array of policy options and increasing awareness	U.S. Environmental Protection Agency (EPA) list of states with CAPs; and Data collected through Phase 1 of this study
Change in unemployment rate	Unemployment rate (%) for current year minus same for previous year	Negative, due to decreased economic activity, and by extension, emissions	Bureau of Labor Statistics (BLS)
Change in per capita income	Per capita income for current year minus same for previous year	Positive, since states with higher income tend to consume more energy	Bureau of Economic Analysis (BEA)
Change in regional energy prices	Change in regional energy prices for current year minus same for previous year	Negative, since higher prices reduce consumption	Bureau of Labor Statistics. Consumer price indices program.
Democratic presidential vote %	% of vote for Democratic presidential candidate in nearest election	Negative, since states with higher percentage of democratic vote tend to be more concerned about the environment	Presidential Elections Data extracted from UC Santa Barbara's The American Presidency Project
Heating degree days (HDDs)	Annual heating degree days weighted by population as a measure of heating energy demand	Positive, since greater number of HDDs means greater demand for energy	National Climatic Data Center
Cooling degree days (CDDs)	Annual heating degree days weighted by population as a measure of cooling energy demand	Positive, since greater number of CDDs means greater demand for energy	National Climatic Data Center
Change in percent GDP from carbon-intensive manufacturing industries	GDP from carbon-intensive manufacturing divided by the size of the economy for current year minus same for previous year	Positive, since states with larger share of carbon-intensive industries relative to the size of their economy tend to consume more energy	Bureau of Economic Analysis (BEA) NAICS
Change in percent GDP from carbon-intensive non-manufacturing industries	GDP from carbon-intensive manufacturing divided by the size of the economy for current year minus same for previous year	Positive, since states with larger share of carbon-intensive industries relative to the size of their economy tend to consume more energy	Bureau of Economic Analysis (BEA) NAICS
Compactness index	State level average compactness calculated from county level composite sprawl score that considers density, land use, activity centering and street connectivity	Negative, since urban compactness reduces VMT and thus transportation emissions	Smart Growth America Measuring Sprawl 2014
Interstate energy trades	Controls for the effect of interstate electricity trades by creating a credit for electricity exporting states and debit for importing states	Positive, since energy exporting states emit carbon for producing electricity	U.S. EIA
Regions	Regions as defined by BLS consumer energy price indices	--	Bureau of Labor Statistics (BLS)

Table 1. Variables

It is also important to control for other variables that can potentially be correlated with the dependent variable, and thus, can provide a plausible alternative explanation for reductions in emissions. Change in energy prices, unemployment, income, and industrial mix are the most important of these variables. The logic behind including these variables comes from the potential relationship between the economy and changes in emissions. Explanation of these variables are provided in table 1, but two of them require further clarification. Following Drummond (2010) I used change in regional energy prices as opposed to state-level energy prices because change in energy prices is one of the major effects of CAP implementation. If I were to use change in state-level energy prices, this could have dramatically underestimated the impact of the CAPs. One limitation of this method, however, is the potential autocorrelation problem. I controlled this effect by adding the regions--where the states were assigned to in the regional consumer energy prices dataset--to the model. Regions are also considered geographic variables, and therefore also control for the potential relationship between location and emission changes.

Change in industrial mix is another variable that can potentially impact emission changes. For example, a shift in industrial output from energy- or carbon-intensive products (e.g. steel) to low-energy products (e.g. computer equipment) can result in emissions reductions. It is very difficult, if not impossible, to track industries within states to know whether a switch in industrial output is responsible for emissions changes. However, it is possible to measure the dependency of a state's economy on carbon-intensive industries and its changes over time. To control for potential effects of industrial mix changes, I calculated change in percent Gross Domestic Product (GDP) from carbon intensive industries. I included two variables related to change in industrial mix in my model: change in percent GDP from carbon-intensive manufacturing and non-manufacturing industries. Generally, carbon intensive industries emit large amounts of GHGs per unit of good produced, and their energy costs are a large portion of their total costs (Zabin, Buffa, & Scholl, 2009). According to the most recent U.S. EPA inventory of GHGs, which is based on an analysis of EIA energy consumption data, several industrial activities consume a lot of energy and emit large amounts of GHGs. Within manufacturing activities, the most carbon-intensive industries are: Petroleum refineries; primary metals (e.g. iron, steel, and aluminum); chemicals; pulp and Paper; nonmetallic mineral products (e.g. cement and glass); and food (EPA 430-R-15-004, 2015; Zabin, Buffa, & Scholl, 2009). Among non-manufacturing industries, construction, mining, and agriculture are considered energy and carbon-intensive (EPA 430-R-15-004, 2015).

In my models, I also included two climatic variables: heating degree days and cooling degree days that show heating or cooling fuel demand on a state-wide basis. The logic behind including these two variables is that greater number of heating or cooling degree days result in greater demand for energy consumption.

Lastly, I controlled for the effect of interstate electricity trade. In most states, electric power generation is the largest source of CO_2 emissions from fossil fuel combustion. Some states are net exporters of electricity, whereas others are net importers of electricity. One way to account for the effect of interstate electricity trades is by constructing interstate carbon credits and debits and calculating an indicator of the full carbon effects of a state's electricity consumption by adding or subtracting emissions with traded electricity. Jiusto (2005) has offered a complex method to deal with carbon emissions from cross-border power flows that has been used for this research.

3. Findings

3.1 Phase I Findings: CAP Types

Broadly speaking, there are two major types of CAPs based on targets: 1) CAPs that set a GHG emissions reduction target—often following an executive order from state governor that sets such targets or appoints a climate change sub-cabinet or advisory group to do so; and 2) CAPs that do not set any emissions reduction target. The vast majority of state level CAPs (30 out of 32) set at least one target for GHG emissions reduction within their jurisdiction; however, sometimes the targets are tied to multi-state climate change planning commitments. For example, the states that partnered in The Western Climate Initiative (WCI), Midwest Greenhouse Gas Reduction Accord (MGGRA) and Pacific Coast Collaborative (PCC), to name a few, agreed to collectively set a regional emissions target. This resolution is either based on targets originally established by participating states or otherwise are reflected in state level plans, with states proposing to either meet or exceed the regional target. Several states have also chosen to join such multi-state initiatives as observers. Observer states often set matching or comparable reduction targets, but normally do not commit to the implementation mechanism set by the regional initiative—such as a regional cap-and-trade program.

State CAPs have set targets that may be single-step, two-step or multiple-step. Typically, CAPs with two- or multiple-step targets set a long-term goal to be reached by 2050 with a midterm target to be achieved by 2020 or 2025. 2050 marks the middle of the century; it is a date often used—in addition to the end of century mark--in scientific scenario analyses to illustrate the impacts of climate change and/or define necessary reductions to possibly avoid the most catastrophic impacts. A number of states also set interim target(s)--to help them make progress towards the midterm target. For example, New Hampshire sets a midterm goal of reducing emissions 20% below 1990 levels by 2025 and specifies five interim targets to reach the 2025 goal. Following the Kyoto Protocol, the most common baseline year is 1990 for state level CAPs, with some states setting emissions of the year 2000, 2005 and 2006 as their baseline. Thus, the first step commonly involves either going back to 1990 emissions levels or lower than that (5%, 10% or 20% lower).

I define long-term ambitious target as: aiming at or close to scientific requirements for emission reductions in the United States by mid-century as interpreted by the CAPs. It is important to note that scientific requirements vary based on different targets for stabilization of atmospheric GHG concentrations. In other words, emission allowances for all industrialized nations (including the U.S.) are different for various GHG concentration levels. Therefore, scientists have developed several scenarios for stabilization levels and mitigation requirements. Gupta et al.'s (2007) systematic analysis of the literature suggests that under low and medium stabilization levels, developed nations would need to cut their emissions substantially (i.e. 40% to 95% below 1990 levels)--even if developing nations achieve significant reductions. Nonetheless, virtually all states with an ambitious target have interpreted scientific requirements for emission reductions as approximately 75% to 85% below 1990 levels in the long run (around 2050).

A short-term target, on the other hand, does not meet the requirements of a long-term ambitious target. A short-term target does not preclude a state from adopting rigorous policy measures or developing an ambitious target in the future. Yet, in and of itself a short-term target is insufficient to guide the state emissions reduction efforts in the long run to meet the scientific requirements. In other words, a short-term target lacks a long-term vision. Additionally, since state level short-term targets tend to be low, having a short-term target only can imply elimination of rigorous policy options from consideration. For instance, South Carolina sets a target to reduce emissions to 5% below 1990 levels by 2020; no long-term goal is set.

In addition to the targets, CAPs differ in terms of the stringency of their implementation. I classified a CAP in the "strong evidence of rigorous implementation" group if: there is stringent state level legislation governing the implementation of the CAP with lead or other responsible agencies identified and clear monitoring and evaluation mechanism, or otherwise, there is evidence of extensive programmatic interventions with progress toward goals clearly documented in some type of a progress report, implementation plan, updated inventory or online tool. I classified a CAP in the "some evidence of implementation" group if: there is some evidence of early actions or programmatic interventions; yet, there is evidence of stopped funding, discontinued or sporadic climate council or advisory group meetings or documents clearly showing that the state is not on track to reach its goals although some programs have been implemented. I classified a CAP in the "no or limited implementation" group if: I found no evidence of implementation whatsoever, insufficient evidence of implementation, or evidence of lack of implementation—meaning that it is clearly stated on the relevant state agency website that the state has stopped the CAP process after its adoption. I considered evidence of implementation insufficient if: there were either very limited information provided and/or I found a few programs that seemed relevant but these were not tied to the CAP or its other documents whatsoever. Considering the type of CAP targets and the rigor of their implementation, plans can be broadly categorized into 6 groups described below and illustrated in Table 2.

CAP Type	Key Identifiers		States with a CAP (Total Analyzed: 32)
	Target(s)	Implementation	
Type 1	No Target	No or limited evidence of implementation	4 CAPs: Missouri, Nevada, Ohio, Utah
Type 2	A short-term target only	No or limited evidence of implementation	5 CAPs: Arkansas, Illinois, Kentucky, North Carolina, South Carolina
Type 3	A long-term ambitious target	No or limited evidence of implementation	5 CAPs: Arizona, Iowa, Montana, New Mexico, Wisconsin
Type 4	A short-term target only	Evidence of some implementation	3 CAPs: Florida, Pennsylvania and Virginia
Type 5	A long-term ambitious target	Evidence of some implementation	7 CAPs: Maine, Michigan, New Jersey, New York, Rhode Island, Vermont, Washington
Type 6	A long-term ambitious target	Stronger evidence of rigorous implementation, monitoring and evaluation	8 CAPs: California, Colorado, Connecticut, Maryland, Massachusetts, Minnesota, New Hampshire, Oregon

Table 2. A Summary of CAP Types

3.2 Phase 2 Findings: CAPs and Change in Energy-related Carbon Dioxide Emissions

This section focuses on findings from the second phase of the study: Analyzing the relationship between state level CAPs and change in energy-related carbon dioxide emissions from all sectors (i.e. dependent variable). Sectors that contribute to energy-related carbon dioxide emissions include commercial, industrial, residential, transportation and electric power. Based on findings from the first phase, I examined the relationship between six types of CAPs and change in energy-related carbon dioxide emissions controlling for other economic, climatic, geographic and political variables. Table 3 provides descriptive statistics for the independent variables.

Variable	**Mean**	**Standard Deviation**	**Minimum**	**Maximum**
Cooling degree days (CDDs)	1071.74	804.68	42.00	3827.00
Heating degree days (HDDs)	5243.83	2085.25	430.00	10810.00
Change in % GDP from carbon-intensive manufacturing	0.00	0.01	-0.05	0.07
Change in % GDP from carbon-intensive non-manufacturing	0.00	0.01	-0.08	0.05
Change in regional energy prices	6.23	15.43	-45.84	34.31
Democratic presidential vote %	0.46	0.09	0.25	0.68
Compactness	95.07	11.24	64.29	129.03
Change in per capita personal income	1081.94	953.06	-5781.00	7527.00
Change in average unemployment	0.05	0.99	-2.54	5.51
Change in interstate energy trade	1008.41	3928213.00	-25200000.00	26600000.00

Table 3. Descriptive Statistics for Independent Variables

My goal with this model was to explain variations in emissions with CAP types as well as a set of control variables. The direct way that CAPs can result in carbon emissions reduction is through implementation of CAP policies and measures. I collected information about implementation of state level CAPs in the first phase. CAP types include information about implementation. For example, I found evidence of rigorous implementation for type 6 CAPs. However, implementation is only one way that CAPs can impact carbon emissions. There are a number of indirect ways that CAPs can lead to reductions in carbon emissions. Perhaps the most important of these indirect mechanisms is the planning process. Altschuler argued that "planning is more important than any plan" (quoted in Baer, 1997, p. 336; and in Drummond, 2010, p. 416). The planning process, especially when various interest groups and the public are actively involved, can yield outcomes. Innes and Booher (1999) argued that a good consensus building process can have outcomes beyond the immediate and/or identifiable results at the end of the project. These outcomes, according to Innes and Booher (1999), can appear after the completion of the plan development process or outside its boundaries in the form of new collaborations, new discourses, learning that extends into the community, and so forth. In the case of state level CAPs, this means that the planning process can indirectly yield outcomes outside the boundaries of the plan in the form of other relevant policies or programs that reduce carbon emissions. Indeed, analyzing these indirect

mechanisms is beyond the scope of this study. Yet, acknowledging the possibility of these indirect effects can help us understand why a CAP may result in carbon emissions reductions even the implementation has quickly faded away after the plan development process, or there is no evidence of direct implementation whatsoever.
Table 4 shows the results of the first regression model. Total number of observations are 1,104, and the number of groups, which is the number states included in the model, is 48. The overall R2 is a reasonable .25, meaning that the model explains a quarter of the variations in state level energy related carbon emissions.

Variables	**Coefficient**
CAP Type 1. No target; No or limited implementation	-2.738705**
CAP Type 2. Short-term target; No or limited implementation	-1.160499**
CAP Type 3. Ambitious target; No or limited implementation	-0.8332563*
CAP Type 4. Short-term target; Some implementation	-2.36251**
CAP Type 5. Ambitious target; Some implementation	-1.546992**
CAP Type 6. Ambitious target; Rigorous implementation	-1.096547**
Cooling degree days (CDDs)	-0.0004712
Heating degree days (HDDs)	0.0001331
Change in % GDP from carbon-intensive manufacturing	-4.979222
Change in % GDP from carbon-intensive non-manufacturing	12.54649*
Change in regional energy prices	0.010386
Democratic presidential vote %	1.108312
Compactness	-0.0602424**
Change in per capita personal income	0.0002443*
Change in average unemployment	0.1368203ø
Change in interstate energy trade	0.000000043**
Region-West	-2.791596**
Region-South	-0.8061115
Region-Northeast	-0.6447329
Region-Midwest	0
Constant	5.765357

Number of observations=1,104 Overall R2=0.25 **P<0.01 *P<0.05 øP<0.10

Table 4. Effects of State CAPs on Per Capita CO_2 Energy Emissions

All CAP types are statistically significant at the 0.01 level (p<.01) except for type 3 CAPs (long-term ambitious target, and no or limited evidence of implementation), which is significant at the 0.05 (p<.05) level. Coefficients are negative for all CAP types indicating that, in the years since 1990, all state level CAPs reduced emissions compared to the states without CAPs, holding all other variables constant. CAP coefficients for all groups range from -0.83 to -2.74. This means that, in the years since 1990, on average states with a CAP reduced per capita emissions by about 1.79 metric tons, when compared to the states without CAPs and controlling for other economic, climatic, geographic and political variables. Ironically, what this model shows is that CAPs, regardless of their targets and implementation, result in carbon emissions reduction. Nevertheless, the model does not reveal mechanisms through which these CAPs work. In other words, the model does not show how exactly CAPs with no or limited evidence of implementation lead to carbon reductions. Although causal mechanisms between types 1, 2 and 3 CAPs (with no or limited evidence of implementation) and emissions reductions are uncertain and unknown, there are a number of possible explanations. One explanation for the statistical significance of the relationship between all types of CAPs, including the ones with no sign of implementation (i.e. types 1, 2 and 3), is the possibility of indirect effects of the planning process on carbon emissions reduction. State level climate action planning is typically a complex process involving numerous stakeholders. It is likely that these CAPs have resulted in other environmental policy measures or programs with similar carbon reduction benefits. Considering that most state CAPs have benefitted from fairly extensive consensus-building processes, the possibility of indirect effects should not be disregarded.
One surprise is that type 6 and 5 CAPs, which have an ambitious long-term target and stronger evidence of implementation, have a slightly smaller coefficient than the type 1 CAPs with no specified emissions target and no or limited evidence of implementation. One possible explanation is that the states with a types 6 or 5 CAP had already achieved lower carbon emissions through other environmental policy measures with emissions reduction

benefits, making it difficult to reduce emissions after the adoption of the CAP. Another possible explanation is related to a general critique of state level CAPs: low short-term targets (Alexander, 2016). Because of these low 2015 or 2020 targets, it is possible that implementation of the CAPs have not yet resulted in reductions significant enough to reveal potential strengths of types 6 and 5 CAPs. The effects may appear later, if these states continue to rigorously implement the ambitious long-term goals set by the CAPs. Ultimately, the reason behind these findings may simply be a lag between implementation of measures and appearance of results.

Interestingly, type 4 CAPs, with a short-term target and some evidence of implementation, have the second largest coefficient (after type 1 CAPs). This suggests that CAPs with a short-term target may also be successful in reducing emissions—at least in the short run. Again, the possible advantage of having an ambitious long-term target may not be apparent yet—especially because CAPs with a stringent long-term target still have a weak near-term target.

Among other variables of interest, compactness is also statistically significant at the 0.01 level ($p<.01$). Its negative coefficient is indicative of an inverse relationship between compactness and emissions, or a positive relationship between sprawl and emissions. This means that the development decisions of communities can have measurable impacts on emissions.

From the set of economic variables, year-to-year changes in per capita personal income and energy interstate trade are statistically significant at the 0.01 level ($p<0.01$). The positive coefficient of these two variables indicates that increases in per capita personal income and energy interstate trade are associated with greater energy related emissions. Because per capita personal income is a measure of personal wealth, this means that, when all other variables are held constant, increase in personal wealth results in greater contribution to emissions through increased consumption of energy. Energy interstate trade is a measure of interstate electricity exports and imports. For net exporters of electricity, this variable is positive; and for net importers, it is negative. In the process of electric power generation, producers of electricity emit carbon dioxide.

Two other economic variables, percent GDP from carbon-intensive manufacturing and non-manufacturing, are measures of dependency of a state's economy on industries that emit large quantities of GHGs per unit of goods or services produced. The first of the two, percent GDP from carbon-intensive manufacturing is not statistically significant in explaining variation in per capita carbon emissions. However, the second variable--percent GDP from carbon-intensive manufacturing--is statistically significant at the 0.05 level ($p<0.05$), and its coefficient is 12.55. Thus, a 1% increase in GDP from carbon-intensive manufacturing leads to an increase of 12.55 metric tons of carbon emissions per capita. This means that the higher the dependence of a state's economy on the three carbon-intensive nonmanufacturing industries--construction, mining, and agriculture—the greater their energy-related carbon emissions would be, when all other variables are controlled for. From a policy perspective, this could also represent an opportunity for significant emissions reduction, for example, through encouraging the use of efficiency measures in these industries.

The remainder of economic variables--namely changes in average regional energy prices, and average unemployment--are not significant at the 0.05 level. The two climatic variables--heating degree days and cooling degree days--as measures of need for energy consumption to air condition buildings are not statistically significant either. Among regions, being geographically located in the West Region is negatively correlated with changes in per capita carbon emissions ($p<0.01$). Lastly, percent democratic vote in the nearest presidential elections is not statistically significant in the model.

4. Conclusions and Implications for Climate Action Planning

Across America, states have taken a range of approaches to mitigate greenhouse gas emissions within their boundaries and beyond. Findings from this study show that all types of CAPs, regardless of the targets and status of their implementation, result in measurable yet modest reductions in carbon emissions, when a set of economic, climatic, political, and geographic variables are controlled for. This can be explained by the fact that climate action planning is a complex process, and can yield outcomes beyond implementation of policy measures specified in the CAP. Mechanisms such as learning that extends into the lower levels of government and the community as a result of the involvement of the public and various interest groups in the planning process, or the development of other related plans, policies or frameworks (with the potential to reduce emissions) that can emerge from a CAP process. Analysis of these mechanisms including the dynamics between CAP processes and indirect outcomes is beyond the scope of this study, but the findings suggest that this can be an interesting topic for future research. One limitation of CAP content analysis is that data about stakeholder processes are limited to what is provided in the plan, and there is a wide variation in the breadth and depth of information included in different CAPs. In-depth interviews with stakeholders involved in CAP processes would enhance our understanding of CAP dynamics beyond what is publically available through documents.

Another limitation of the model presented in this study is that it does not include a local climate action variable. Municipal and community level CAPs may or may not be an extension of the state level CAP. In California, for example, many cities adopted a CAP due to a state level mandate. In Ohio, on the other hand, Cleveland and Akron adopted a CAP in 2009, two years before the state of Ohio released its first CAP. Unlike Ohio's CAP, Cleveland's plan set two goals for GHG emissions reduction, and provides evidence of progress. Regardless of their relationship with the state level CAP, these local plans can be successful in reducing emissions. Future research can assess the potentials, effectiveness, strengths and weaknesses of these local CAPs. Collecting comparable monthly or annual emissions data at the city and metropolitan levels can provide an opportunity for evaluation of these CAPs.

Currently, state CAPs with an ambitious target and evidence of implementation have not proven greater emissions reductions than those with a short-term target and limited evidence of implementation. As explained earlier, this can be due to weak short-term targets, a lag between implementation and results becoming visible, the possible effect of indirect CAP processes, and/or the difficulty of emissions reductions beyond what has already been achieved through other actions by the states with a type 5 or 6 CAP. This finding is another evidence that CAPs are very complex involving many factors, and their success in significantly reducing emissions can be influenced by various dynamics. It is important to note that the regression model presented in this study is exploratory. Better understanding of possible mechanisms that link CAPs to emissions reductions are needed to develop an improved model.

Evidence from the content analysis of state CAPs shows that climate action is a heterogeneous phenomenon within various jurisdictions across the nation—ranging from no action at all to rigorous implementation of stringent climate regulations. This heterogeneity, in and of itself, irrespective of potentials and constraints of individual action taking jurisdictions, can be problematic and highlights the importance of federal level action. This is not only because of carbon leakage potential, but also due to sending mixed messages about our stance on climate action as a nation—which can hinder global efforts to mitigate emissions. Lack of strong federal leadership on climate planning has created an opportunity for innovative bottom-up climate action; however, this has also resulted in a patchwork of climate action across the nation. A robust federal leadership on climate protection can level the playing field for all jurisdictions, diminish possible carbon leakage to the states with minimal regulations, support the implementation of lower-level CAPs, and finally enhance chances of global cooperation against the threat of climate change.

Lastly, we should move beyond energy efficiency measures to be able to reduce emissions sharply. Findings from this analysis show that CAPs are reducing energy-related carbon emissions in a measurable but modest amount. Continuing the current trend of emissions reductions is insufficient to reduce emissions dramatically to meet the long-term targets. Achieving greater reductions involves major technological and policy innovations as well as lifestyle changes. A content analysis of state CAPs shows that Transportation and Land Use

(TLU) targets are low compared to the sector's contribution to total emissions (Alexander, 2016). This suggests that we have not yet developed the tools and measures to reduce emissions from TLU significantly and efficiently. This is a great opportunity for planners, policymakers and urban scholars to develop creative solutions for smarter urban living. It is impossible to illustrate what future innovations will exactly entail or what can be achieved through major technological advancements. However, planning tools and techniques that involve wide stakeholder participation and scenario planning that challenges current thinking, can be used as a framework to create an ecosystem amenable for innovation. Through these techniques, various decision-making alternatives--ranging from urban development decisions to lifestyle choices—are converted into dynamic stories that involve "credible series of external forces and actors' responses" (Peterson, Cumming, & Carpenter, 2003, p. 361). Additionally, these techniques can provide a forum for not only policy creation but policy implementation and evaluation. Stakeholders involved in the visioning process are likely to find that some outcomes or processes represent a future or a situation that is more desirable than others. And then the question is: how do we get from the present to the desired situation. The excitement about climate action planning simply begins there.

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Climate Change Strategy for the Urban Planning and Development Sector in Qatar

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1. Introduction

The State of Qatar lies between latitudes `27 24° and `10 26° north of the equator and longitudes `45 50° and `40 51° east Greenwich line. Qatar is a peninsula situated in the middle of the west coast of the Arabian Gulf and extends northward into the Arabian Gulf. (MDP&S, 2017)Qatar is about 160 km in length from the south to the far north and about 89 km in width from east to west. Its total area is about 11,627 square kilometers. (MDP&S, 2017)Most of Qatar is a flat and rocky, sandy plain. Low hills punctuate the landscape, west and central, with massive sand dunes in the southeast.

The climate of Qatar is of a desert nature with high temperatures especially in the summer. The mean high temperatures in the summer are characterized with a relatively high humidity, especially in coastal areas. Winter in Qatar is warm in general with a drop in temperatures to low levels from time to time. Qatar suffers from scarcity of rainfall throughout the year. (MDP&S, 2017)

In the last 30 years Qatar has seen immense growth in industry, population and urban settlements. This has been driven by the oil and natural gas reserves that have been developed, contributing to one of the highest per capita Gross Domestic Product (GDP) in the world (Forbes, 2012). In response to this growth, a number of documents have been developed to guide and manage the impacts associated with these changes, including:

- Qatar National Vision 2030 (QNV 2030)
- Qatar National Development Strategy 2011-2016 (QNDS 2011-2016)
- Qatar National Masterplan (QNMP)

Qatar National Vision QNV 2030 has paid a special attention to the environmental theme, which is unparalleled in many Middle Eastern countries, and has dealt with the environmental development pillar on an equal footing with the rest of QNV four pillars; human development, social development and economic development.

Recent studies in the region reveal that the urban development and the economic growth in Qatar will be adversely affected by the impacts of climate change in near future. The 2009 report of the Arab Forum for Environment and Development on the Impact of Climate Change on Arab Countries (AFED, 2009) reveal that Qatar will be subject to high risk of inundation of its coastal areas, due to predicted Sea Level Rise (SLR) in the Arabian Gulf. Qatar's geography consists of a relatively flat terrain and as such, the inundation of the coastal areas stretches into its vast urban development, posing risks to life and causing significant property damages. Another study conducted by Qatar University in collaboration with the University of Portland, USA identified a large section of the urban settlements in Qatar that will be subjected to Heat Island Effect (HIE)[1] from climate change impacts, meaning extended period of relatively high temperature in certain areas, causing elevated level of discomfort, diseases and health issues. In terms of Green House Gas (GHG)

[1] Heat Island Effect :describes built up areas that are hotter than nearby rural areas (USEPA, 2016).

emission from all the relevant activities, including urban development, Qatar has the highest per capita emission in the world. Whilst the total volume of emission has not been considered significant on a global scale, the highest per capita emission poses a leadership challenge for country's leaders, as Qatar is a signatory to international protocols to reduce its GHS emission.

A number of studies and initiatives addressing climate change have been undertaken by the community and private entities in Qatar. For example, 'A climate change and temperature warning in Qatar' study was undertaken by Qatar University's Social and Economic Survey Research Institute (SESRI). From the different studies and initiatives, it can be summarized that there is a general acknowledgement and understanding of climate change and its effects in Qatar by its citizens and commercial entities. However, knowledge of certain impacts and how they may be mitigated seems limited.

Following the lead of the Qatar National Vision (QNV2030) and the Qatar National Development Framework (QNDF) a strategic spatial land use framework of the Qatar National Master Plan (QNMP), the Ministry of Municipality and Environment (MME) in 2018 has developed its Climate Change Strategy (CCS) for the Urban Planning and Development Sector for the state of Qatar.

The primary objective of the Climate Change Strategy is to address how urban planning and urban development can be managed effectively to reduce the impact of climate change. The focus on urban planning and development is achieved by concentrating on aspects directly or indirectly related to spatial land use in Qatar. Four key sectors that the strategy focuses on are: (i) adaptation to the risks of Sea Level Rise (SLR), (ii) reduction of Heat Island Effect (HIE), (iii) reduction of GHG emission and (iv) ensuring relevant emergency management systems are in place to avoid risks on life and properties.

The paper highlights the methodology and the process for developing the strategy with necessary actions and recommendations to reduce the impacts of climate change in the urban planning and development sector in Qatar. It also lays out a plan to progressively implement the proposed actions.

2. Climate change impacts in Qatar

It is a global phenomenon that climate change would have issues such as sea level rise and coastal flooding, temperature rise and Greenhouse gas (GHG) emissions affecting the development and infrastructures.

2.1 Sea level rise and flooding

All human settlements are either in or near the coastal areas, similarly, Qatar's major population centers and urban expansion also lie near the coastal areas. Therefore, Qatar's population is vulnerable due to the sea level rise. Currently, the data shows that the mean sea level at Qatar is already at an increasing rate of approximately 1.5 mm/year in Doha which is the capital city of Qatar. Within the Middle East and North Africa (MENA) countries, Qatar is the most vulnerable to sea level rise and associated flooding, as a 1m rise in sea level would affect about 3% of its area, while a 3m rise would affect 8% (UNDP,2010). The critical issue here is all these affected areas are within the current urban settlement zones that comprise approx. 8.5% of the total area of Qatar.

Climate change is almost certain to result in both higher sea levels and an increase in the frequency or magnitude of coastal flooding due to extreme weather events. Qatar currently receives a minimal quantity of rain at approximately 80 mm per year, with the majority falling in the winter months. In any case, rainfall is increasingly likely to arrive as short, intense events, with an increased likelihood of flash floods.

Much of Qatar's land area is low lying and vulnerable, including parts of several municipalities and notably some critical public facilities e.g., major hospitals and police stations in Doha. The highest point in Qatar is only 103 m above sea level (Figure 1) and is relatively flat along the coast with relief increasing to the southwest. Urban and industrial development in Qatar has been concentrated in the low-lying coastal areas. As large tracts of land have also been reclaimed in the past 30 years, it is more likely to have increased coastal flooding from the sea level rise. The idea is that the risks and cost of flood damage can be reduced through planning by a range of methods through:

- Implementing appropriate planning regulations to guide the development in order to reduce flood risks from SLR
- Installing strategically located flood defenses
- Planning for future development away from flood-prone/flood-risk areas
- Including flood-resilient features in future designs

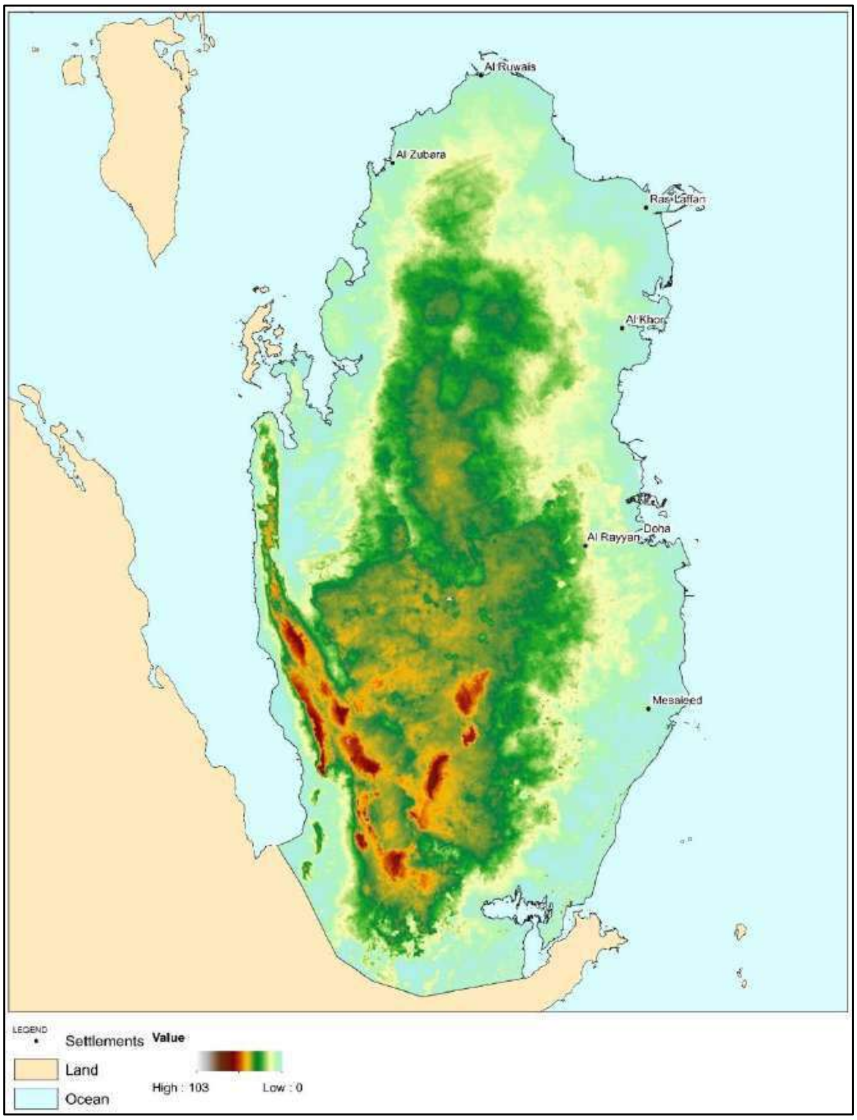

Figure 1 :The highest point in Qatar is only 103 m above sea level

Source : MME (2017). P. 2016/2: Climate Change Strategy for the Urban Planning and Urban Development Sector in Qatar. Stage 3: Situation Analysis Report. GHD Pty. Ltd.

Figure 2 :figure showing the vulnerable areas from Sea Level Rise (SLR)/ Projected coastal flooding of Doha area by 2100

Source : Ministry of Municipality and Urban Planning (2014a) Integrated Coastal Zone Management Plan for the State of Qatar: Climate change and sea level rise study, Ref: MA 2.1. Dated 17 May 2014.

2.2 Increased Temperature

The International Panel for Climate Change (IPCC) expects temperatures in the Middle Eastern countries (including Qatar) to rise by about 2°C in the next 15-20 years, and by more than 4 °C by the end of the century. Recent modelling work reported in Nature Climate Change suggests that:

"By the end of the century, annual wet bulb temperatures in Doha will exceed 35°C several times in the 30 years, and the present-day 95th percentile summer (July, August, and September) event becomes approximately a normal summer day."(IPCC, 2001a)

35°C is the threshold wet bulb temperature beyond which any exposure for more than six hours would be intolerable for most humans, resulting in hyperthermia which becomes a medical emergency requiring immediate treatment to prevent disability or death. In the current climate, the wet bulb temperature rarely exceeds 31°C. Figure 2 represents an annual temperature profile between 1962-2013 showing the minimum, maximum, mean and the highest recorded temperatures.

In urban areas, increasing temperatures will be exacerbated by "heat island effect" and the key factors leading to the heat island effect include:

- Population density: Higher density corresponds to more heat (although not everywhere)
- Tower blocks with glassed outer walls
- Percentage of impervious surfaces
- Industrial activity
- Vehicular activity
- Increased frequencies of heat waves

Factors that may aid in reducing the heat island effect for future developments include:

- Parks, green areas, and water features for reducing temperatures – this is the most consistently considered factor.

- Wind flow management/ urban ventilation – consideration of urban design/planning for spaces that allow wind to flow through, especially coastal wind as this is cooler than the adjacent land areas.
- Environmental friendly city/neighborhood layouts – i.e. breaks between areas of the city through green/ shaded areas.
- Reduction of large impervious areas, particularly outdoor parking areas and wide roads with photovoltaic pavements
- Reducing traffic levels.
- Technical approaches like roof coatings, green walls, roof gardens, etc

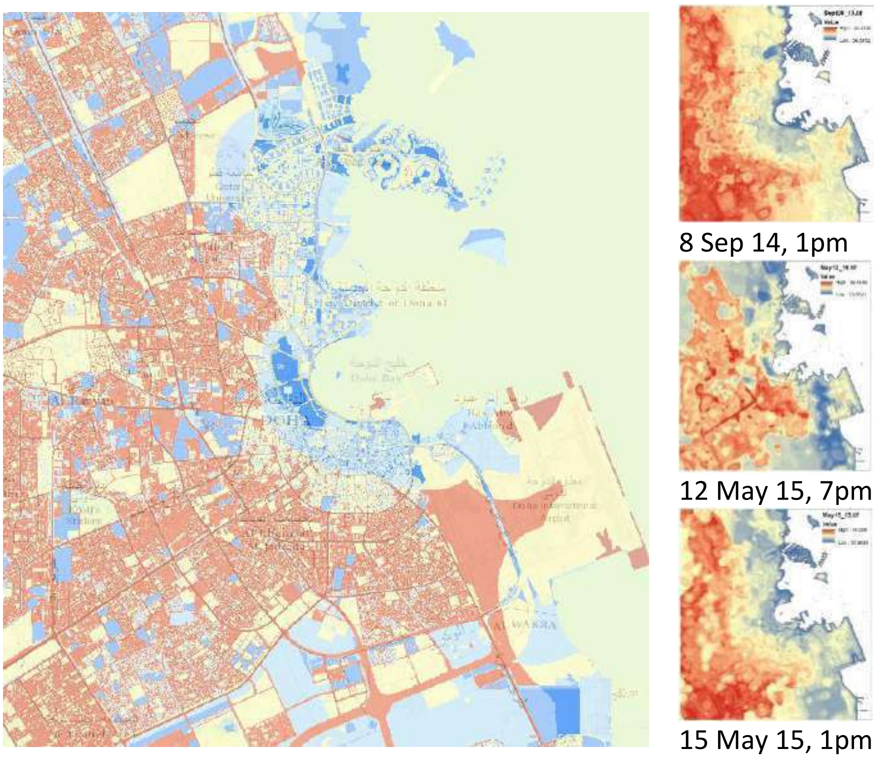

Figure 3 :Heat Island Map generated for Doha (left) with comparison of actual heat island measurements (right)
Source: NPRP research (#5-074-5-015) granted by QNRF

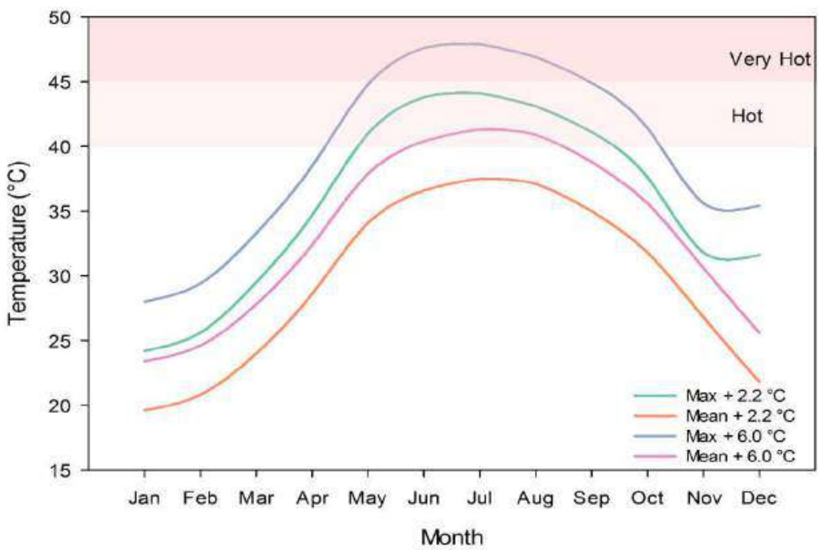

Figure 4 : The maximum, minimum, and mean temperatures in Qatar over the long-term period from 1962–2013 .

Source: Qatar Meteorology Department, 2016

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2.3 Increased Green House Gas (GHG) Emission

According to the United Nations Climate Change Secretariat (UNFCC, 2015), Qatar has the highest per-person CO2 emissions in the world. Based on available data from Kahramaa (utility provider) and publicly available national greenhouse gas emissions inventory for Qatar, a baseline per capita GHG emissions of 14.7 metric tons CO_2e (CO_2 equivalent) is estimated.

The total baseline per capita GHG emissions include water and power (72%), transportation (18%), waste management and treatment (9%), and domestic use (1%). Approximately 90 % of the GHG emissions result from water and power consumption and transportation. Utility consumption data for commercial facilities/operations such as restaurants, hospitals, malls, etc. are not readily available.

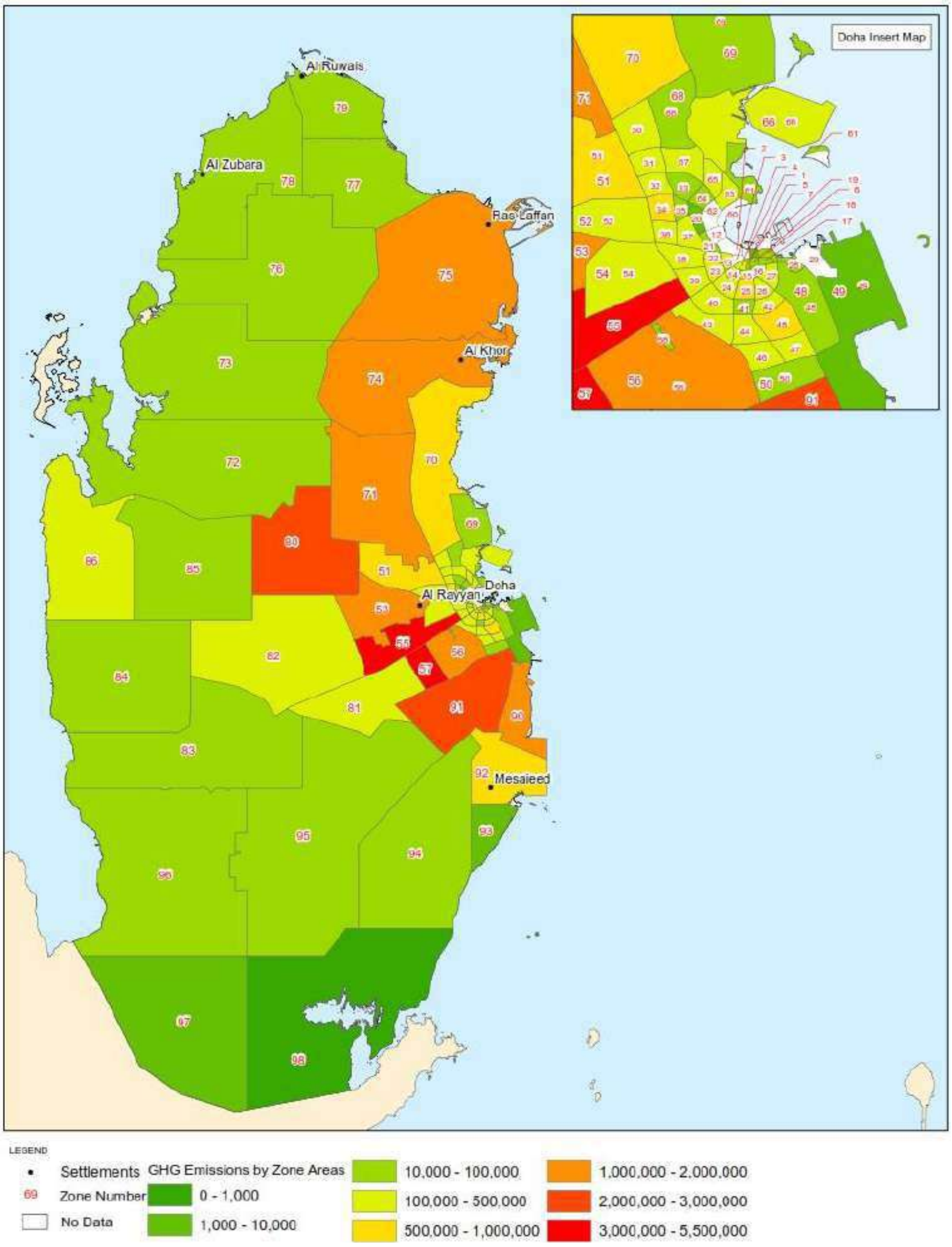

Figure5 : Baseline GHG emissions by zone

Source : MME (2017). P. 2016/2: Climate Change Strategy for the Urban Planning and Urban Development Sector in Qatar. Stage 3: Situation Analysis Report. GHD Pty. Ltd.

3. Climate Change Challenges for Qatar's Urban Planning and Development Sector

The Qatar National Vision 2030 aims to Transforming Qatar into a developed country by 2030, given that Qatar has the highest GDP in the world, capable of sustaining its own development and providing for a high standard of living for all its people for generations to come (GSDP, 2008).

This is a high level document for Qatar identifying a range of challenges it seeks to manage and address by the year 2030. It also provides roadmaps on development trends of Qatar by 2030.

There are challenges relevant to the Climate change. The aspects and relevance of these challenges to the Climate Change are detailed in Table 1 below:

Challenge	Aspect	Relevance to CC
The needs of this generation and the needs of future generations	This challenge identifies that continued dependence on hydrocarbons without developing other 'sources of renewable wealth' could be detrimental to Qatari society as hydrocarbons are a finite resource.	Utilizing hydrocarbons and associated GHG will influence the proposed mitigation and adaptation relating to land use planning.
Managed growth and uncontrolled expansion	Stress from rapid and/or uncontrolled growth can lead to financial vulnerabilities, environmental damage and widening social gaps and stresses.	Shows the value of planning and implies that the uncontrolled/ unplanned urban expansion is detrimental to the environment.
Economic growth, social development and environmental management	Acknowledges that development is likely to have a negative impact on the environment but states that development should be compatible with protecting and conserving the environment. If an environmental cost is identified from economic development, it should be "compensated with investments in technologies that help improve the environment" (GSDP, 2008).	Introduces the concept of compensation in spatial land planning and development. Places the economy before the environment, in some circumstances.

Table 1 : QNV challenges relevant to the Climate change

Source : MME (2017). P. 2016/2: Climate Change Strategy for the Urban Planning and Urban Development Sector in Qatar. Stage 2: Data and information collection and assessment Report. GHD Pty. Ltd.

The main challenges relating to Climate Change for Qatar is the development pressures for FIFA 2022 and massive infrastructure development while the ratification status on Climate Change convention that was in place since 1996 as part of the Kyoto Protocol and came into force since April 2005. Amendments to the Kyoto Protocol (https://unfccc.int/process/the-kyoto-protocol/the-doha-amendment) requires Doha's commitments to comply with some of the UNFCCC's requirements. In 2012, Qatar hosted the Doha Amendment on Kyoto Protocol reassuring its commitments towards climate change. In November 2015 [https://unfccc.int/news/qatar-submits-its-climate-action-plan-ahead-of-2015-paris-agreement], Qatar submitted its new climate action plan to the UNFCCC. The Intended Nationally Determined Contribution (INDC) was submitted to set the target and direction of how Qatar is going to address climate change.

The commitment stated in QNDS 2011-2016 stipulates that the legacy of the FIFA 2022 must be considered when commissioning any projects, particularly in relation to the long- term socio-economic and environmental impacts. These include climate change impacts into industrial sectors to reduce CO2 emissions in Qatar; as well as improving governance on climate change impact of air pollution, environmental degradation.

For a developing country like Qatar, since there has been INDC being submitted to UNFCCC, the Ministry of Municipality and Environment (Urban Planning Department) has recognized the vulnerability of the footprint of urban sprawls and structures being constructed and developed maybe under future threats from potential climate change impacts; hence the initiation of this strategy is especially tailored for the urban planning and development sector.

4. Existing Climate Change Management in Qatar

At present, there is significant lack of awareness of the potential impacts of climate change in the region. As such no tangible initiatives have been undertaken to initiate relevant research to ascertain credible assessment of the impacts.

It should also be noted that there is a significant gap in Qatar's existing legislation and planning framework to specifically address the impacts of climate change such as sea level rise, increased flooding, and increased temperatures. Within the existing regulations and initiatives, there are no actionable measures to be implemented or supporting monitoring and review mechanisms to mitigate (if not eliminate) the identified climate change impacts.

The Climate Change Strategy (CCS) for Urban Planning and Urban Development Sector in the State of Qatar is aiming to engage stakeholders and citizens to mitigate some of the Climate Change impacts.

5. Proposed Climate Change Strategy

The Climate Change Strategy aims at comprehensively addressing how the built environment can effectively mitigate against and respond to Climate Change.

The role of the Climate Change Strategy is to:

- Guide and influence where development takes place
- Regulate urban planning, land uses and urban design
- Encourage and support household and community actions that reduce risk

Coordinate and support links between protection (disaster avoidance), disaster preparedness and post disaster response and rebuilding

Develop tools to estimate and predict GHG emissions and climate change impacts from the spatial urban planning and urban development activities in order to explore ways to minimize emission and at the same time support Qatar's commitments in the international platforms.

5.1 Strategy Vision

"*Urban development in Qatar will progressively reduce average per capita greenhouse gas emissions and be resilient to the potential impacts from climate change*"

5.2 Strategy Objectives

The strategy objectives are based on adaptation (i.e. managing the adverse impacts of current and potential future climate change to reduce associated risks) and mitigation (i.e. reducing the GHG emission to support Qatar's international commitments and its leadership) opportunities. Table 2 categorizes the key objectives as per the adaptation and mitigation potentials:

No	Strategy Objectives	Nature of the Objectives
1.	Protect members of population from effects of climate change	Adaptation
2.	Reduce travel demands and improve access to public transport in new developments	Mitigation
3.	Facilitate the optimal siting of solar energy installations through land use planning and integrate small scale solar energy generation into all new developments and major projects	Mitigation
4.	Facilitate emergency response at the planning and building permit stage for developments within high risk flood and heat island affected areas	Adaptation
5.	Design new and retrofit existing developments to be resilient against increasing sea level rise and associated flood events	Adaptation
6.	Monitor GHG emission in urban developments and make information publicly available	Mitigation
7.	Retain and protect sensitive ecosystems that sequester carbon	Mitigation
8	Incorporate 'Green Building' measures to improve the energy and water efficiency of homes and businesses	Mitigation
9	Design the urban form to reduce the urban heat island effect and energy demand	Adaptation

Table 2 : categorizes the key objectives as per the adaptation and mitigation potentials

5.3 Action plans

Specific Actions have been developed for each category of key impacts, namely:

- Responding to Sea Level Rise and Flooding
- Responding to Increasing Temperatures
- Reducing Greenhouse Gas Emissions
- Protecting Biodiversity

An example of built environment mitigation/adaptation measures for each category of impact is provided below:

	Responding to Increasing Temperatures
Establish Vulnerable Coastal Zone to communicate risk and regulate development • Utilize the 1% AEP mapping to identify the Vulnerable Coastal Zone (VCZ) • Develop MSDP Zoning Regulation for VCZ to prohibit new development (with certain exceptions) • Update the existing and future zoning maps to incorporate VCZ • Continually update the 1% AEP contour as new sea level rise projections are made available with IPCC releases.	Improve green space in areas vulnerable to the Heat Island Effect • Utilize the finalized Qatar University UHI ongoing study to determine areas subject to the heat island effect and generate a hot spot map. • Overlay the hot spot map over future zoning maps to identify the need for any additional publicly accessible green space. Reallocate land use (if needed) and ensure the implementation of the green space. • Incorporate requirements for vegetation around buildings.
	Protecting Biodiversity
Create higher densities and mixed use to reduce travel demand • Require compact, mixed use development to the densities necessary to promote public transport	Introduce buffer zones to protect sensitive ecosystems • Commission a study into appropriate buffer zones and a need for migration corridors for

use • Require development to involve a mixed use (i.e. medium and high density residential and non-residential uses), with non-residential uses on the ground floor • Integrate walking, cycling and public transport networks into existing mega-projects • Implement higher residential density targets for new development. • Require new development to be sequenced, such that with development further from existing urban areas is permitted only after areas nearer the existing urban areas have been developed.	Qatar's Protected Areas and mangroves. • As an interim measure, prohibit development within 250 m of Protected Areas, mangroves, seagrass and coral reefs. • Include requirements in the MSDPs to identify and protect the buffer zones from any future development. • Provide a minimum of 250 m width 'escape routes' from Protected Areas. Where this is not possible due to existing development, provide a continuous wildlife corridor that is as wide as possible.

Table 3 : built environment mitigation/adaptation measures for each category of impact

5.4Implementation of the Strategy

The Climate Change Strategy will be implemented by developing specific initiatives to support the above action plans. These initiatives include the following:

1. Development of a 'planning overlay flood layer' that represents the areas subject to specific categories of risks from the SLR and increased rainfall intensity. This overlay layer will then be supported by a series of land use regulations. (An example of the Policies and Policy Actions outputs of the strategy : Establish Vulnerable Coastal Zone (VCZ) to communicate risk and regulate development)

Output from actions	**SL1: Establish Vulnerable Coastal Zone (VCZ) to communicate risk and regulate development**
Specific Actions	**SL1-1**: Utilize the 1% AEP mapping to identify the Vulnerable Coastal Zone (VCZ). **SL1-2:** Develop regulations for VCZ to prohibit new development (with certain exceptions). **SL1-3:** Update the existing and future zoning maps to incorporate VCZ as an overlay. **SL1-4:** Continually update the 1% AEP contour as new sea level rise projections are made available with IPCC releases.
Mechanism	Overlay on existing and future Zoning maps (SL1-3)
Implementation responsibility	MME-UPD
In coordination with	MME-IPD (SL1-1 and SL1-4)
Timeframe	Immediate
Resource implications	Low cost (SL1-1, SL1-2) Medium cost (SL1-3, SL1-4)
Performance Indicator	Establishment of a VCZ

Table 4 : Establish Vulnerable Coastal Zone to communicate risk and regulate development

Source : MME (2017). P. 2016/2: Climate Change Strategy for the Urban Planning and Urban Development Sector in Qatar. Stage 4: Strategy Report. GHD Pty. Ltd.

2. Development of specific urban design guidance and tools that will be included in the Qatar Urban Design Compendium (currently under development phase). These tools will propose with benchmark examples the best practice neighborhood and building design guidance/ requirements that considers climate friendly design options including conservation of resources, climate friendly building materials, environmentally friendly infrastructure, waste minimization etc.

3. Specific planning requirement (with specific template) for submission of a “Climate Change related Disaster Management Plan” in the event of an anticipated emergency.
4. Tools to estimate and predict GHG emissions and reducing climate change impacts for the spatial urban planning and urban development activities. The proposed tools include the following modules:
   - **Urban Planning Module**
     Key function: To estimate and project GHG emissions and GHG intensity based on land use categories. It compares GHG emissions associated with current land use, as well as projected future land uses, for a particular parcel of land. It also has the capability to display heat island and building floor level information.
   - **Building Application Module**
     Key function: To estimates the GHG emissions associated with construction activities and materials (e.g. demolition, site preparation, and construction portion of the real estate development process). It is intended to be used once in the lifecycle of each project to evaluate the expected GHG impacts, both from emissions during the construction process and embodied carbon in the materials used. It has the capability to capture greenhouse gas emission associated with the construction process.
   - **GHG Emission Tracking Module**
     Key function: To collect annual CO2e emissions resulting from specific reportable activities undertaken by major urban emitters. This tool has the ability to capture greenhouse gas emissions associated with ongoing operations at a site.

6. Conclusion

- Qatar is subject to considerable risks from climate change impacts that poses significant threats/ hazards to life, properties, infrastructure and necessary services
- Urban planning and development sector needs to play an important role to address the impacts of climate change because careful planning with regulatory instruments can prepare a safe and resilient spatial urban settlement.
- Ministry of Municipality and Environment, being the urban planning legislative body in the State of Qatar has recognized and evaluated the risks from climate change impacts and proposed a comprehensive strategy supported by specific action plans and tools for implementing the strategy.
- Public awareness and understanding of the climate change related risks are not that strong at present, hence a comprehensive education and awareness program would be necessary at all levels of public and private sectors including the citizens through all ages and educational backgrounds. The awareness would influence taking ownership of the issue by the general public and assist in welcoming the implementation of the strategy.
- Current institutional and planning regime is already facing major challenges in implementing a recently introduced new planning regulations and planning system. The climate change related regulatory instruments are yet to be included in this new planning system and is expected to face considerable difficulties in understanding let alone implementing them. Stakeholder consultation at the time of developing the strategy and actions plans was an integral part of the project, however, because of lack of understanding and lack acknowledging the problem, the participation was not very effective.

- A comprehensive plan for on-the-job training is currently being planned for its execution for all relevant internal and external stakeholders.
- The next amendment of the planning regulations that is due in less than six months would include all the regulatory requirements of the climate change strategy.
- There will be a need for establishing an inventory to capture the GHG emission from the land use and development activities.
- The MME management needs to demonstrate a significant leadership role in facing the challenges posed by the climate change in Qatar and take ownership of the strategy actions to support implementing them

7. Acknowledgements

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Main Revisiting the Concept of Resilient Cities: The Case of Doha, Qatar

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Abstract

Given the mixed interpretations of the concept of "Resilient Cities", this paper calls for a more comprehensive understanding of the concept and its holistic impact on the way cities are designed, planned and developed. By labelled as resilient, cities should transcend the limited definition of the resilient cities concept which focuses on merely environmental and readiness for climate change impact and other forms of natural disasters. Resilience as an attribute for cities and as will be shown in the case of Doha, the capital city of Qatar, should be holistic and inclusive to embrace all aspects of city development including economical base, cultural assets, social structure and urban development. Using the case of Doha, the paper illustrates a new conceptual understanding of cities' resilience.
The paper analyses the contemporary evolution in Doha and highlights the milestones in structuring the new vison for Doha's development as a resilient city holistically. In the last decade, the city was subjected to a number of radical transformations started from winning the bid to host the 2022 FIFA world cup, decrease in oil prices and finally the sea, air and land blockade imposed on Qatar by its adjacent neighbors. The paper illustrates Doha's model in providing an interesting case of resilience which allows the city to successfully cope with the consequences of all the major shocks, stress and unforeseen challenges, the city have faced in the last decade.

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1 THE GLOBAL VIEW: Climate Change Impacts, Sustainability and Resilience.
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1- Introduction

Cities worldwide are challenged by a high complexity of acute and chronic problems, including challenges related to economic development, social polarization and segregation as well as climate change and ecological degradation. Hence, cities must become resilient to a wider range of shocks and stresses. The notions of urban resilience and the resilient city have gained considerable attention and interest over recent years**.** Urban resilience is a broad concept that is sometimes blurred and abstract. We are also interested in the scope of this research to relate the concept of urban resilience with the concept of urban sustainability. Our positon as explained in the case of Doha, Qatar suggests that the resilience of cities facing variable conditions, threats and forces should also consider the sustainable future of the local communities and the urban territories they belong to. As Zhang and Li (2018) indicate that rational urban development can be achieved only when it is both resilient and sustainable, and conclude that urban planners, policymakers and researchers should pay equal attention to both urban resilience and urban sustainability before decision-making. In current studies, some scholars hold the view that urban resilience has already replaced of urban sustainability as the mainstreaming concept in the discipline of urban studies.

2- Interrogating the Standardization of Planning Concepts: The Case of Resilience

The most recent terminology used in the realm of urban planning and development is resilience. Accumulated literature, particularly conferences and journal papers, are discussing the topic in the domain of urbanism and planning. Conferences are organized around the globe to discuss how to make cities resilient? Yet, we never pause and question the validity of having a sequence of concepts that each would emerge every decade or so. Lately, resilience has become an important goal for cities, particularly in the face of climate change. Yet, for a lot of cities around the world, the concept of resilience is still ambiguous. Cities are deeply complex, sophisticated and adaptive systems. The city is the most complex and typical social-ecological system shaped by human beings. Hence, every single city has its own narrative. The mechanistic model of urbanization which is merely using globally accepted concepts coined by international organizations like UN-Habitat should be contested. During the last four decades, UN Habitat, World Bank, International Monetary Fund and other development agencies supported by researchers and academics maintain the ritual of inviting a description for the successful city and change it every five to ten years. Cities in the whole world and particularly in the developing countries were kept confused whenever a new concept emerged; modern, sustainable, smart, green or resilient city. Once a city tries to use its local resources to fully understand the concept and how it will positively affect its development, a new one and even more sophisticated and ambiguous is introduced.

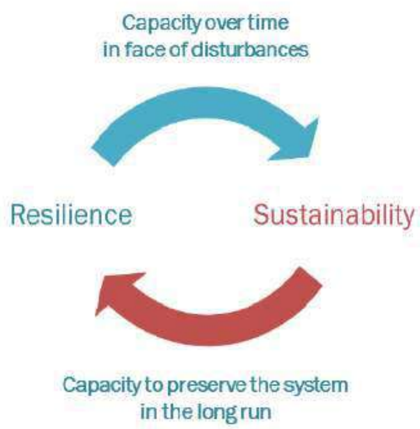

Figure 1: The dynamic relation between resilience and sustainability.

In an increasingly complex and changing world where global problems are felt locally, the approaches used to plan, design, and build our urban neighborhoods are failing due to the adoption of standardized planning concepts. Primarily, the evolution of cities through rigid, top-down action proved ineffective particularly with the continuation of the same problems including environmental threats, urban poverty, housing crisis, car dominance urbanism and other constant challenges. Campbell (2018) argues that the key to fixing our broken patterns of urban development does not lie in grand plans or giant projects; rather, it lies in the collective wisdom and energy of people harnessing the power of many small ideas and actions to make a big difference. He calls this making “Massive Small” change. Such perspective is significant to the discussion on the emerging concept of resilience in cities and urban areas. A shift towards a holistic understanding of the local context and engaging the local community would pave the way to an authentic and credible urban resilience related to people and places.

In order to create resilience in urban systems, cities need to be able to learn, adapt and transform across sectors and levels. One definition of urban resilience is the capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow regardless of the kinds of long-lasting pressure and severe shocks they experience. Cities are very vulnerable when any of their subsystems are destroyed or fail to adapt to new challenges. Such a situation may lead to a fatal crisis or even destruction. Uncertain factors, such as natural disasters, climate change, energy crises, political instability, financial crises, food security and terrorist attacks play an important role in threatening urban development (Spaans & Waterhout, 2017). In other words, the concept of resilience should be overextended and transcend the main topic it is associated with; climate change. As explained, cities face plenty of negative and positive challenges which require resilient policies and strategies articulated from within and not imposed by outsiders.

3- Conceptualizations of Resilience

Resilience is the ability of a system, community, or society exposed to hazards to resist, absorb, accommodate to, and recover from the effects of a hazard in a timely and efficient manner (Jha and al., 2013). The paper initiates a discussion of how the definition might serve as a boundary object, with the acknowledgement that applying resilience in different contexts requires answering: Resilience for whom and to what? When? Where? And why? Using general terms and global concepts won't help in achieving any level of tangible change as long it is not coupled with a sincere attempt to fully understand the local condition and adopt the concept to the realities on the ground. In the work of great urban theorists such as Jane Jacobs, Christopher Alexander, and E. F. Schumacher, the main invitation for urban planners is to consider locality and value small actions and humble interventions. After reviewing the scholarly literature on urban resilience (Meerow and el., 2016) have concluded that the term has not been well defined. Their justification was based on that Existing definitions are inconsistent and underdeveloped with respect to incorporation of crucial concepts found in both resilience theory and urban theory. (Pizzo, 2015) problematizes the introduction of the concept of resilience into the planning domain from three main starting points: 1. The nature of the events which are said to require resilience; 2. The different nuances in meaning that resilience assumes according to those different events, and 3. The theoretical and operational problems the concept entails. The paper sustains that: Multiple sub meanings are embedded within one interpretation of resilience that leave the concept open to rather large margins of ambiguity, which emerge considering its operationalization; 3. The concept seems to fit and to be appropriate within different paradigms, planning traditions and policy frameworks. Its alleged 'neutrality' is one of the main reasons of its pervasiveness, but also of its ambiguity, showing latent controversial implications, which are progressively emerging in critical planning theory.

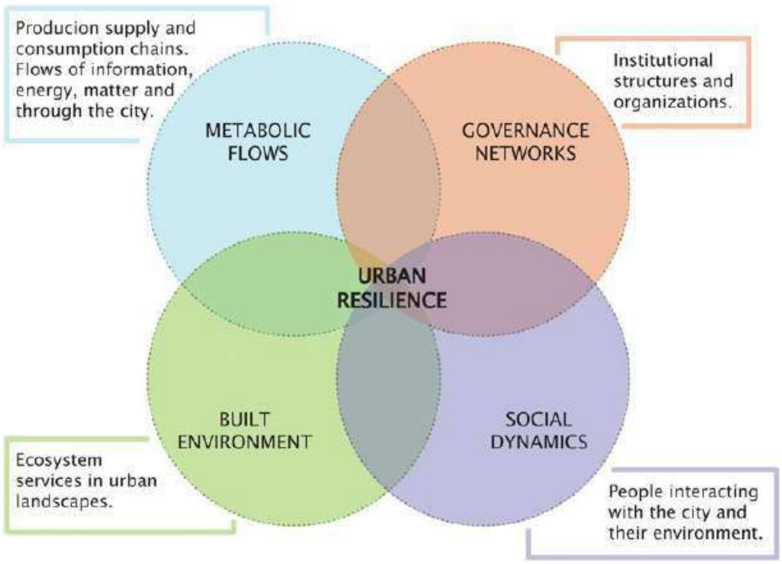

Figure 2: The holistic approach to urban resilience.

3-1- Resilience in Urbanism and City Planning

This paper provides an overview of the development of the resilience concept in the domain of urban development and planning. Over the last two decades the concept of resilience has experienced escalating interest. However, due to a lack of consistency in defining and measuring this theoretical construct within and across disciplines, the recent explosion of literature on resilience has contributed more to confusion than clarity among researchers and policy makers. The notion of resilience is gaining increasing prominence across a diverse set of literatures on cities and climate change. Although there is some disagreement among these different literatures about how to define and measure resilience, there is broad consensus that: (1) cities must become resilient to a wider range of shocks and stresses in order to be prepared for climate change; and (2) efforts to foster climate change resilience must be bundled with efforts to promote urban development and sustainability (Leichenko, 2011). Hence, the paper calls for a need to revisit the concept and its utility to the prosperity of cities. However, resilience has been closely associated with sustainability for more than a decade, although without precise meaning and often as an additional label attached to pre-existing research (Timon, 2014). Urban resilience is a broad concept that is sometimes blurred and abstract. Part of the effort to render the concept to a more clear interpretation is first to assert that Urban resilience addresses adaptation as well as mitigation. It is associated with spatial planning policy-making in the context of different levels and forms of uncertainties. Therefore, urban resilience provides a new way of framing and responding to uncertainty and vulnerability. In light of this interpretation, urban resilience offers an alternative paradigm for planning strategies.

4- Contextualizing Doha: The Rising Competition between Gulf Cities

Before discussing the experience of Qatar, this section is contextualizing the State within the Gulf context and elaborates on the notion of the regional competition. While most people think of cities developing organically over hundreds of years, many who live in the Gulf are aware of how quickly some cities can grow, expanding exponentially in terms of buildings, infrastructure, and population. Much of the rapid transformation has been guided by an intense inter-city competition to attract investments, human resources and tourism particularly as a consequence of oil prices decline. The states in the Gulf region have grown rapidly due to their large reserves of oil and gas. Being aware of ending resources, the era after the oil is already being planned by the governments in the Gulf region (Höselbarth, 2010). The Gulf States while mostly young and small, they are the largest builders and developers in the world. Every single capital Gulf city is characterized with shopping malls, skyscrapers, artificial islands, gigantic airports, real-estate fantasies and signature museums. Yet, they have also realized that another transformation is needed from oil-based to post-oil societies. With oil resources running out, a focus on the post-oil era is a priority.

As these cities compete with each other, aiming to highlight their unique offerings and attempting to clearly distinguish themselves from other cities, they have chosen to rely on place-branding as a tool. The staging of events of international importance (such as Formula One Races in Abu Dhabi, upcoming World Expo 2020 at Dubai and prospective 2022 FIFA World Cup at Qatar), the emphasis awarded to star-architecture and the emergence of strongly themed mega-projects characterize such development. Thus city-positioning and place-branding begin to assume the status of urban development models (Mishra, 2016). All Gulf cities are in the process of diversifying their economic base, with the vision of transitioning to a sustainable post-oil future, they are positioning themselves as places to visit, work and live. Place-branding has emerged as a significant trend across the Gulf cities in the construction of this image and consequently in the production of places.

Questions about the future of contemporary Gulf cities are important as the drastic changes taking place particularly in the economic side, indicates a necessity to consider a new blueprint for Gulf cities' future. Replacing glittering facades, high-end hotels, artificial islands, huge shopping malls, and the tallest constructions of the world, the region nowadays need to attract people from all over the world to contribute in a different kind of economy. The catalyst for the old model of development was the discovery of huge amounts of oil and gas resources in the 1960`s leading to prosperity (Gremm and els., 2015). But oil reserves will be exhausted in the near future. How do the cities of the Gulf region respond to this drastic change? Are they, like so many other cities in the world, trying to reach the status of a knowledge or creative city? Is it indeed a target of these wealthy oil-based cities to set up a knowledge society based on knowledge economy not mere natural resources?

5- The Narrative of Qatar: A Small State with Big and Legitimate Aspirations

The skeptical positon regarding Qatar's ability to construct an inspiring model of development is based on its small size, limited population and the massive presence of expatriates. Roberts (2015) stresses the concept of "brand Qatar" as a catalyst which helped the small size State to gain global recognition and changed its character so completely in so short a period of time. He based his interpretation on shifting the leadership in 1995 to an emerging leader with a progressive vision for the future. The pillars of this progressive vision are diversified and balanced foreign relations, establishing a leading role in media through Al Jazeera network, and extensive investment in gas production and liquefaction. Ultimately, bold initiatives require bold leadership and Qatar is yet again, blessed with this resource (Richer, 2014). Additionally, Kamrava (2013) argues, Qatar's enormous oil and gas wealth has permitted the ruling Al Thani family to exert a disproportionately large influence on regional and even international politics. Qatar is, as Kamrava (2013) explains is a "tiny giant": although severely lacking in most measures of State power, it is highly influential in diplomatic, cultural, and economic spheres. He presents Qatar as an experimental country, building a new society while employing what he calls "subtle power." It is both the headquarters of the global media network Al Jazeera and the site of the U.S. Central Command's Forward Headquarters and the Combined Air Operations Center. Qatar's effective use of its subtle power, Kamrava argues, challenges how we understand the role of small states in the global system.

Figure 3: Al Jazeera News Network is one of the most effective tools for Qatar's plan to achieve big aspirations regionaly and internationally.

Figure 4&5: Doha's Evolution from a humble traditional settlement to a metropolitan urbanity (Source: MME).

6- Contesting Doha's Model of Resilience

In this section, an analysis of the most dominant forces that challenged the development of Doha city in the last decade will be provided. Hence, all the strategies, processes and policies which were adopted by the city will be shared to illustrate the city's resilience model. Interestingly, some of these dominant forces were celebrated like winning the bid to host the 2022 FIFA World Cup, while other were a substantial shock and have created a seismic impact on the city's people, economy and development. Hence, Doha was alert for the critical need for a flexible and dynamic approach to building resilience that goes beyond risk mitigation. Therefore, in the coming sections, three main challenges will be narrated and Doha's answer to each of them will be illustrated.

6-1- Challenge One: March 2008; The Inevitability of the Post-Oil Paradigm

A major challenge which the paper addresses is the fluctuation of oil prices and how Doha is structuring a vison for the city in the post-carbon paradigm. Such paradigm implies a move from oil-based economy to a knowledge-based economy and how to plan the city to facilitate such a new economical paradigm. With an unprecedented financial resources, creative strategic thinking and political commitment, Qatar is constructing a new development and urban brand; *Dohaization* which is a brand but also a continuous dynamic process[1]. The case of Doha is stimulating as new mega projects are made to pave the way for a new development vison structured upon the value of knowledge economy and knowledge-based urbanity. By any measure, Qatar's growth is phenomenal; in the past decade the population has trebled, and the size of metropolitan Doha has increased fourfold. From its humble origins as fishing and pearling village, Doha has emerged as an expanding world city, where ambition and means are fueling exciting experiments in education, health, sports and culture (Framherz, 2012; Jodido, 2014; Alraouf, 2016). For a better understanding of how Doha came to structure its current identity, an investigation into the State's main strategy and the articulation of Qatar's role regionally and internationally is crucial. In this section, we will discuss the State main strategies which affected the development of Doha. The Paper sheds light on the concept of Doha's attempt to construct a new identity which transcends the model that was created by Dubai's iconic development and real-estate fantasies. Then, the notion of knowledge economy as adopted by the State and clearly articulated in QNV 2030 will be analyzed to illustrate the quantitative and qualitative shift towards knowledge-based urban development in Doha. Evidently, in the last decade a new pattern of planning interventions can be clearly observed in the urban fabric of Doha. These new interventions described as the city's mega projects due to its size, location, population served and visual and urban impact.

[1] The term *Dohaization* was coined and used for the first time in Gulf Research Meeting at Cambridge and later published in Alraouf, Ali. 2016. "Dohaization": An Emerging Interface between Knowledge, Creativity, and Gulf Urbanity. Pp.: 47-68. In Katodrytis, G. and Syed, S. Gulf Cities as Interfaces. Cambridge: Gulf Research Centre Cambridge.

Figure 7: The post-oil urbanism suggests a paradigm shift towards walkability and tranisti oriented developmt in Doha.

Doha is considered by many indicators as the most advanced city within the Middle East to adopt knowledge economy as a conceptual base for its 2030 vision. Qatar did a radical transformation to go beyond the typical image of a Gulf city relaying on presumably endless assets of oil and gas. A move towards being a regional center for education, knowledge and culture is the new aspired sense of identity for the Gulf State. A major investment in knowledge-based urban development characterizes major projects in the country during the last five years (Alraouf, 2008; 2014). This new identity of Qatar paved the way for a new paradigm in Doha's urbanity which can be best described as the Knowledge-based urban Development Paradigm. Qatar has become a showplace for renowned architects, several U.S. universities have established campuses there, and it will host the FIFA World Cup in 2022. The quantity and the quality of architectural and urban projects which will be added to the city's urbanity to facilitate hosting the 2022 FIFA World Cup would definitely make Doha a very unique world destination. Significantly, Doha has gained global significance through the growth of knowledge economy related projects. The city's new urban development and its spatial qualities contribute to the global attractiveness of Doha for knowledge economy investments, firms and people. Such urbanism fulfills the requirements of Knowledge workers coming to the city from literally every spot of the globe anticipating an attractive smooth quality of life which would foster their creativity and innovation.

Figure 8&9: The new cultural districts help Doha in establishing a new form of Knowledge-based Urban Development (KBUD).

With increasing awareness about the carbon emissions and the negative impacts of climate change, the paper evaluates Doha's attempt to transform its urban movement pattern from purely car-dependent city to a model for a transit-oriented development with the vitalization of connected network of public transportation, pedestrian streets and bicycle routs. Doha's model of urban resilience as reflected in the city's masterplan is answering the fundamental question of how to design and operate the city so it can withstand major threats and how to recover from them? Yamagata and Maruyama (2016) argue that land-use planning and carbon-neutral scenarios for urban planning are fundamental tools in urban management leading to a better urban resilience.

6-2- Challenge Two: October 2010; Winning the Bid for Hosting FIFA 2022

Qatar's interest to brand itself as an appropriate choice to host mega sports events started with preparing Doha to be the sports capital in the Middle East. A fact which was successfully demonstrated when the country organized the 2006 Asian games and gained the world respect. Doha was the first city in its region and only the second in West Asia (following Tehran in 1974) to host the games. Later, Qatar has lost its bid for the 2016 Olympics, but has vowed to try again. On the second of December, 2010, Qatar was selected as the host country for the 2022 FIFA World Cup. The model of Qatar hosting a major global world event generates number of interesting issues. All the lessons learned from analyzing the different world experiences in hosting major global sports inspired Qatar to take a different route. One can observe the transformation in strategic thinking towards the whole process of hosting the FIFA event in Qatar. When Qatar was declared as the host country for the 2022 FIFA World Cup, an immediate decision to form an organizing committee with outstanding authorities and capabilities was issued. The committee was called 2022 FIFA World Cup Supreme Committee and it has an excellent team of consultants, advisors, strategic thinkers, logistics experts and some members from the team who prepared the successful file that won the bid. Later and in light of the new understanding that hosting the event is a catalyst for future progress and community development, the whole conceptual approach has changed. Also, the title and the responsibilities of the committee have altered. The new title for the 2022 FIFA World Cup organizing body in Qatar is Supreme Committee for Delivery and Legacy (SCDL). The model as discussed in the outcomes of the supreme committee has learned profoundly from recent experiences in hosting the FIFA cup particularly in Brazil and South Africa. The main responsibilities of the committee are being confident that Qatar will provide a state of the art experience in hosting the event but more significantly that the event will positively affect the future prosperity of the country and create a sustainable legacy that would last for generations to come.

Figure 10: Doha is balancing hosting the 2022 FIFA World Cup with the future aspirations of the city.

Qatar is consciously aware of the day after oil and is using the unprecedented opportunity of hosting the 2022 FIFA world cup as an engine to inspire a new blueprint for the future of its people and cities (Nadine, 2014). The strategic thinking transformation towards how to host a global sports event in Qatar resulted in a new blueprint and a road map. This blueprint was based on a number of integrated aspects. All of which were designed and assembled in a way to guarantee that the process of hosting the event will be successful not only during the thirty days of the competitions but for decades to come. Qatar has been using sports strategically as a foreign policy tool that contributes to national security and allows the country to gain soft power. Even on the level of enhancing the global image after the blockade, Qatar smartly used sports to deliver a positive message about its stability and commitment to global investment. Current evidences particularly during the events of the 2018 FIFA world cup in Russia and the excellent presence of Qatar suggests that The 2022 World Cup in Qatar will happen, although not everybody might like that. As explained earlier, hosting the Cup will be a turning point for Qatar and would substantiate its global reputation but it is not the ultimate goal. The goal as explained in the paper is to use hosting the event as a catalyst for a better post 2022 Qatar.

6-3- Challenge Three: June 2017; A City under Siege: A Plight or a Historical Opportunity

One of the major forces which led to unprecedented challenge for Doha and Qatar as a whole is the blockade imposed by its close neighbors. The blockade as the paper illustrates opened new dimensions in the city's acknowledgment and comprehension of resilience. Ironically and surprisingly, in the 50 anniversary of the six days war in 1967 where Arab armies were humiliated and defeated, four Arab States decided to activate an unprecedented sea, air and land blockade against Qatar. The whole Middle East and the world wake up on the fifth of June 2017 reading the news about the decisions imposed by Saudi Arabia, United Arab of Emirates, Bahrain and Egypt on their neighbor and founding member of the Gulf Cooperation Council (GCC), Qatar. Pressure mounted further after relations with its regional neighbors hit rock bottom last June. Since then, Saudi Arabia has led a boycott of Qatar, with full participation from Bahrain, the UAE and Egypt. Planes have been prohibited from flying to Doha, banks from dealing with Qatari banks, and the country's influential satellite TV channel, Al-Jazeera, remains off the airwaves throughout most of the Arab World.

Figure 11: On the 5th June 2018, Qatar's nighboors imposed an unprecededted bloackade against the whole State.

6-3-1- The Social Cohesion as a Catalyst for City Resilience

Baldwin and King (2018) emphasize that strong social networks and social cohesion can be more important for a community's resilience than the actual physical structures of a city. That what was exactly noticed in Doha after the activation of the blockade. More significantly, urban planning and design support these critical collective social strengths by stressing the necessity of creative spaces for all and enhance the inclusivity of the city's urbanity. In the process of realizing the goal of both sustainable and resilient development, we should see the dominant role of social factors such as urban governance in the process of urban adjustment and adaptation. The social aspect will be also addressed in the paper as Doha, similar to most of Gulf cities, has a much diversified population coming from all corners of the world.

Figure 12: The city spaces are planned to accommodate the different social groups and emphasize the social cohesion.

The city is taking a number of measures to create better connections between expatriates and the city significantly sense of belonging and ownership which would radically help in inspiring the city's overall population of locals and expatriated to better defend the city and take a solidifying position towards realizing its future aspirations. The paper concludes with articulating a more holistic framework for city resilience which takes into consideration the multifaceted nature of the city and better prepare it for different forms of changes and transformations which might occur in the future. Coaffee and Lee (2017) examine how the concepts and principles of resilience exert increasing significant influence over the form and function of planning. Their discussion of the 'politics of resilience' in which fundamental questions of social and spatial justice are posed is relevant to the notion of social cohesion in Doha after activating the blockade.

Conclusion

The Model of Doha, Qatar extends the conceptualization of resilience to go beyond the well-known risks and move to planning the city to face different forms of crisis. More significantly, prepare the city to face uncertainty as the case with oil prices fluctuation and its impact on the economic stability of the country as a whole. Such a model matches with Coaffee and Lee (2017) call for a focus towards an integrated and adaptable model for coping with risk, crisis and uncertainty. In such time of uncertainty, urban planners are increasingly tasked with the responsibility of safeguarding the future of urbanized centers and those that live in them. In facing an unprecedented blockade from closest allies and adjacent neighbors, getting ready for hosting the biggest sports event on earth; FIFA world cup and coping with radical changes in its economic base as a rentier capital, Doha provided a worth analysis and appreciation case. The experience of Doha after the blockade asserts that an urban rational and holistic development mechanism could help improve the urban capability more effectively to cope with the various crises involved. The model of Doha illustrates the difference between process-oriented resilience than an outcome-oriented. Hence, Doha provides a rational urban development model because it is both resilient and sustainable. Part of the city' success story stems from the fact that social cohesion was considered as a pillar in enhancing the resilience capabilities of the city. It describes and illustrates the ideas, tools, and tactics being used to help engaged citizens, civic leaders, and urban professionals to work together to build viable urban society.

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Governance, management, administration and planning systems in Ghana

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ABSTRACT:

Since Rio, climate governance has gradually been subjugated by contestations between developed and developing countries. Africa has been mandated to develop national and regional climate governance frameworks in line with the UNFCCC mandating Ghana to do likewise. However, these policy frameworks may not be implemented meaningfully or developed national institutional capacities to respond organically to climate change. This paper seeks to address the following objectives:

To understand climate governance in Ghana

To review the management and administration of climate change in Ghana,

To determine the extent climate change has been mainstreamed in the planning system in Ghana

Africa has been mandated to develop national and regional climate governance frameworks in line with the UNFCCC mandating Ghana to do likewise. The Ghana National Climate Change Policy developed seek to enhance coordination, establish clear mandates and roles for the various stakeholders, including the policy oversight role of the Ministry of Environment, Science, Technology and Innovation, the coordination of climate finance by the Ministry of Finance and the Economic Planning (MoFEP), and also measures to support small farmers and safeguard food security by the Ministries of Agriculture and Health. The establishment of a statutory coordination unit, the National Climate Change body would minimise the duplication and maximise synergies, overseeing all climate-related policy areas and coordinating activities. Also, governance mechanisms established to meaningful implement the National Climate Change Policy include the essence to ensure coherent, cross-sectoral action; address local level priorities; ensure the transparency and openness of the responsible agencies, and to allow public participation and access to information.

In order to ensure the successful implementation of policies and strategies on climate change, the government is not the sole institution responsible for the success of interventions on climate change. Non-governmental agencies including Civil Society Organisations and the private sector are the implementing bodies at the national, regional, district and community levels.

It is worth noting that planning in Ghana dates to the first National Development Plan, (1920-1930) under the British colonial rule. Over the years these development plans lacked the spatial dimensions of socio economic visions and policy goals focused at planning and managing human settlements. Post-independence planning focused on the path to broaden the spatial coverage and to strengthen institutions, and this led to the establishment of the Town and Country Planning Department in the country. Spatial planning prior to the new act, Act 925 has been restricted to the traditional function of land use zoning and development control at the level of MMDAs. Therefore, with the enactment of the Land Use and Spatial Planning Act, Act 925, a three (3) tier spatial planning system is enforced. Accordingly, the introduction of contemporary planning system since the beginning of the Fourth republic has mainstreamed climate change in decisions, policies, and programmes and of the country.

The Government of Ghana has demonstrated commitment to mainstreaming climate change into key planning processes at the national, regional and local level. Ghana’s resolve to mainstream climate change into development agenda is through the Ghana Shared Growth Development Agenda I&II (2010-2017) attest to this commitment. The government through the Ministry of Finance and Economic Planning (MoFEP), Environmental Protection Agency (EPA), and the

National Development Planning Commission (NDPC) has carried out a number of measures to reflect climate change mainstreaming efforts in budget formulation, implementation, monitoring and evaluation in line with the medium term climate change objectives.

In conclusion, an overview of the governance, management, administration and planning systems in Ghana would portray the country's commitment to climate change issues, adaptation and mitigation measures established by the various institutions.

Future Direction for a Volcanic Basin Planning
(Case Study of Opak Sub-Basin, Yogyakarta, Indonesia)

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1. Introduction

There are about 1,500 volcanoes with potential activity in the world (USGS, 2018) and out of this, at least 500 are known to have historical eruptions. Out of this 500, many of them are located within 10 to 80 km radiuses of urbanized areas, with more than 1 million populations (ESRI, 2018) meaning that they could get direct impact from a volcanic eruption. A volcanic eruption produced the pyroclastic flow, lava, and lahar (Trenberth and Dai, 2007, Wood and Soulard, 2009, Chester, 1994, Bignami, Bosi, et al., , 2013). Nowadays, more scientific research has proven that climate change may induce more frequent volcanic activities (Swindles, Watson, et al., 2018). As climate change progressed, this meant that more volcanic eruption risks are faced by these cities. Appeals for living in these cities by the volcano consists of the volcano's beautiful scenery, the fertile soil, and the good groundwater sources (Chester, 1994, Cashman and Giordano, 2008). Many cities in developing countries are located in the active tectonic belts or in the location of the most explosive volcanoes. A study had calculated more precisely on the urbanization rate and population growth of these volcanic cities in 2001. It proposed about 9% of the world's population lived within 100 km of a historically active volcano, while 12% lived within 100 km of an eruptive volcano in the last 10,000 years, while the density decreased within 200 km (Small and Naumann, 2001).

Lahar is the Indonesian word for the volcanic debris flow, which is a natural phenomenon for an active volcanic river basin when an eruption produced materials and combined with rainwater. For those cities located in these locations, there is a need for a paradigm shift to integrate this lahar condition into our river basin planning. This need on the shift is because most river basin planning is based on general geological condition, for the non-volcanic region and does not address this issue. Examples of lahar strategies management in Japan, US, New Zealand and the Philippines (Pierson, Wood, et al., 2014a, Major, Pierson, et al., 2000, Rodolfo, 1991) are used by the Indonesian government in deciding their lahar management.

In this paper, Mt. Merapi is chosen as the case study as it is one of the most active volcanoes in the world, recently erupted in 2010 marking a-100years periodical cycle and also located near a highly populated urbanized area of around two million in Yogyakarta-Sleman-Bantul agglomeration (BPS Provinsi D.I. Yogyakarta, 2018). The standard measurement for an eruption is the Volcanic Explosivity Index (VEI), ranging from 0 to 8, where the 2010 eruption was at 4 VEI. The lahar in Opak Sub-Basin is handled with Sabo Dam System(Chanson, 2004, De Bélizal, Lavigne, et al., 2013), combined with the land use plan and early warning system. This paper aims to tackle the complexities of lahar management planning in the Opak Sub-basin located in an active volcanic river basin, with relation to water resources management, by means of answering the research question on "What are the interrelations of lahar management in integrated water resources management?" This study signifies the importance of learning from the lessons from a volcanic river basin management to shape future plans.

2. Conceptual Framework

2.1 Lahar definition

In this research, due to the location, Opak river basin faces threats concerning the volcanic activity. The most posing threats in the relation between water and volcanic activity would be lahar hazards or volcanic debris flows (Marso, J. N., 2013, Pierson, Wood, et al., 2014b). Hazards do not always happen in extreme natural phenomena; however, when it occurred in the human surrounding, it may threat life, environment, infrastructure, and property. Hazards in themselves do not constitute disasters. A volcano has an immediate hazard; the pyroclastic flow and the non-immediate hazards; the earthquake and the lahar. Pyroclastic flow as the most dangerous hazard is a fast flow (up to 700 km/h) of hot gas (1,000'C) and molten rock or tephra (Lavigne et. al., 2000). The earthquake happens as volcanic eruption blows this tephra and during the process of eruption in low tremor movement. Lahar is developed as volcanic materials build-up on the flank of a volcano after eruption is triggered with heavy rainwater, creating a debris flow with speed up to 100 km/h, and volume up to the unlimited amount depending on the scale of eruption (Lavigne and Thouret, 2003, Marso, J. N., 2013, Rodolfo, 1991).

As a term, lahar has been used as an international term since 1929 in addressing mudflow from volcanic activities deposit (Scrivenor, 1929). However, this definition is too narrow, as it does not explain the composition of water and volcanic materials, also as it refers mainly to sand and clay, while in reality it also contains rocks, pebbles and even boulders. Another definition explains the character of lahar as mudflow, which contains volcanic materials transported by water, including "debris and angular blocks of volcanic origin" (Bemmelen, R. W. v., 1956). This more "loose" definition fits better with the lahar terminology used in this research. As mentioned earlier, the generation of rain lahar can be seen as an iterative process of water and volcanic material mix (Pierson and Scott, 1985). The differentiation of the percentage of composition cannot be measured in detail as lahar continuously changes its composition throughout its flow downstream. The phase of formation can be explained in the following diagram(Rodolfo, 1991), each phase of the rain lahars may form differently in each condition as it also varies based on the condition of sediments and geomorphology of the volcano slopes. This condition shows the process of lahar formation as partly water induced. Only some literature relates to water and lahar hazard in water management issues (Jakob, Hungr, et al., 2005) those that are addressing lahar, most are in the field of geology or volcanology. Most literature in water management addresses water-related hazards as a climate-related hazard, but does not include lahar (Parry, Canziani, et al., 2007, Viviroli, Archer, et al., 2011, Yusuf and Francisco, 2009). Therefore, to pinpoint this issue, it would be wise to see the relation as lahar characteristics have fluidity in which relate to the rainwater composition (Rodolfo, 1991). The starting point would be seeing lahar as rain derived, which therefore creates the link to water management in general. Lahar may be directly related to eruption, but in the case of Merapi it more related to high precipitation after eruption, which can add up to several years after the actual eruption happens (Lavigne and Thouret, 2003, Lavigne et. al., 2000, Pallister, Schneider, et al., 2013). This kind of lahar is also known as rain lahar (Rodolfo, 1991).

In this regards, lahar hazard is mostly dealt with common water infrastructures (Marso, J. N., 2013), such as retention dams and check dams (Pierson, Wood, et al., 2014a). Indonesia adopts Japanese Sabo dam system since the 1970s (Chanson, 2004). Under this arrangement, water resources managers are amongst the most influential stakeholders in lahar mitigation (Lavigne et. al., 2000). As analysis result for lahar hazard, a hazard map is usually produced (Jakob, Hungr, et al., 2005), it indicates peak flow, sediment concentration, sizes of rocks, depth of flow, movement directions, speed, distribution, frequency, duration, destructive magnitude, distribution, and predictability. This lahar hazard map would be used to analysis further chance in merging lahar management to water resource management.

Lahar as part of water-related disaster is treated as a form of a flood in reality. The engineering approach answer to lahar risks mitigation is employing sediment check dams or retention dams, which in Japanese is termed as Sabo Dam. This term is used for this case study. This condition presented lahar to be tackled as normal floodwater in river channels, which is not enough, as the magnitude of the water discharge with the debris easily could destruct these dams (Pierson, Wood, et al., 2014b). As one of the focuses on water resources management is to mitigate water-related hazards, it would be more economical and less costly to focus on preparedness, than relying on emergency responses. New implementation in disaster risk reduction framework represents an opportunity to larger stakeholders. Water-related hazard risks need to be addressed in operational plans, such as the water resources management plan (Ndirangu, Kabubi, et al., 2009, Renaud, Sudmeier-Rieux, et al., 2013).

2.2 Conceptual Interrelation of Lahar in Integrated Water Resources Management

As lahar in this study refers to rain lahar, the relationship of the lahar is part of water-related disaster as the base of IWRM (integrated water resources management) to include lahar as part of its problem (Pierson and Scott, 1985). The IWRM, in general, would point out the flood, drought, and landslide as the water-related disaster, yet there is not much mentioned in the literature on managing lahar as part of IWRM. Rain lahars are the most common features of lahar in the world, as 46 percent or about 400 active volcanoes are located in te tropical region, however, they are poorly documented as most are occurred in developing countries where not many trained scientist can be found (Rodolfo, 1991). Lahar is specifically formed in volcanic river basin as part of indirect eruption cycle activities, and therefore should be addressed as part of one of the main challenges in managing water resources in the volcanic area.

The IWRM approach implemented in this case study is using its four dimensions (Savenije and Zaag, 2008): (1) natural: types of water resources (Graefe, 2011, Savenije and Zaag, 2008, Gleick, 2003), (2) spatial: characteristics of up, mid, downstream river basin and their interrelations (Molle, 2009, Hofwegen and Jaspers, 1999, F. G. Jaspers, 2003), (3) temporal: water and seasonal cycle (F. G. W. Jaspers, 2014, Savenije and Zaag, 2008), and (4) human: actors in water governance multi-levels interrelationship (F. G. Jaspers, 2003, Medema, McIntosh, et al., 2008, Edelenbos and Teisman, 2013). Additionally, within a volcanic river basin, the lahar (volcanic debris flow) as part of water-related hazards is also addressed. In the context of the lahar management, it is placed under the IWRM implementation in this volcanic river basin (VRB). Therefore, the lahar management dimensions follow the same structure: (1) natural: volcanic activities leading to lahar production, geomorphological characters leading to lahar flow and lahar's characteristics (Pierson, Wood, et al., 2014b, Bignami, Bosi, et al., , 2013), (2) spatial: map of distribution and direction in recorded history and future prediction (Bignami, Bosi, et al., , 2013), (3) temporal: volcanic cycles, hydro-meteorological cycles (Lavigne, Thouret, et al., 2000, Case, Ardiansyah, et al., 2007), and (4) human dimensions: components of relationship and stakeholders in lahar management (Edelenbos, Bressers, et al., 2013). Based on these dimensions, the patterns of management for the volcanic river basin are characterized.

Water in volcanic river basin has a major role in the eruption process, but volcanoes are also water storage (Delcamp, Roberti, et al., 2016). This interrelation is the departure point of addressing the study with the Nexus approach. As the dimensions are interrelated directly, they suggest the existence of Nexus (Kurian and Ardakanian, 2015, Schreier, Kurian, et al., 2014, Herath, 2014) between the water-lahar-volcano management. Therefore, the authors choose to address this interrelations using multi-level governance framework (Edelenbos, Bressers, et al., 2013, Gupta and Pahl-Wostl, 2013, Moss and Newig, 2010, Termeer, Dewulf, et al., 2010) starting with policy setting, managerial context (divided into national, regional, municipal) and interaction attempts, finally the integration level of the lahar management with water. The integration level is divided into coordination, collaboration, and cooperation. Each level is based on the shared 'things' the stakeholders are commonly working on. The coordination is the lowest level, which meant when there is information sharing. While for collaboration in the intermediate level, this is proven by sharing of information and aim. The cooperation is the highest level with sharing of information, aim and aligning budgeting supports. This analytical framework is used to explain the research findings.

2.3 DRR framework for Lahar

By including the lahar management into IWRM, the DRR framework for lahar hazards should be incorporated. The concept of disaster risk reduction (DRR) aims in reducing statically expected loss from a particular type of risk, by mean of reducing likelihood of hazards, reducing the expected loss, or both, with prerequisites of clear understanding on cultural and organizational character in society and active involvement of NGO and local communities (Ingleton, 1999 in(Wisner, Blaikie, et al., 2004)). The risks mitigation of water-related disaster is one amongst challenges of water resources management. The DRR framework is divided in the stages of disaster: pre, onset, and post-disaster. These stages are used with the lahar management dimensions, which are explained in the next concept. Due to the nature of rain lahar, this hazard has similar characteristics of a flash flood, i.e. the tendency of high volume in short period, flowing from up to downstream, and high magnitudes of force, which may destruct anything on its path. Reducing risks of natural disasters should give more attention to social than physical approaches, it should be more pro-active than reactive, it must focus more on the reduction of vulnerability, as part of on-going policies and programs (Weichselgartner, 2001).

3. Methods

The case study as a research strategy is used for the volcanic river basin of Opak Sub-Basin in the slope of Mt. Merapi. The multi-level governance framework is used to divide, the case study into national, regional, and municipal levels. In the municipal level, the representation is done by selecting three villages with worse lahar impact post-2010 eruption for up, mid and downstream locations, based on damage report provided by the disaster management agency (BPBD DIY) and the river basin organization (BBWS SO). These three villages are Argomulyo (upstream), Gowongan (midstream), and Kebonagung (downstream). Meanwhile, the organizations selected were based on the criteria of directly link to the volcanic river basin management, by means of resources and authority. This paper uses a qualitative approach, with ethnographic intentions, based on 57 open-ended and in-depth interviews, with two months of fieldwork in 2016 and one month in 2018. Additionally, the secondary data (maps, minutes of meetings, planning documents, regulations, etc.) is used to support the interviews. These secondary data were referred by the respondents or by other document or regulations. The respondents' samples were chosen based on the position in the organizations or community and their length of minimum five years tenure using the snowballing method of referral from main respondents.

The analysis process uses axial coding based on the conceptual frameworks, especially the dimensions of lahar and water management combined with the multi-level governance framework. With the help of Atlas.ti and constant comparative analysis on the research materials: 57 interviews, three sub-cases observations, the implementation of lahar management in the case study of a current volcanic river basin Indonesian condition were investigated. The interviews were audio recorded, transcribed, and to be coded in the Atlas.ti software. The observations of the villages were photographs and video recorded, some notes were also taken during the fieldworks. The analytical framework is later on used to present the research findings.

4. Results

4.1 Planning Policy Settings for Water and Lahar Management in a Volcanic River Basin

The Indonesian policy sets the boundary of a river basin based on geomorphological characteristics, in which rivers drain in its catchment toward the sea. However, to define the boundary for this case study, a volcanic river basin is characterized by a volcano at its upstream. Thus, the volcano policy setting should be explained as its hold a specific natural character to the river basin. In this section, the policy settings for lahar management are not directly stated in a law, but dispersed in several related policies on the volcano management, the disaster risks reductions (DRR), the hazard zone spatial planning, and the river basin management, especially on water-related hazard control.

On the volcano management, the Indonesian policy setting belongs to the Ministry of Energy and Mineral Resources (Kemen-ESDM) and to be exact under the Geological Agency at the Centre for Volcanology and Geological Disaster Mitigation (PVMBG). Moreover, being the most active volcano in Indonesia, the Merapi has a special office: BBPTKG (Centre for Investigation and Development of Geological Disaster Technology for Merapi or Volcano Centre for short). The Merapi is a Strato-volcano (a cone-shaped mountain), with effusive-lava flow and eruptive-sudden burst type of activities. The policy sets to manage a volcano include the monitoring and prediction of the volcanic activity status. It is legalized as Minister's ESDM no. 15/2011 on Guidelines of Disaster Mitigation for Volcano, Land Movement, Earthquake, and Tsunami. It stemmed from the Law no. 24/2007 on Disaster Management. Based on these policies, the main duty of volcano management is monitoring the volcanic activities, which falls under the PVMBG. The above mentioned minister's regulation states the 127 active volcanoes in Indonesia are divided into 3 types: (A) those which still erupted after the year 1600, (B) those which does no longer have any magmatic activity after the year 1600, but still has some mild activities such as solfatara crater, (C) those with remnants of mild volcanic activities, such as solfatara field. Merapi is categorized as type A, along with 75 other volcanoes are actively affecting the river basin they located on.

Meanwhile, the Law no.24/2007 explained the framework of disasters risks reduction (DRR) as both human and natural caused. It calls for the implementation of disaster management:

> "... A series of efforts covering the establishment of development policies at risk of disasters, disaster prevention activities, emergency response, and rehabilitation."

Based on this law, the BNPB (National Disaster Management Agency) was established. The agency is an organization at a ministerial level that steers and implements the disaster management policy. It aims to "formulate and determine disaster management policies and the handling of refugees by acting quickly, appropriately, effectively and efficiently; and also to coordinate the implementation of disaster management activities in a planned, integrated, and comprehensive way." The management of the DRR in Indonesia is based on the establishment of a new agency: BNPB (National Disaster Management Agency) in 2007. Since it was established, the command line during disaster became clear and more systematically organized. Its function will be explained more in the national level managerial contexts. The following diagram presents the main disaster management cycle translated from a report by BNPB 2011 and adapted for this research.

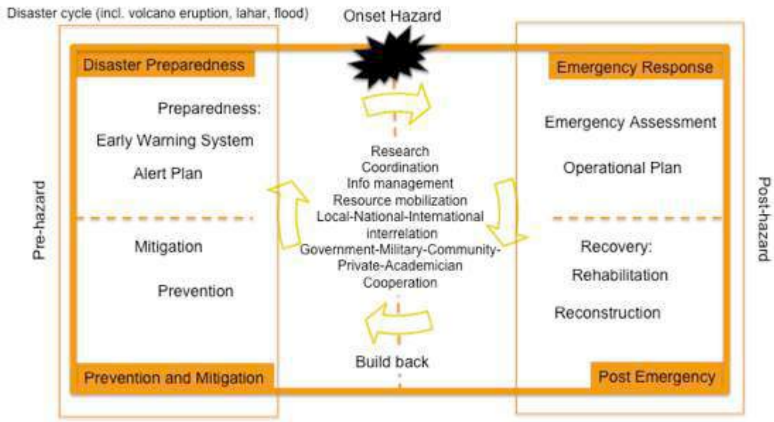

Figure 1 Model of disaster management with author's adaptation (BNPB, 2011)

Another relevant law on the water-related hazards in a river basin planning would be Law no.7/2004 on water resources management. This law is the Indonesian version of the integrated water resources management (IWRM), which appoints the ministers and departments related to water management to control water hazards, under this responsibility the disasters referred to are:

> "… Floods, lahar floods, landslides, ground surface sink, drought, change of characters chemical, biology, physical of water, threats of endangered species and animal, the epidemic of a disease; intrusion; and seepage."

Although not explicitly pointing the Ministry of Public Works and Housing as the ministry to be in charge with this, it is common with the kind of formal language used in Indonesian law, as changes of names and merging or splitting of ministries are likely to happen throughout changes of the Presidency. Thus, the law refers to the mandate to "the minister who is in charge of water resources," and to be more exact it also explains:

> "… Ministers or heads of non-regional government agencies, which are those whose field of duty relates to the field of water resources, including the functions of forest management, groundwater, agriculture, fisheries, water transportation, spatial planning, meteorology, environment and weather modification technologies."

The overlapping of policy in lahar and water management is happening taking place in the disaster management. Although, each stakeholder has a role in lahar management, the Law for DRR does not directly refer to the Ministry of Public Works and Housing. Instead, it puts 'all related ministries,' but the Law for Water Management does this referring. This ministry is responsible for coordinating with the BNPB and BPBD to decide the status of disaster. This broad undertaking by one ministry is hoped to be addressing is already signaling the expectations of collaboration between ministries and agencies. The rationale here is: this ministry builds most of infrastructures on water resources; hence the way to mitigate disasters using the technical approach should also be handled through the same ministry.

The policies and concepts are inadequate in addressing these interrelations, but interestingly on the managerial level, the implementation of these policies are working organically based on experiences towards solutions, as presented in the following section. Based on these stages, the managerial contexts in each level of governance as follow are explained with pre, onset, and post-hazards.

4.2 Planning in Managerial Contexts

National

For pre-eruption, the volcanology department at the Ministry of Energy and Mineral Resources (KemenESDM) has the leading role. Its role is also extended during onset and post-eruption as volcanic. This ministry has the responsibility to monitor the geological activities, which is implemented in the form of Geology Agency (Badan Geologi). This Agency performs the following functions: conducting research, investigation, and service in the fields of geological resources, volcanology and mitigation of geological, groundwater, and environmental geological disasters, as well as geological surveys. The Center for Volcanology and Geological Disaster Mitigation has the task of conducting research, investigation, engineering, and service in the field of volcanology and geological disaster mitigation. The central office of this agency has many branch offices: the PVMBG directly monitor all the volcanoes in Indonesia.

During onset hazards, as presented in the policy setting, the BNPB is the main actor. Although not specifically relate to lahar, this actor is also the commander in times of other disastrous conditions. Using the law on disaster management, the implementation of this law is the establishment of BNPB and the formulation of Renas-PB (National Plan on Disaster Management). Under this law, the implementation can be seen during the 2010 eruption, where the BNPB took over the command line collaborating with BPBD DIY established orders in the emergency condition. In the occurrence of a disaster, the Bappenas is also a part of the coordinated stakeholders by the BNPB, while in normal condition is vice versa. The type of roles for each the disaster may differ. Using this overarching framework, the BNPB operations' are limitless as long as the main idea is to maintain safety and order during disaster events. In the event of 2010 Mt. Merapi eruption, the BNPB and the ministries were involved as the eruption hazards areas consists of the whole Java Island. On the week of the eruption, all the flights went and came accross Yogyakarta sky was canceled, as the ash was flown to east and west of the Java Islnd, limiting visibility. The hazards area also covered two provinces, thus, inter-provinces authority belongs to the national government. Another ministry, which relates to technical assistance on water-related disaster management, would be the KemenPUPR or the Ministry of Public Works and Housing. This role has to do with their tasks in mitigation of water hazards (pillar no. 3 of the Indonesian IWRM). However, this ministry has more roles during pre and post-hazards (normal condition), as the water resources management is its domain, where two other pillars: conservation and utilization of water are also managed. Each of the pillars supported by the information system and community development. The management includes the planning, implementation, operation, and maintenance of irrigation, dams, and weirs, rivers and other water resources infrastructures. Consequently, this ministry implements the IWRM approach. In the case of water-related disaster, this is managed through coordination with the BNPB. In the lahar disaster, the KemenESDM will provide their technical assistance to determine the status of volcanic activities, while the KemenPUPR give the status for water level in the rivers. Thus, for lahar, both ministries will give input to the BNPB. The involvement of JICA (Japan International Cooperation Agency) on the DRR of volcanic basin management is grounded on the experience cooperation, between the two countries: Japan and Indonesia especially with the Director General of Water Resources within the Ministry of Public Works and Housing. For the case of Merapi lahar, as already being introduced before, the JICA (Japan Indonesian Cooperation Agency) has been the Indonesian's partner since 1976. Based on the JICA master plan for volcano disaster mitigation plan, there are two types of hazards against rainfall (secondary impact) and volcanic eruption (direct impact). The master plan directs the direct impact to be managed with non-structural measures (evacuation plan, land use plan, early warning system, disaster response training, etc.), while for the secondary hazard; it is possible to have structural (lahar management infrastructures) and non-structural measures. The volcanic disaster mitigation plan by the national government is oriented strongly with the recommendations made by the JICA. Even though, the Ministry of Energy and Mineral Resources have made regulations on volcano management, but the forms are not as rigid as a plan. Therefore, this arrangement shows the flexibility of the Indonesian government in adopting foreign influence; yet at the same time also propose flexibility of different stakeholders to engage and taking roles with during various stages of a disaster.

Regional

The planning for lahar management is dealt with the BPBD DIY (regional level disaster management agency), with the hazards zone map being developed with many other differences. Although not established in one roof (not originated from the national government), the BPBD DIY is the regional partner of the BNPB (national level). The command line goes through the Ministry of Home Affairs, and the highest commander is the Governor or the Sultan. However, the BPBD has its Chief, and it uses the RPB as the document to address all disasters potentials that are belonging to the region, either natural or man-made. The document is valid for 20 years from 2013 to 2017. As the BPBD DIY was newly established in 2011, consequently, there is only one RPB (Disaster Management Plan) for all kinds of disasters in the region. The priority zone of the disaster management of the Yogyakarta Special Region (BPBD DIY, 2013) is based on historical records. It consists of all potential disasters in Yogyakarta, including earthquake, tsunami, flood, landslide, volcano eruption, extreme climate, and drought. But, for this sub-section, the priority for Opak Sub-Basin consists of the volcanic eruption and its relation to lahar flood and water management.

The BPPTKG (Volcano Center) as the KemenESDM branch office has the main task is to prepare plans and programs, and manage the cooperation and information, also implementation. This office monitors the Mt. Merapi disaster mitigation, provision of recommendation on activity level, and technical recommendation of Mt. Merapi eruption mitigation, implementation of research, investigation and development of geological disaster methods, technology and instrumentation, management of geological disaster management laboratory, and the facilities and infrastructures. Using the example of Mt. Merapi, the monitoring uses International standards and observation posts, remote sensing and UAV (unmanned area vehicle).

> “Monitoring, for Merapi the standard is international, it is seismic, deformation, geochemical, visual… Yes, the visuals are represented by observation posts of our volcanoes. Depending on each volcano… In Merapi, there are 5, because it (the eruption direction) moves around and active, but if the direction is the same, one is enough.” Respondent BPPTKG.

Essentially, this monitoring explains that sophisticated and remote sensing technology with international standard is also used by the PVMBG (national level) to monitor other Indonesian volcanoes. However, there is also the need to visit the sites (observation posts), when the device is not working or cannot be remote from the office or when they need to crosscheck measurements directly. The following hazards zone plan is derived based on the types of volcano eruptions impacts: direct and indirect. The map collaborated the works of the volcano center (BPPTKG), the river basin organization (BBWS SO), and the development-planning agency (Bappeda DIY). Based on the status, the Merapi is not only a provincial level threat but also a national concern, where two provinces were involved: DIY (Yogyakarta Special Region) and Jateng (Central Java). Thus, the BNPB (National Disaster Management Agency) has agreed the 2010 Merapi disasters map produced by the BPPTKG to be used as the main reference (figure 2).

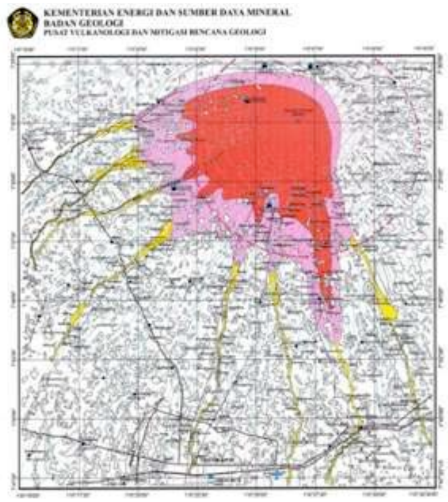

Figure 2 Hazard Map of Mt. Merapi (KemenESDM, 2011)

This map presents the hazard zone of Merapi is divided into three categories post-2010 hazard. The policy for the spatial plan for this disaster location is as follow:

Table 1 Hazard Zone Delineation

Zone	Zone characteristics	Spatial plan policy
KBR3 (most dangerous) ~4 km Red	Very close to the summit of Merapi volcano with threats: pyroclastic flow, lava, rock avalanches, incandescent stones hurls, and heavy ash rains (directly impacted). Recommended not to be used as a non-fixed residential area, When volcanic activities escalated, prioritized to evacuation.	Direct volcanic activities impacts, recommended to be used as conservation area or limited cultivation. Non-direct volcanic activities impacts recommended as zero growth zones. The facilities and infrastructures are used only for the existing residential and limited cultivation, research and community's safety Directly impacted zones are assigned by the local Regents up to hamlet scales
KRB2 (dangerous) ~4-15km Pink	Areas with pyroclastic flow, lava, lahar threats. The community has to take care of evacuees from KRB 3 when escalated volcanic activities. Based on 2010 eruption the hurls of incandescent stones reach up to 10 km of the Merapi summit	Recommended as limited cultivation zone, in accordance to related regency's RTRW
KRB1 (less dangerous) >15km Yellow	Areas with potential lahar flood, lava, and pyroclastic flow. During high precipitation, lahar flood will inundate settlements, agricultural land, and infrastructure. During lahar flood in big scale, the community has to be evacuated. Safety strategy by to move away from the catchment (wrongly used terminology, supposedly river channel).	River boundaries should be made in segments, not generalized for the whole river channel. The segment is based on the river morphology and with regards to lahar impacts. The budget for relocation to directly impacted areas (non-urban), includes compensation for land by National Government. Urban area policy needs further studies

The BPPTKG explains that in a way share the role in calculating the lahar potential at post-disaster is better, as it was done in the 90's. There were instances in the past that both (BPPTKG and BBWS SO) were working together in the calculation lahar potential.

> "Our sharing was good, actually. Yes, in the 90's, about four times. It happened with the collaboration with the ProMer (Merapi Project under BBWS SO) to calculate the lahar (volume potential)… We worked together then … that time we are 'one word' (consensus)." Respondent BPPTKG.

In terms of lahar though, the authority falls under the BBWS SO (RBO-river basin organization of Serayu Opak), especially lahar in the river channels, which have been studied thoroughly by the JICA as mentioned in the national level. Thus, the results of their studies proposed the Sabo Dam System, with a series of consolidation dams and sub-dams in all rivers originated at Mt. Merapi. The concept of Sabo Dams is adapted in the Indonesian context adding multi-functions (temporary bridge, irrigation intake, etc.) and uses the sand mining activities as sediment management. These Sabo dams were prepared based on a calculation for 100 years return period of lahar (DGWR, JICA, 2001), however, as proven in 2010, the calculation may have not properly predicted the amount can reach up to 140 million m3. There are two types of Sabo dams implemented at Mt. Merapi: closed and open. The closed type is used to completely stop the lahar sediment flow, at which the dead storage condition can happen. Meanwhile, the open type has the conduit/slit pass, which still let pass smaller rocks and sand up to 50% of discharge. It is clear in this figure that the lahar is controlled using Sabo dam system as a whole throughout the river systems, which located in the Mt. Merapi. Thus, the volcanic river basin characteristic management, in this case is quite developed and anthropogenic controlled. The infrastructures damaged the natural condition of the rivers to secure the settlement and agricultural area. It is also clear that the upstream will suffer for the benefit of residents who live in the mid and downstream. This information may not be disseminated, as it is considered as a sensitive matter to the upstream village communities, but they do deserve to know this risk. By presenting this figure 6, the perception of lahar management is based mostly on a technical solution, while in reality; the most important thing is the readiness of communities to evacuate on time.

This means that lahar management, although has high priority comes second to daily needs of water and transportation. These other functions can be established, as there are similarities of dam function for water and lahar, which is a cross-river body infrastructure.

> "Of course…. Converted into multifunctional, the main function is the sediment control, but second (function) is an intake for irrigation, because it has the same principal form, only with a gate (irrigation gate)… We do have a vision of a direct impact on the community. If it's that (the bridge- described with hand movements), it has a direct impact, the public could directly benefit from it." Respondent BBWS SO

Thus, with the multi-function, it favors permission from the villagers, as many protests were drawn after the 2010 eruption when the BBWS SO proposed to rebuild the Sabo dams. However, after discussions with the community, all of them want the Sabo dams to be rebuilt. The way the Sabo dam system in Mt. Merapi works in managing lahar is philosophically using filtering strategy from bigger boulders using open type and the sand pocket for upstream Sabo; closed type with holes between up to mid-stream with the help of diversion channel; embankments for mid-stream. The whole river basin territory (WS) is supposedly managed based on the land use plan made by the Bappeda DIY (Regional Development Agency) as the highest in the hierarchy. But, during hazards, the BPPBD DIY took main commander of all scale of management. In summary other stakeholders are explained in figure 3: (1) BBWS SO (RBO): all the rivers, lahar and flood, including floodplains and the infrastructures to manage them. (2) BNTGM (Merapi National Park Manager): under the Ministry of Forestry and Environment or KemenLHK –with 4 km radius from the summit. (3) BPPTKG (Volcano Centre): the Mount Merapi's volcanic activities monitoring – scales of management: the whole mountain up to its flank and the rivers where the volcano channels its debris flow. (4) PU-P ESDM DIY (Regional Agency on Public Works, Housing, Energy, Mineral, and Resources): all infrastructures belonging to the provincial government and management. (5) BPDAS SOP (Catchment Management of Serayu Opak Progo): also under the KemenLHK, for all catchment managements especially for water retention inland

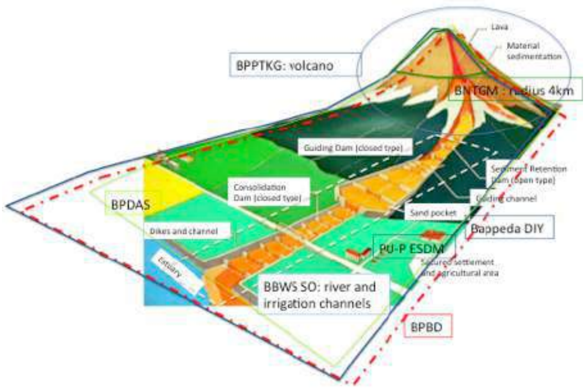

Figure 3 Arrangements of a Volcanic River Basin in Mt. Merapi

Municipal

For the onset lahar occurrences, the municipal BPBD is to evacuate as many people as possible from the riverside. The BPBD at Sleman Regency is more actively engaged as lahar potential in the upstream is still an eminent hazard potential. Most of the time during rain lahar, the victims were sand mining trucks and their teams. The EWS (early warning system) alarm sometimes is not being regarded, as it made too much sound, but, when visual on the lahar is seen, it is usually already too late to evacuate from the river. The Tagana is the disaster response personnel at the village level. Its role is to maintain safety in the village in the case of hazards occurrence. For this study, the hazards are related to lahar flood.

> "At Adem stream (upstream Opak), there was already there. Here, (in Argomulyo) we have the SKSB, luckily. If there were victims, those were breaking the rules. As (the incident with) the truck was carried by the lahar, that is because they did not obey us (*Tagana*)." (Respondent Argomulyo).

During onset hazard of lahar, the river channels are filled with the volcanic materials. Depending on the locations, the severities of impacts are based on the distance from the volcano, the closest the distance the biggest the impact will be. The BPBD at the municipal level works together with local communities regarding monitoring the lahar. In Opak Sub-Basin, the municipal includes Sleman Regency, Yogyakarta City, and Bantul Regency. Although each municipal has their disaster management agency, they relied heavily on the aids from the national (also international aids through national government) and regional level. Especially for locations on the riverside, the BBWS SO aid for heavy equipment is needed all around. During onset lahar, there are no activities relating to water resources management conservation and utilizations.

As for the post-hazards condition, the direct impact of lahar would be the submerging of riverside locations and the sedimentation. In the upstream, the lahar may fill up the river channel and submerged existing spring, except for one by the Sabo GE-D, upstream of the village. As the lahar sedimentation was dredged, the underground water channels were cut off, and the post-eruption hot spring water stops producing. Even if lahar cannot exist without water, but water can also be interrupted by the lahar. This condition is especially related to the quantity of water diminishing and hot temperature; also the water quality changed with the volume of volcanic materials submerging the wells, such as Fe and Sulfur. The lahar sedimentation impacted the water springs by the, some were buried, some moved, some newly emerged. The case of 2010 eruption changed the conditions of springs by the upstream village. However, the river base flow is still utilized as an alternative water source. Concerning water utilization, the lahar infrastructures (Sabo Dam) in the upstream village can also be used as an irrigation weir. However, for the upstream sub-case, the Sabo Dam is only used to control lahar flow and a temporary bridge. In the mid-stream, the lahar in 2010 devastated the homes of the communities who live on the riverside. The lahar filled up the houses up to 1 meter deep. As the Code River has been built with a fixed embankment, people felt safe to live by the riverside. But, during that occurrence, all was affected, and the lahar is tackled momentarily, using temporary dikes (gabion-mesh), which seems to last longer than temporary as of during the fieldwork in 2016, this still existed. The lahar submerged most of the Riverside water wells and low elevation settlements, resulting in the whole elevation of the kampong, being uplifted to 1meter. Consequently, the wells needed to be dredged from the lahar sediment before being re-utilized. In the downstream, lahar impacts were not as severe as the first two locations. The locals were more concerned about the sedimentation of the Opak River, especially near the Tegal Weir, as the villagers used to use the river for water tourism attraction. The lahar flows to the fork of Opak from Mt. Merapi and Oyo from Karst Gunungsewu. Most of the sediment from 2010 is still fully intact as no significant dredging activities were done in this part, as it never received any aid for dredging from BBWS SO or anyone.

On water conservation, the lahar management has a relation as the river channels filed with volcanic materials. In the upstream village, the conservation is highlighted as the main activities especially because most of the area is located in the hazard zone and being resettled elsewhere in safer locations. These areas are conserved as both hazard zone and water permeation area. In the midstream, the conservation is not taken into consideration as the land is mostly used for settlements. The lahar control is more dominant than conservation, for this sub-case, it is presented by means of dikes and dredging the river channel. Meanwhile, the downstream village was not so aware of the need for water conservation. This village never had any problem of irrigation supply shortage due to the existence of the weirs and irrigation canals in the Opak River.

Another side effect of the lahar post-hazard is the existence of the sand mining industry. Unfortunately, the municipal government paid more attention towards the income generated by this industry, than the sustainability of the river regimes. More permits than necessary were given to gain access to the lahar materials. The river channels were dug up, deeper than the original condition pre-2010 eruption. Initially, in 2010, the municipal governments are responsible for declaring permits for the sand mining or the C type mining, but during the fieldwork of 2016, this has changed to the regional government. The sand mining industry in downstream is also not as burgeoning as in the upstream, this is due the quality of the sediment is not as good as those in the upstream area for construction material. The sand mining activities in the upstream village is still very much active, with hundreds of trucks going back and forth daily to the channels to collect sand and other aggregates of the volcanic materials (observed both in 2016 and 2018). The upstream sand mining uses machinery, such as the backhoe, pump and stone splitters. This sand mining is not the case for mid-stream and downstream. The mid-stream respondents explained that the sand was used to elevate the riverside area up to 1meter above its original elevation or to build their own homes. However, traditional sand mining activities downstream were reported and observed nearby the Tegal Weir. This activity is using simple tools such as bamboo boat and human diver with a bamboo knitted container, which can drain the sand as soon as it gets to the surface. Additionally, the lahar sedimentation in the river channels, which was not being part of the sand mining industry were used as temporary farmlands during the dry season.

The training for preparation of pre-eruption is dealt, by addressing the readiness and tasks planning are proposed by training of the CBO with the local BPBD. The training was more often took place in upper stream areas, than the midstream and downstream. The training is more intense in the upper stream due to the impact of the hazard are greater there compared to other locations. More focus on Sabo Dam training is also given to the villagers by the RBO in collaboration with the community-based organizations (CBO). The CBO in the upstream area is based on their awareness towards safety during hazards. In relation to the training, evacuation routes and meeting points are also prepared for each location.Especially for lahar, the hazard zone is mapped based on historical review of earlier lahar. However, lahar safe zones are not yet implemented A system of sister village is also established for the upper stream villages.

> “It exists, fortunately, we have for some time now, a sister village program from the BPBD. The sisterhood exists between villages. Like here in Argomulyo, from upstream we have Glagaharjo….There is already an agreement. The MoU has already been signed.“ (Respondent FGD Argomulyo).

Meanwhile, for the upstream village, the initiative relates more to the disaster information with the Forum SKSB (Shared Social Communications Channels). Although training for Sabo Dam monitoring does exist, the setbacks of rivers in the upstream area are unknown for certain. Hence, people living in this area do not know for sure what is the safe distance from the river. Another attention is given to the awareness of residents in the mid-stream area, as post-hazards, by delineating the riverside setback to 3 meters from the current dike. Although this is not safe zone from inundation of lahar, it can give some buffer time to evacuate the riverside residents. The residents have also developed an informal gathering of the lower level of government under the village administrative into the *paguyuban RW* to address riverside Kampong's issues, especially with respect to the river and flooding. The kampong in this sub-case study is characterized by its location by the riverside. Normally, a village consists of several hamlets, where each is consisting of several RW (community), and under this, there is also RT. However, the RW does not usually form a gathering. This mid-stream village presented an example of self-governance by means of formulating the *paguyuban.* The downstream village is more active in tourism, especially agro-tourism, by forming community-based organizations of the secretariat of tourism village initiative and the agricultural museum. The setback in this area is decided on the embankments along the river, with buffer zones of farmlands up to 100 meters. Based on historical experience, this distance is safe for flood and lahar zones.

The planning for future volcanic river basin should consider these conditions, which presented more vividly in the village level. Even if the volcanic activity considered by the villagers in the downstream area as a danger and sad occurrence for the victims upstream, but for the downstream area this had advantages. The volcanic ashes are considered as a natural fertilizer, and so is the lahar sedimentation, made up fertile land for the non-irrigated crop.

4.3 Interaction Attempts and Integration Levels in Lahar Management

Interaction Attempts

For these attempts during onset lahar, it is termed as the disaster interaction attempt, called as Disaster Task Force. In this task force, the members are ministerial level. At the national level, this coordination attempt for lahar risk management is dealt at BNPB, the national disaster management agency. This lahar management is done through mapping of lahar and the KRB (hazard zone) delineation in collaboration with other ministries and also to the regional level. For the case of Merapi 2010, the eruption was of a national scale priority as its ash also impacted the whole Java Island's flight routes. Even as the KRB's are inter-regional or inter-provincial delineation, the attempts are collaborative works across vertical and horizontal levels. The core of disaster management coordination lies heavily on the BNPB. However, the collaboration works is no longer integrated at post-reconstruction phase. As the coordination is not as frequent, the command line of interaction attempts is through the Development and Planning Agency (Bappenas). This attempt is termed as general development interaction attempt and active during pre and post-hazard. This attempt through the Bappenas proposes the annual budget as preparation for disaster finance. This mechanism of budget preparation is commonly known as the disaster funds. In each of the level, the funds exist, but the higher level of government can support lower levels, through transfer mechanism. The Musrenbang and the Rakorbang are the forms of this attempt, which existed in all level of governance. The first consists of supposedly two ways discussion between government and the people, while the second consists of only governmental agencies. The interaction attempt is coordinating provinces within the national government and also the different ministries. However, this attempt is shared with other development programs, not just water and disaster. It is also about other issues in development, meaning that the time to focus on one subject is very limited, even though the interaction attempts are done several times a year. Meanwhile, for the water interaction attempt, this is through the meetings of the Water Council (DSDAN). The council meets at least three times a year focusing on different aspects of water management. The members consist of 50% government and 50% of non-government representatives. The attempt is not relating directly with the water development fund, but hosted by the General Directorate of Water Resources in KemenPUPR. This attempt handles general water management, which is active during pre and post-hazards. It is not active during lahar onset or other water-related hazards, which became the domain of the BNPB.

At the regional level, the BPBD DIY (the Provincial Disaster Management Agency) acts as the leading actor for the commander during the onset disaster response implementation. The lahar is intersecting two main actors at the regional level: the BBWS SO and the BPPTKG. Both have the sound technical expertise needed to decide the lahar status and when to evacuate. During an eruption, both works along under the BPBD DIY, coordinating and collaborating data towards cooperation in deciding the status. The coordination meetings during an eruption are held and led by the BPBD DIY, which aiming all sectors cooperation. However, during normal condition, this coordination line is missing. There is a need to create a mechanism in which the BBWS SO and the BPPTKG can coordinate, even collaborate in providing their expertise and prepare the technical recommendations, even during normal condition. Again, as happened at the national level, the regional also experiencing the same thing. The fragmentation occurs of the disaster management in the precondition. This fragmentation is again based on the inexistence of responsible actors to manage the lahar. The coordination works better through direct communication during eruption and rain lahar occurrence right after the eruption, which heightens the integration level. The Musrenbang and Rakorbang exist at the regional level connecting the municipal levels within the provincial governments. The same mechanism is copied from the national level, also for the disaster funds. The leading stakeholder is the Bappeda DIY. A similar approach also occurred in water development funds for the regional level. However, due to current division of roles, the rivers are no longer become the responsibility of the regional level, but national level through the river basin organization. During rain lahar occurrence at pre and post-hazards Mt. Merapi's condition, this is the task of BBWS SO at the PPK PLG Merapi, a branch office of the RBO, which manages the lahar hazards control. Although, coordination is also done with BPBD's at municipal and regional level through the disaster task force headed by the BPBD. The main tasks of the PPK PLG Merapi are to operate the Sabo dam system, for that to function, the infrastructures are needed to be built and maintained. As discussed earlier, due to the limitation of personnel, the PPK PLG Merapi cannot monitor the 259 Sabo dams on the whole Merapi slope. For this task, the JICA suggested community level monitoring approach. Direct coordination between the local communities to PPK PLG Merapi can be done informally through calls, walkie-talkie report, or chat apps. However, also due to the limitation of local community members who have communication access to this office, especially for Sabo dams in a remote area (secluded upper stream), not all areas are covered. Still, this points out that along the rivers, the management belongs to BBWS SO, through the PPK PLG Merapi for those related to Sabo and the main office for the whole river regime. In this sense, the coordination is crossing levels of regional-municipal coordination.

In the regional level, the water interaction attempt also exists in pre and post-hazards, especially for the conservation and utilization through the meetings of water councils of TKPSDA, DSDAP and Forum DAS. These are hosted by different government agencies. The TKPSDA WS POS, based on the river basin territory and is hosted by the BBWS SO (RBO under the KemenPUPR). The DSDAP DIY is by the PU-P ESDM DIY (regional public works agency), based on the administrative boundary of the regional government. The Forum DAS by the BPDAS SOP (catchment management by the KemenLHK) is based on the catchments boundary. Specifically, on irrigation, the irrigation commission or the Komir deal this. The members of such councils are copying the structure of the national level in DSDAN. The members are representative of government: national (the branch of ministries), regional and municipal, combined with the private and communities (ration of 50%: 50%). Out of these attempts, only the TKPSDA discussed the lahar occurrence in their 2011 meeting, but no apparent results of the recommendations were taken into direct actions. However, as the RBO is the host of this council and rivers are one of the main responsibilities of it, it does make sense to discuss this in this council rather in the others.

At the municipal level, this attempt is also made through municipal level BPBD's. Although at this level, there is no coordination line with BBWS SO and BPPTKG, they work directly with SAR (search and rescue team) and community organizations (for example the Tagana or the Forum SKSB). More active works are done for lahar management in the upstream and mid-stream area, as the hazard level is still considered high. For the downstream area, the Tagana does not work with lahar, but more with the flood as the lahar has slowed down in this area and sedimentation is formed, which filled the river's channel. Crossing boundaries attempts (international-municipal, without national-regional intervention) can also happen, as international humanitarian activities have the flexibility to go directly to the impacted area during the lahar. At this level, local communities are more active in seeking ways to reach out for aids at any level of the management. The water interaction attempt takes form only in the Komir, as the water council became inexistent. Similar general development interaction attempt with the Musrenbang and Rakorbang exist with the municipal representatives given more participatory approach in this level. The two ways discussions occurred more frequently than in the other two levels.

Integration Level

The integration levels are also differs based on three stages: pre-lahar, onset lahar, and post-lahar. At the national level, the pre-hazard coordination disintegrated due to the inexistence of lahar management focused regulations, and the directive position of the BNPB is no longer at the focal point. Thus, making the approach in disaster management as reactive and not pro-active. Based on this, the national integration level is ranged as partial coordination only. At the regional level, the tasks of the BPBD is to study the possible hazards and coordinating EWS during the time the fieldwork was done, coordination between these different agencies for EWS has not been established, but meetings to discuss this possibility is ongoing. The case in 2016 fieldworks shows that the almost normal condition of the Merapi river basins proposes no strong connection between each actor who has the EWS. The attempts in coordinating are still at the beginning, yet, there seems to be just still at the level of discussion and no concrete actions have taken place. So at this stage, the integration level is still non-existent.

During onset lahar, the integration level for national, regional and municipal are high towards cooperation. This is due to the urgency of saving as many lives as possible and the volunteerism values towards one another. Many actors are more aware of the importance of integration and work collaboratively and cooperatively aiming the same target. Based on the experience of 2010 eruption, the line of communication is busied with the BNPB organizes the expertise of each institution, government, private, or community organization and either from international, regional and municipal levels. Surprisingly, the integration level at the regional under the BPBD is cohesively merged; this is not due to the law of integration, but more to the characteristics of the people in this case study in Yogyakarta. The *gotong royong* (collective action) spirit is almost gone, but due to the 2006 earthquake, this regains the momentum. Cultural values and local wisdom in this case are embodied into *gotong royong*, which include volunteerism, reciprocity, helping one another, collective action, and cooperation. In this regard, the *gotong royong* is seen as a latent composition, which is activated most commonly during difficult times. However, this may not be the case in other parts of Indonesia. At post-lahar condition, long after there is no lahar is flowing in the river, the lahar management is transformed into resources management. In this case it became the sand mining activities and the use of lahar sediment in the river channel into agricultural lands. The sand mining permission process is done previously (up to 2014) through the municipal agency of water and natural resources (DSDAEM) Sleman, but after the Law no.23/2014 on Local Government, the task for giving permit is at the regional level by the PUP-ESDM DIY.

The integration at the municipal level for lahar is not yet established, especially as the transferred responsibility like this requires implementation mechanism. During the process between 2014-2015, all of the rivers belong to BBWS SO, where the sand mining locations are located. This sand mining acquires technical recommendation, whether certain location can be mined or not. But, since 2015, the permit is processed is by the Licensing Office (Dinas Perizinan) at the regional level, with the technical recommendation by PUP-ESDM. Again, the integration is striving to coexist with the current fragmented institutional framework. However, the level of integration is also still at the beginning of coordination.

5. Conclusions

A volcanic river basin planning for water resources management should take into consideration the volcano activities, especially the lahar management. The current approach in implementing the IWRM in a volcanic basin proposed alternatives of combinations using spatial and temporal plan. There is a shift within the IWRM dimension priority for lahar management, which also impacted on the shift of command role. For example, during the pre and post-eruption, the RBO has the command for the river, but during eruption and lahar flow the disaster management agency became the commander for all aspect. The findings proved that in the current condition there is little proof whether integration exists between water and lahar management. There are 'boxed' managements according to the statuses of volcano eruption. These boxes created segregation, but integration could still be detected in the interaction attempts. First, the LRM is termed as lahar risk and resources management. Within this context, the risks management oversees the whole status of pre, onset, and post, while the lahar resources management belongs in the post-eruption only. This status has to do with the activities of extracting the lahar sediment or the sand mining activities, which is also part of the later status. Second, there are overlapping interrelations, which for this paper is termed as VRBM (volcanic river basin management) styles, where the LRM condition and the pillars of IWRM are put in the order of the second. This is in line with the findings that the Disaster style includes not just eruption, but also other onset disaster related to water is focusing on the hazards control, where the focus is disaster relief. Meanwhile, the conservation and utilization pillars at the moment would be stopped due to circumstances.

The Normal style is where the water utilization and water conservation are fully implemented and lahar risk management is at the preparatory stage. During this style, utilization of water is in full optimized condition, while the water conservation, includes both on land and water. The water discharge in the rivers and springs is at average capacity, not being interrupted by the volcanic activities. The lahar sediment would already be removed and no more sand mining activities are allowed, as the riverbed also required a minimum amount of sediment transfer for ecological function. The RBO and the catchment authority are taking control of the management. During the Disaster VRBM, includes both water-related hazards on normal volcano condition and the water-related hazards during a volcano eruption. The primary hazard (pyroclastic flow, lava, hot flames, and ashes) and the secondary hazard (lahar flow) may take place according to the severity of the eruption. This VRBM style is when the function of the volcano and lahar risks management is activated to reduce risks. But, as the focus of this research is more about the water-related hazards, the primary hazards are not part of the main findings, although still plays a role in the Sabo management. The disaster management agency is taking control with the help of the RBO and the volcano center.

Meanwhile, for the Normal+ is when the eruption stops, but then the lahar flow may still take place, due to the deposit of volcanic materials triggered by the rain. This is where the lahar risks and resources management are overlapping. This style may already include the water utilization from the river, wells, etc. yet the conservation pillar implementation would still wait after the condition is walking to Normal. The additional function of the Normal+ is the extraction of lahar sedimentation in the form of sand mining activities. This Normal+ is the consequence of having Sabo Dam system in the rivers; it needs to be dredged to pre-eruption condition, so the volume of the dam can function. The RBO is taking control for determining the volume of extraction and distance to the Sabo facilities.

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How to combine resilience theory with regional policies? A network based methodology

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1. Introduction- A Brief Look to Resilience Theory

Resilience theory has appeared at the same time as sustainability in the science arena by following the global environmental problems in the 1970s; however, it has begun to take part in the planning science since last 10 years. This transformation can be explained by the despite of continuum of sustainability studies for fifty years in the international ground, efforts could not prevent the arising of inevitable natural, economic and political global crises since the beginning of 21cc. Along with globalization, the nature of crises has also changed. It is seen that the causes and consequences of crises are related to each other and trigger each other, both from global to local and from ecology to the economy. With this new phenomenon there is required a new perspective to understand the causes and interactions of crisis within a complex perception (Pendall, Foster, & Cowell, 2009).

Therefore, the resilience approach will present a new perspective for the analysis of complex problems and systems. Within this scope, targets of sustainability and resilience approach cannot be separated. Moreover, while resilience approach includes the targets of sustainability, additionally it provides a holistic, systematic and relational perception for preventing and taking action to alarming global changes (Schipper & Langston, 2015).

In order to understand these global complex relations in a given system, resilience theory combines different disciplinary of studies, such as ecology, economy, and social knowledge. Besides, historical evolution of resilience theory grounded in different sciences, such as, it initiates in engineering science with *bounce-back* concept by systems approach (Bertalanffy,1951), continues in ecology with *multi-equilibrium point* (Holling, 1973) and at last it league together ecological, economic and social sciences by *beyond the equilibrium state concept* (Gunderson & Holling, 2002). The last phase of resilience theory *"socio-ecological complex adaptive systems"* term has been used to explain the complex relations between human and natural environment. This terminology provides evidence that the resilience approach has strong links with other contemporary disciplines such as system approach and complexity science (Pendall et al., 2009). Together with, the complexity science comprises various methodologies and theories that use for understanding and assessment of complex systems. These theories can be listed as system theory, network theory, nonlinear systems theory and game theory. In addition that, these methodologies have advanced along with the development of computer science technologies and computational models (O'Sullivan, 2009).

On the other hand, there are some ongoing discussions that resilience theory has no clear definition, wide conceptual context and it is hard to assess resilience of a system. However, despite the decades of work, there is a similar situation for sustainability. There are still deficiencies, such as the lack of a negotiated definition of sustainability, the uncertainty of its boundaries and the inability to measure it (William A. Brock, Karl-Göran Maler, & Perrings, 2002).

In order to overcome these theoretical and practical struggles, resilience as a new emerging theory in the planning studies can be an efficient and holistic approach to develop new perspectives in order to achieve the goals of sustainability. Especially in the context of system approach and complexity, it has the potential to develop new methodological tools in examining the cross-scale relations of social, economic and ecological systems. However, it should be noted that it is a new area of research and needs to progress particularly in practice and assessment studies (Levin et al., 2013; B. Walker & Salt, 2006).

Furthermore, the multi-disciplinary aspect of the resilience theory has common similarities with planning science. This similarity can form a strong link between the two disciplines. Thus, resilience approach expected to provide new theoretical and methodological perspectives and contributions to the planning science (Scott, 2013).

1.1 Research Aim, Questions and Content

From that point of view, the general aim of the study is to develop a new methodology in order to integrate the resilience theory in the planning science for understanding the complex socio-ecological systems inter-relations, risk factors and develop resilient policy measures. Specifically it has been taken into consideration that this new methodology has the capability of being reproducible, compact and simple in order to assess the resilience of any given system.

Thus, the main question of this study is "*how can resilience theory contribute to regional development policies?"* In addition, sub-questions defined as; "How can the systems approach and network theory be combined to evaluate regional resilience?" , "How can we assess the resilience of a regional system in multi-dimensional, multi-scale and multi-temporal approach?" , "What are the different sub-sytems of a complex SES's?" ,"How can we describe the sub-sytems by networks?", "What are the nodes and edges of the SES's networks? ", And "Can resilience attributes be assessed by network analysis? "

In order to develop a compact resilience assessment methodology, firstly key-concepts of resilience theory clarified with "socio-ecological complex adaptive systems" terminology in the chapter two. Results pointed out that with the relation of complexity science, network theory can be an analytical tool to analyses the resilience of complex systems. Then to understand the contribution of the resilience theory to the planning science, the theoretical and practical resilience assessment examples and recent international spatial development policies examined under chapter three. Results shows that, to assess the resilience of any given system, there is a need to understand the system in two way. One is assessment of specified resilience and the other is generalized resilience. Thus with the findings from literature, two-step analytical methodology developed. In chapter four, a network based resilience assessment methodology in SES's and key concepts of network theory and analysis explained. In chapter five assessment of specified resilience and relational network analysis explained. In chapter six assessment of general resilience and spatial network analysis methodology explained. In chapter seven discussion of future studies and contributions described. Finally in the chapter eight summary of the study is given.

2- Socio- Ecological Complex Adaptive Systems: Multi- Scale, Multi- Dimensional and Multi- Temporal Complex Interrelations

The components of the "socio-ecological complex adaptive systems" (SECAS) give an outline of the basic characteristics of resilience (Figure1). These characteristics highlight the systems multi-dimensional, multi-scale and multi-temporal properties and relationships while evaluating the resilience of a system. These multiple features are examined separately in relation to the

SECAS term, in order to contribute to the resilience assessment methodology to be developed for planning science.

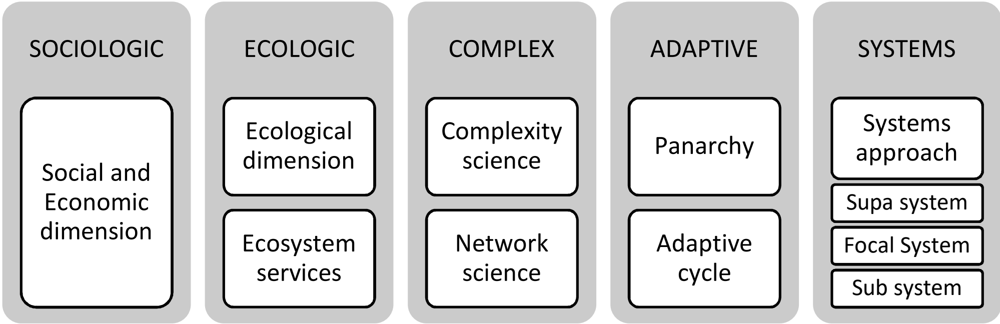

Figure 1: Main components of the "Socio-Ecological Complex Adaptive Systems" Term (SECAS)

The multi-dimensional aspect of resilience is composed by the socio-ecological context. The sociological dimension of this term includes economic, social, cultural, managerial and economic relations ranging from individual scale to social organizations, companies to the entire economic system. Under the ecological dimension, the relationship between ecosystems and ecosystem services are explained (Heide & Heijman, 2009; Rizzi, Graziano, & Dallara, 2017).

The multi-scale content of resilience is based on system theory. It examines the relationship between upper system and subsystems where the focal system scale is engaged. It allows the boundaries of these systems to be determined and considers to cross-scale interactions by a combination of different scales that vary globally, regionally and locally (Folke et al., 2011; Gotts, 2007; Straussfogel & von Schilling, 2009).

Multi-temporal relationships are represented by the adaptive cycle concept, which is take part under the Panarchy term. According to the Panarchy term, the cyle of systems are defined in four phases, exploitation, conservation, release and reorganization (Gunderson & Holling, 2002). This concept, also called system dynamics (ResilienceAlliance, 2010) and can be adapted to social, economic, ecological systems behaviors.

Adaptive Cycle is a metaphor to classify systems, order events, and suggest specific questions and testable hypothesis for understanding transformations in linked systems of people and nature (Gunderson & Holling, 2002). In order to specify connections between planning studies and resilience theory more detailed information will be given about this key metaphor of resilience.

In adaptive cycle, first and second phases are expressed as the front loop, while the third and fourth phases are defined as the back loop and these two loops have opposite characteristics (B. Walker & Salt, 2006). The characteristic of the front loop is slow and can be predicted while the backside is fast, sudden and unpredictable (Table 1).

Loops	Front loop		Back loop	
	System connectedness		System potential	
Phases	1. Phase	2.Phase	3.Phase	4.Phase
	r	K	Ω	α
	Exploitation	Conservation	Release	Reorganization
Properties	Predictable and certain and slow Maximum production and accumulation		Unpredictable, uncertain and fast Maximum invention and reassortment	

*Table 1 Adaptive cycle phases and properties Source**:** Generated From Book, Panarchy; Ch 2 (Gunderson & Holling, 2002)*

Knowing which stage the system is in, gives important information about the system dynamics. For example, on the front side, connectivity and the maximum level of production and accumulation can be defined in the system, on the contrary in the backside while the system in a fragmentation it has a high potential for creativity, innovation and discoveries. This metaphor is also adapted to the planning process. Accordingly, a policy plan is prepared in the first stage, policy decisions are made in the second stage, then failure occurs in the third stage, and then alternative plan decisions are made in the fourth stage.

The complex structure of the system refers to the "Complexity Science" which is used to understand inter-relations of systems components (Holling, 2001) . It also provides information about the methods to be used in the analysis and assessment of socio ecological systems by establishing relationships with current scientific field of studies, such as system theory, network theory, nonlinear system theory, game theory.

Addition to the multiple characteristics of SECAS , *general characteristics of resilient systems* are explained in different theoretical studies of resilience (StockholmResilienceCentre; B. Walker & Salt, 2006) and in the methods for empowering resilience of cities (ARUP, 2015; Eraydın & Taşan-Kök, 2013). Among this variety of sources, the most common and repetitive resilience attributes are diversity, connectivity, modularity, robustness, redundancy and flexibility. Given the fact that these attributes are part of a complexity science terminology, it can be concluded that the general resilience properties can be analyzed by complex system analysis methods.

3- Contributions of Resilience Theory to Spatial Planning

The resilience of human environment aims at preventing the occurrence of unwanted surprises in the face of external disturbances and at the same time targeting the continuity of the quality of services and products, i.e. ecosystem services (B. Walker & Salt, 2006). In order to fulfill this goal it is important to enable the integration of planning concept and resilience theory for future studies.

From this point of view, main influences of the resilience approach to planning science are emphasized as providing new perspectives for both methodological studies and policies, taking in the account the local and global scales at the same time during planning decisions, to provide a holistic view of social, economic, ecological and governmental relationships at multiple scales (Scott, 2013).

However, up to now in the planning science resilience theory generally has been studied separately at different scales and different issues. Resilience assessment studies have shown that economic vulnerabilities (Anthopoulou, Kaberis, & Petrou, 2017; Rizzi et al., 2017), natural disasters (Eraydın & Taşan-Kök, 2013; Skerratt, 2013) and social problems are studied at different scales (Müller, 2011). But these particular studies are not enough to understand the interactions between scales and problems of complex systems. This gap in the literature needs to be filled (Kinzig et al., 2006; B. H. Walker, Anderies, Kinzig, & Ryan, 2006).

In addition, examples of applied resilience researches deliver notable contributions to planning science. One of them is, *Workbook of Assessing Resilience in Socio-Ecological Systems* produced by Resilience Alliance (2010). In this workbook, the iterative cycle of five steps of resilience assessment described in a comprehensive way. First step starts with describing the system with the question of resilience of what and resilience to what and identifying key issues, scales above and below. Second step understands system dynamics, thresholds, transitions, change and multiple-system states. Third step explores cross-scale interactions, general resilience status, cascading changes. Fourth step is defining system governance, adaptive governance and institutions, and analyzing social networks and at the fifth step is acting on the assessment, synthesis of findings and starting the transformation. These steps of resilience practice have a strong link with the planning process and this resembles the opportunities for building strong links between resilience approach and planning intelligence.

Another key intersection between resilience and planning decision making described by Béné, Headey, Haddad, and von Grebmer (2015) is the correlation between the impact of shock and the period and content of responses. It is highlighted there is three capacities that that the system can develop as a response to the disturbances or shocks. These are absorptive, adaptive and transformative capacities. As an example, against a mild intensity shock relates with the system absorptive capacity or stability which it requires short-term humanitarian interventions in a short term. On the other hand, it will be necessary to develop adaptive capacity and flexibility of the system against moderate shocks, which can be achieved with mid-term projects and strategies. In order to be able to cope with a severe impact, systems will need to improve the transformative capacity and this change can be successful with long-term development programs.

In addition to these examples, another contribution that the resilience theory can make to the planning science comes up with the need from the policy objectives. Recent international, regional and spatial planning objectives and priorities in planning science are focused on enabling regional development through spatial cohesion thus empowering rural-urban integration and connectivity (ESPON, 2017; OECD, 2017; UN-HABITAT, 2017). In order to realize these policy objectives, it is important to understand complex spatial relationships and analyze the links of components with network analysis, which is part of the resilience and complexity literature.

Conversely, it has been pointed out that in resilience assessment studies there is lack of strong hypotheses and clear concepts, and necessity of developing holistic approaches, understanding the factors and processes affecting resilience of the system are important (Schipper & Langston, 2015). Additionally for future studies, it is recommended to develop strong definitions of resilience in regional systems and prepare applicable criteria and matrices, exploring resilience with reproducible methods based on quantitative and qualitative data, and identify the roles of social actors (Pendall et al., 2009).

Consequently, there are many new fields of study and development possibilities and synergies arising from the needs and shortcomings of these two sciences. It is important to conduct studies that evaluate these opportunities and provide new approaches by contributing to both disciplines. The literature survey results shows that, the most important outcomes are that the perspective of resilience determines the problems faced by human settlements in multi dimensions, at multi scales and in multi temporal characteristics, and takes into account the complex relationships between them. Thus, it is important to develop policies within this approach in terms of producing effective solutions.

4- A Network Based Resilience Assessment Methodology in SES's

From the findings of literature of resilience theory, recent planning agendas and workbooks of resilience implementation and assessment studies two main approach has been deduced in order to integrate resilience theory to planning science. One is assessment of *specified* resilience, and the second is assessment of *general* resilience.

First, in the specified resilience assessment model, for a given system, "Resilience for whom and for what?" and "Resilience to what?" questions are answered. After that there is tried to reveal inter-relational risk factors with network analysis. Thus, this methodology can contribute as a decision support systems to the determination of risk factor in the SES's and making the plan objectives.

Secondly, general resilience assessment model, try to understand general attributes of the specified system, such as diversity, modularity, openness and redundancy. This approach will contribute to understand complex feature of the socio-ecological systems by spatial interrelations, components, and connectivity of the system and this will allow making comparative studies for to understand the factors that influence the formation of resilience in different systems.

Within this direction, the study target is to develop a new compact, holistic and practicable methodology for resilience assessment in socio-ecological complex adaptive systems. The network theory that emerged in the 1990s is one of the most commonly used tools to evaluate complex interrelations of a system. Thus, network theory and analysis method will be used in the study as a resilience assessment tool. In the next section, essential information about the network theory and analysis method and the contributions it can provide will be explained.

4.1 Network Theory and Analysis

Network analysis provides information about the interrelations of sub-components in the system and helps to visualize the complexity of the system in a simple way (Barabási, 2016). This method is also referred as "Graph Theory" in mathematic science. Two basic components that constitute network are named as nodes (vertices) and edges. While nodes represent the connected entities, edges describe the connection between these two entities.

	Node 1	Node 2	Node 3	Node 4	Node 5
Node 1	0	1	1	1	1
Node2	1	0	1	1	0
Node3	1	1	0	0	0
Node4	1	1	0	0	0
Node5	0	0	0	1	0

Figure 2 Adjacency Matrix

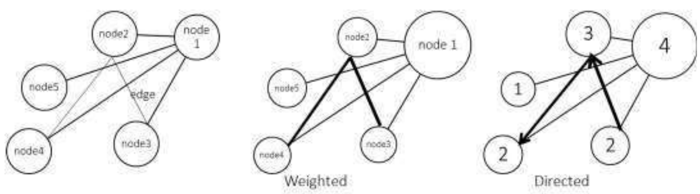

Figure 3 Network Elements; nodes and edges

Adjacency matrix is one of the methods used to determine relationship between nodes in a network. The adjacency matrix (Figure 2) is formed by determining the points in the system and then placing the names of the points in the row and column headings of the table. If there is a relation for each node pair, it is filled with value 1; otherwise, it is filled with value 0 (Estrada & Knight, 2015). Different computer programs are used to visualize the network as a graph (Figure 3), and one of them is the open source R Programming language. The I-Graph library in the R program is a widely used tool for analyzing and visualizing the network. In this study, R programming and I-graph library were used in the network visualization.

After generating the network, it is possible to analyze some basic and complex calculations with network measurement tools. For example, the node with the highest connection number can be specified by *node degree*. It may also be possible to grasp the relationships between edges and nodes more precisely by weighting and orienting the edges according to their quantitative or qualitative value. In addition to these network measures, with more complex algorithms it is possible to identify the flow and spread of the effects, the robustness of the system or the scheme of the organization by defining the global topology of the network. Another network metric is calculation of centrality according to different features. This can help to understand the connectivity of the system, most critical nodes and distributions of weakly connected parts in the system (Estrada & Knight, 2015).

5- Assessment of Specified Resilience

The scope of resilience can vary according to the different problems, different relationships and characteristics of the region. For this reason, there is a need to develop a reproducible method that allows identification of the specific resilience.

In this study, a new matrix has been developed by combining the key priorities from the examples and the features highlighted in the resilience literature for to analysis of systems resilience. This matrix provides a method for describing the system and risks and examining the relationship between administrative measures and components in multi-dimensional, multi scale and multiple temporal way. This model has been developed with a compact and holistic characteristic that can be applied easily and reproducibly in complex systems.

This methodology has two steps: the first is to create the resilience assessment matrix and the second is the development of the relational network. These steps will be explained in detail in the subtitle of the fifth chapter.

5.1 Resilient Assessment Matrix

The matrix investigates the social, economic and ecological dimensions of the system under three different scale macro, meso and micro scale. In each column, five questions ask for describing the systems resilience.

MULTI - TEMPORAL / MULTI – SCALE/ MULTI - DIMENSIONAL	DISCRIBING THE SYSTEM						
	BOUNDRIES OF THE SYSTEM		1-RESILIENCE OF WHAT?	2-RESILIENCE TO WHAT?	3-SYSTEM DYNAMICS	4-SYSTEM GOVERNANCE	5-DEVELOPING CAPACITIES
			What are the key components and priority issues in the social-economic-ecological dimension for the different system levels?	Which are the slower/ fast risks that change the system?	In which phase is system positioned in the adaptive cycle ? 1-Exploation 2-Conservation 3-Release 4-Reorganization	What are the current Govermental and institutional affects	What type of measures can be taken by the management units?
	MACRO (UPPER) SYSTEM		MAIN ISSUE- KEY COMPONENTS OF SES'S	RISKS-DISTURBANCES-SHOCKS	ADAPTIVE CYCLE PHASE	INSTITUTIONS-MEASURES	CAPACITIES
	SLOW-LONG TERM	SOCIAL	SOC-1	A1		X1	TRANSFORMATIVE – (POLICIES)
		ECONOMIC	ECN-1	B1		Y1	
		ECOLOGICAL	ECL-1	C1		Z1	
	MEZO (FOCAL) SYSTEM		**MAIN ISSUE- KEY COMPONENTS OF SES'S**	**RISKS-DISTURBANCES-SHOCKS**	ADAPTIVE CYCLE PHASE	**INSTITUTIONS-MEASURES**	**CAPACITIES**
	MID-TERM	SOCIAL	SOC-2	A2		X2	ADAPTIVE – (STRATEGIES)
		ECONOMIC	ECN-2	B2		Y2	
		ECOLOGICAL	ECL-2	C2		Z2	
	MICRO (SUB) SYSTEM		MAIN ISSUE- KEY COMPONENTS OF SES'S	RISKS-DISTURBANCES-SHOCKS	ADAPTIVE CYCLE PHASE	INSTITUTIONS-MEASURES	CAPACITIES
	FAST-SHORT TERM	SOCIAL	SOC-3	A3		X3	COPING-PERSISTANCE-(ACTIONS)
		ECONOMIC	ECN-3	B3		Y3	
		ECOLOGICAL	ECL-3	C3		Z3	
	CROSS-SCALE INTERACTIONS						

Table 2 Resilient Assessment Matrix

The first question is "Resilience for whom and of what?" to determine the main components, limitations, and priority issues of the system. Second question is" resilience to what" in order to determine the risks against the system resilience for each scale and dimension. Third question is "What is the phase of the system in the adaptive cycle?" It is asked to provide information on the level of connectivity and substance concentration in the system or the innovation potentials of the system and to ensure that policy decisions are taken according to the characteristics of the adaptive phase. In the fourth question, "Which institution is responsible and what are their effects?" Is asked in order to determine the management system and understand the institutions and policies that have an impact on the formation of risks. And at fifth question, "What is the targets of system capacity and how it will be realized?" is asked in order to determine the types of measures, plan decisions and interventions to be carried out according to scales and dimensions in the prevention of identified problems and in ensuring resilience.

5.2 Building Relational Networks

After defining the components of the system and risk factors for each scale and dimension, a relational network analysis can be conduct between these titles, in order to understand key factors that shape the system resilience. One of these kind of example has been prepared by B. Walker and Abel (2002) in the study of “Resilient Rangelands: Adaptation in Complex Systems”. In this example factors affecting the resilience of rangelands areas were determined by the complex adaptive system framework at national, regional and local scale and a relationship diagram was established. The important factor in selecting the factors that affect system resilience is that these factors can be adapted and changed by humans. This rangelands example shows that, defining the relationship between the factors that influence the resilience of the system, points to the important intervention factors and reveals the multidimensional complexity of the system.

Based on these examples in the literature, to provide a methodologically reproducible model for the specified resilience assessment, defined titles in the resilience assessment matrix will be analyzed by network analysis method. In order the understand cross-scale interactions that affects system resilience, an exemplary case study developed, in the context of climate change risk effects on rural areas (Table 3).

	System Boundries	**Resılıence Of What?**	**Resılıence To What?**
MULTI DIMENSION MULTI SCLAE	**Macro-Upper System (Regıon)**	**Key Components Of SES’S**	**Rısks-Dısturbances-Shocks**
	Social	Rural Population Dynamics	Rural Shrinkage
	Economic	Agricultural Sector Diversity	Loss Of SME's
	Ecological	Biodiversity	Climate Change
	Mezo-Focal System (Rurban)	**Key Components Of SES’S**	**Rısks-Dısturbances-Shocks**
	Social	Local Culture Diversity	Rural Out-Migration
	Economic	Agricultural Business Number	Loss Of Products
	Ecological	Agricultural Land Cover Types	Seasonal Instability
	Mıcro-Sub-System (Villages)	**Key Components Of SES’S**	**Rısks-Dısturbances-Shocks**
	Social	Rural Population Size	Rural Aging-Loneliness
	Economic	Income Level	Poverty
	Ecological	Agricultural Product Types	Flood-Drought

Table 3 Case Study- Climate change effects on rural areas as risk factor

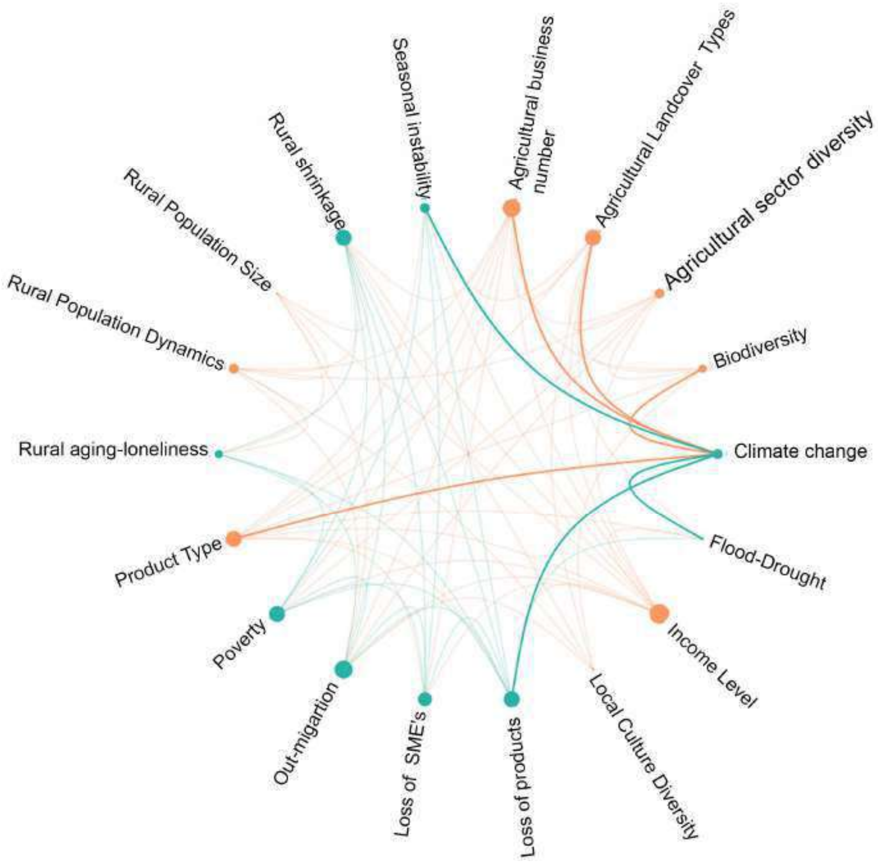

Figure 4 Circle Relational Network Graph

According to this example, key components of the SES's and risk factors defined for each scale and dimension. After that, defined titles inserted in the adjacency matrix and related titles marked with 1 in the adjacency matris. Next, this matrix placed in R program and by using I graph, edgebundleR libraries, circle type network graphic delivered (Figure 4). In these graphic, orange nodes represents the key systems components, while blue nodes represents the risk factors.

Results shows that climate change risk factor effects mostly at meso-scale. These are at economic dimension the number of agricultural business and at ecologic dimension the agricultural landcover type and at micro scale the product type. These components are also the most connected nodes in the whole network with highest node degree.

Thus, in order to ensure system resilience, priority issues for policy measures can be identified by recognizing high node degrees according to their different scales and dimensions. The results from this example show that, in order to prevent climate change effects on rural areas, policy measures must be taken especially at mezzo-scale. This requires the development of strategies to develop adaptive capacity and flexibility of the system, accordingly mezo scale projects need to be developed particularly to strengthen the agricultural businesses.

6- Assessment of General Resilience

General resilience properties of a system, such as connectivity, diversity, robustness, flexibility and modularity are associated with complexity science therefore they can be assessed by network analysis. Network analysis methods are widely used for understanding the complexity of systems.

On the other hand, in planning science, network analysis method has been used separately for different purposes, both in the analysis of tangible and intangible relations. Especially it has been used in the context of social networks with actor-network theory (Grabher, 2009; Jóhannesson & Bærenholdt, 2009) likewise physical networks usually studied with transportation or infrastructure networks (Yazdani, Otoo, & Jeffrey, 2011) as well the geographical analyses has been measured by ecology network (Bergsten & Zetterberg, 2013; Rüter, Vos, van Eupen, & Rühmkorf, 2014)

However, within the context of planning science, due to the fact that complexity and network theory is a progressing scientific disciplines, there has not yet been established a multi-dimensional and multi-scale approach that practice network theory in analyzing the complex relationships of socio-ecological systems.

For this purpose, examining complex socio-ecological systems with the network analysis methods through multi -dimensional and multi-scale approach will be a novel approach, which has been proposed in this paper. To achieve this, initially there is a need to define the sub-systems that constitute the socio-ecological system. Afterwards it is necessary to define the nodes and edges of networks of the specified sub systems.

The following subtitles, describe the findings and compilations from the literature search on the formation of spatial networks in order to assess to general resilience of a system.

6.1 Defining sub-systems- City as a Network

In order to analyze the complex relationships of socio ecological systems, determination of sub-systems prerequisite. In different sources sub-systems are referred as social, cultural, governmental -institutional, economic, physical economy, technological and ecologic (Heide & Heijman, 2009; Janssen, 2002) which also show similarity with the sustainability components. Based on these studies and in accordance with sustainability essential components, sub-systems of complex adaptive systems can be classified under three main subject, social, economic and ecological. Social system can be detailed by cultural, governmental, institutional systems, and the economic system can be detailed by physical and infrastructure systems.

After specifying the sub-systems, to be able to create the system as a network, conception of the city network need to be clarified. About this scope, in network theory literature, there are theoretical contributions to understand city as a network. In the book named "The connected city, How Networks are Shaping the Modern Metropolis" Neal (2013) delineate the urban networks under three scales of macro, mezo and micro interrelations. This approach is also corresponding to the multi-scale method of resilience theory. According to his representation, macro-scale networks establish among the cities, at the mezzo-scale networks are as the city system itself, and in the micro-scale, networks are defined as sub-connections within the city (Neal, 2013).

6.2 Defining Nodes and Edges of the Network

After understanding the city system as a network, the nodes and edges of the urban or spatial network should be determined. In this regard, in different sources spatial linkages has been defined with the flow of elements from different localities (Neal, 2013; OECD, 2017; UN-HABITAT, 2017). These spatial linkages has been described through the different functions, such as social, economic, politic, and cultural. They have also similarities as content with the sub-system definitions and consist of the flows of capital, people, goods, services, information and expertise. These flow elements can be specified as the edges between different localities, i.e nodes of the networks.

Within this approach, for every each network type, different flow characteristics defined as in in the Table 4. In first column social network defined by flow of services, information and human, also intangible governmental networks can be defined as institutional connections by laws and policies. Economic network identified by flow of monetary, labor, product, waste and energy. In addition to economic network physical economy of the given region can be determined by the existing infrastructure such as transportation roads. At last ecological network of the region can be described by the raw-material, biological material and water flow.

	Network Types				
	Social Network	**Institutional Network**	**Economic Network**	**Physical Network**	**Ecologic Network**
Flows	Information	Capital	Trade	Transportation	Raw material
	People	Service	Labor	Stations	Biological Material
	Culture	Expertise	Products-Goods	Broad band	Water
		Policy	Energy		
			Waste		

Table 4 Network Types and Flows Source: Compiled from(Neal, 2013; OECD, 2017; UN-HABITAT, 2017)

Additionally, while making the definition of spatial network of complex socio-ecological systems, essential group of questions should be asked in order to understand the linkages more deliberately. Briefly, these questions are; "What is moving?"," Where does it move from?" "for what purpose does it move? ". "While moving which connection is being used?". In addition to these questions, the quantity (number) or quality (importance) and direction of the moving objects will enable a more detailed analysis of the network edges.

After defining the edges between different localities, nodes of the network will be specified based on the Neal's definitions, within multi-dimensional and multi-scale approach. An example of this approach is given in the Table 5. In this example, macro-scale network nodes can be described as cities, regions, countries. Meso scale network nodes in the urban system can be defined as districts, neighborhoods, villages or functional regions such as industrial regions,. At micro-scale, network nodes can be represented in the city as companies, administrative institutions, households and buildings.

Furthermore, nodes and edges of networks can be varied due to different dimensions. For instance, in the macro-scale social network can be defined by international policies and laws, which will constitute a link between the nations and regions and cities. Also directions of global migration and location of governmental investments will define the macro-scale social linkages. These linkages can be detailed with mezo and micro scales, such as regional and local policy linkage and migration flow, regional investments, local NGO's-projects and local service buildings.

		MULTI-DIMENSION		
		SOCIAL	ECONOMIC	ECOLOGIC
MULTI-SCALE	MACRO	**Nodes as nations, regions or cities**		
		International Policy Linkage	Industrial regions	Land cover
		International Migration Flow	Global Transportation	Regional Corrıdors
		National Investments	Technological Infrastructure	Cross-border rivers
	MEZO	**Nodes as towns, districts, neighborhoods, villages, functional zones**		
		Regional Policy Linkage	Functional zones (touristic-industrial)	Agricultural zones
		Regional Migration Flow	Transportation Network	Forest zones
		Regional Investments	Main Stations	Rivers
	MICRO	**Nodes as institutions, business, buildings, household**		
		Local Policy Linkage	Transportation Network and Stations	Agricultural Product
		Local Migration Flow	Business	Vegetation Type
		Local Service Buildings	Energy Plants	Water bodies
		NGO's-Projects	Cultural Touristic Areas	Natural Touristic Areas

Table 5 Definition of nodes and edges of the spatial network (linkages) within multi-faceted network approach

Nodes and edges in the economic dimension in the macro-scale, can be identified as, industrial regions, global transportation network, and technological infrastructure. These features can detailed in meso-scale by functional zones of the city (touristic-industrial), city transportation network and main stations, and at micro scale by business, energy plants, and cultural touristic areas.

Ecologic dimension's nodes and edges in the macro scale can be represented as regional land cover characteristics and land-cover types, cross-border corridors, and in meso-scale main land-cover types of the city, forest and agricultural zones and rivers can be assessed. At micro-scale, agricultural product type, natural vegetation type, water elements and natural touristic zones will be represents the nodes.

7- Future Studies- Assessing Resilience Attributes and Interdependent Networks

In the further studies of spatial network analysis, there can be used network analysis metrics as explained before in the Chapter 4.1. These network metrics will help to assess the critical or weak nodes for interventions, strong connected parts of the network and critical stakeholders' positions for to understand cascading effects.

While evaluating the general resilience attributes of the system, for example, the diversity of the system can be defined with the node types and the level of connectivity in the system will be proportional to the number of edges. Additionally, in order to define key components or localities the centrality betweenness can be used. Likewise, the number of hubs can determine the robustness of the system and clusters will show the modularity and flexibility of the system. Also, the number and types of clusters can determine system redundancy. Furthermore, feedback and percolation of the system can be identified by network topologies.

Moreover, recent studies in network analysis realm continues on interdependent network analysis. This type of analysis will contribute to the understanding of the relationships and dependencies between the different network layers such as social, economic and ecological networks in the near future.

8- Summary

In consequence of this study, a network based resilience assessment methodology has been developed to provide the integration between planning and resilience theory. This reproducible resilience assessment method consists of two steps, namely "specified resilience" and "general resilience" assessment, using multidimensional approach and network analysis method in order to evaluate and analyze complex SES's.

Firstly, in the context of specified resilience assessment, the system components and risks of study-area are determined by the matrix prepared according to multi-scale, multi-dimension and multi-temporality approach. Afterwards, a relational network was established between the identified components and the risks, so that critical issues could be recognized before the policy decision-making process. Thus, priority policy measures and targeted system capacities can be determined by understanding complex multi-temporal, multi-dimensional and multi-scale interrelations.

In the second step of the methodology, nodes and edges of spatial networks and their components are determined by multi-dimensional and multi-scale approach in order to assess the general resilience in the region.

In the further stages of the study, this methodology will be applied in an exemplary study. Therefore, after the formation of the spatial network model, network analysis metrics will be carried out by using R program. Thus, in the resilience literature, a reproducible method has been proposed to provide comparative studies and to determine the factors affecting resilience. This method can contribute both theoretically and practically to the creation of regional plans.

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Metabolic impact assessment for strategic urban planning

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ABSTRACT:

The success of climate change policies is strongly dependent on the rational and socially sensitive use of natural resources, namely land, water, energy and materials. In this respect, strategic urban planning plays a decisive role in the definition and implementation of sustainable development models to promote resilient, efficient and inclusive territories.To understand climate governance in Ghana

The effectiveness of spatial planning, taking into account different urban development alternatives and scenarios, depends heavily on the overall quality, representativeness and responsiveness of decision-making processes. In this regard, the evaluation of the metabolic performance of planning proposals, urban development projects or urban policy options is crucial to enhance the overall balance and efficiency of a city or metropolis.

Applying Metabolic Impact Assessment (MIA) in the planning process, particularly through Strategic Environmental Assessment (SEA), enables the emergence of a distinctive spatial dimension provided by the urban metabolism approach. Despite the wide range of studies and approaches to urban metabolism, various practical limitations and barriers involving usability, data collection and comparability, have been limiting its dissemination in the planning profession.

In face of these challenges, this presentation intends to: i) describe a methodological approach to metabolic impact assessment, encompassing four main components - energy for buildings and transports, water, materials, and land use; ii) guide its future application to municipal development plans in different contexts (in terms of urban size, alternative territorial models and development goals), as part of current SEA procedures; and iii) critically appraise the added value of the metabolic impact assessment model as a strategic planning support tool.

The presentation concludes with a set of case-studies of urban development plans in Lisbon (master plan, urbanization plans and detail plans), aiming to illustrate the potential of a decision-support tool such as MIA in the framework of the whole decision making process. It will be possible, from real cases, to show the main added value of this pragmatic, operational and ready to use instrument. The production of useful, objective and tangible information (on the metabolic impact of each planning alternative), with the application of the metabolic model to planning alternatives, provide political decision-makers an important decision support tool. We believe this plug-in proposal of MIA into SEA will be also a relevant contribution to solve an environmental impact assessment insufficiency (extensively debated both in strategic urban planning and in strategic impact assessment literature), namely how to deal with the climate change challenge, beyond vague and inconsistent considerations. In that sense, and having in mind the central role of cities to climate change, MIA is presented as an important contribution focused on local urban mitigation strategies, in the framework of strategic urban planning. This is a non-negligible aspect of the proposal, considering strategic urban planning a particularly adequate forum to implement climate change policies.

Climate Resilience through Land Use Regulations in Asian Cities

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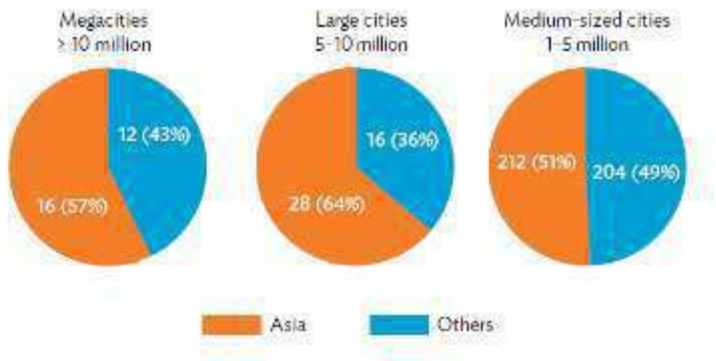
Synopsis

Climate resilience is a critical imperative for Asian cities and it needs to be mainstreamed into land use regulations to achieve a durable and cost-effective outcome. The present paper demonstrates why developing and implementing climate resilient land use regulations is the first, essential and most cost-effective step to urban climate resilience. It analyses successful national and local examples from selected Asian countries and shares insights into how this critical approach may be put in place in a wider context of developing Asian cities' political, institutional, economic and societal challenges.

Structural measure alone have failed Asian cities

Asia has been rapidly urbanising and half of Asia's population will be living in cities by the end of 2018. As a result, Asian cities face an unprecedented population load. The population of Dhaka increased from 10,3 million in 2000 to 17.6 million in 2015 and the population of Bangkok grew from 6.3 million in 2000 to 9.3 million in 2015 (World Population Review, 2018). This trend will further accelerate in the next 35 years, in which additional 1,2 billion Asians will move to cities (UN-HABITAT, 2015).

This pattern has been taking place in an often sporadic and unplanned manner, creating significant vulnerabilities. As per UN Habitat, over 40% of South Asian urban population lives in slums. Less than 50% Asian urban dwellers have direct access to water supply. Less than 75% of the Asian urban population has access to improved sanitation. Over 60% of urban population in Nepal and Bangladesh live in inadequate housing (UNESCAP, 2015). Basic infrastructure and housing needs are tremendous: ADB estimates that between 2010 and 2020 over USD 8 trillion need to be invested into infrastructure in Asia (ADB, 2009).



1: World Urbanization Prospects of the United Nations 2014 revision, New York, UN 2014

In this context, climate change and increasingly intense and frequent extreme weather events create a major threat in Asian cities. Asia has been recognised the most climate vulnerable region in the world: 6 out of 10 most affected nations are in Asia-Pacific, summer temperatures are projected to increase by 6°C by 2100 if there is no slowdown in the global warming trend. Global mean sea-level (GMSL) rise is projected to reach 5-8 millimetres per year by the end of this century (Bhandari, 2017). South-East Asian coastlines will experience sea-level rise about 10‑15% higher than the global mean level (Schaeffer, 2017). Coastal and low-lying areas in Asia are prone to increased flooding and fresh water salinization while other regions face heat waves and concentrated precipitations. These threats could significantly compromise economic development and living standards' achievements in the region (ADB, 2017).

Asian cities are particularly vulnerable to this climate risk. Over 410 million Asian urban dwellers will be at risk of coastal floods by 2025: 19 of the 25 world cities most exposed to a 1-meter sea-level rise by 2100 are in Asia, and 7 in the Philippines alone. Indonesia may have nearly 6 million people affected every year until 2100 (Gupta, 2017). **The climate risk is severely enhanced by extremely affected natural coping ecosystems in cities**. Indeed, most cities have grown at the expense of their natural eco-systems: infrastructure development often took place over water bodies, forest and green areas or urban agricultural land. Cities such as **Bangalore and Chennai** have respectively lost 79% and 90% of their water bodies in the last four decades (CSE, 2016). As a consequence, Bangalore faces severe floods regularly since 2000 (IISC, 2017) and the massive 2015 flood in Chennai caused an estimated damage of USD 2.2 billion. As per the Niti Aayog report, released in June 2018, both cities are expected to run out of ground water by 2020 (NITI Aayog, 2018). The **Manila** 2012 disastrous floods were aggravated by the lack of trees and open soil to absorb torrential rainfall water. The urban heat island (UHI) effect in the city further intensified the southwest monsoon impacts (Singh, 2012). In other words, **weakened natural ecosystems make cities simultaneously exposed to floods, water shortages and UHI effect.**

To address this challenge, most climate resilience efforts have been put into structural engineering solution, such as a water retention wall along a canal, water pumping stations in low lying areas, a river desilting. Such solutions punctually address a specific challenge, however are **very costly and have significant limitations since they rarely holistically build urban climate resilience** in the medium-long run.

Dhaka is located in the world's largest delta system and experiences severe annual floods since the capital has mushroomed over a series of wetlands. Particularly devastating flood years include 2004 and 2007, during which over 30 million people became homeless in Bangladesh, with over 40% of Dhaka inundated (IRIN, 2012). The city invested into flood protective embankments, flood walls, elevated roads along with flood control barriers, sluices and pumping stations. These structural solutions have punctually helped control flooding in several parts of Dhaka, but have gradually become less and less performant: steadily damaged embankment walls, internal flooding due to increased pressure on outdated drainage networks, inefficiency of temporary pumping systems, etc. These flood control measures' effectiveness has been severely challenged by increasing urban encroachments over retention pond zones, settlements in low lying areas or increased social conflicts around flood control structures (Bala, et al., 2010).

A 2014 ADB commissioned study highlighted that in South-East Asia most highly flood prone areas are protected by some structural measures such as levees, however the quantity and quality of such measures are not sufficient because these are not often linked to critical non-structural measures (Osti & Nakasu, 2014).

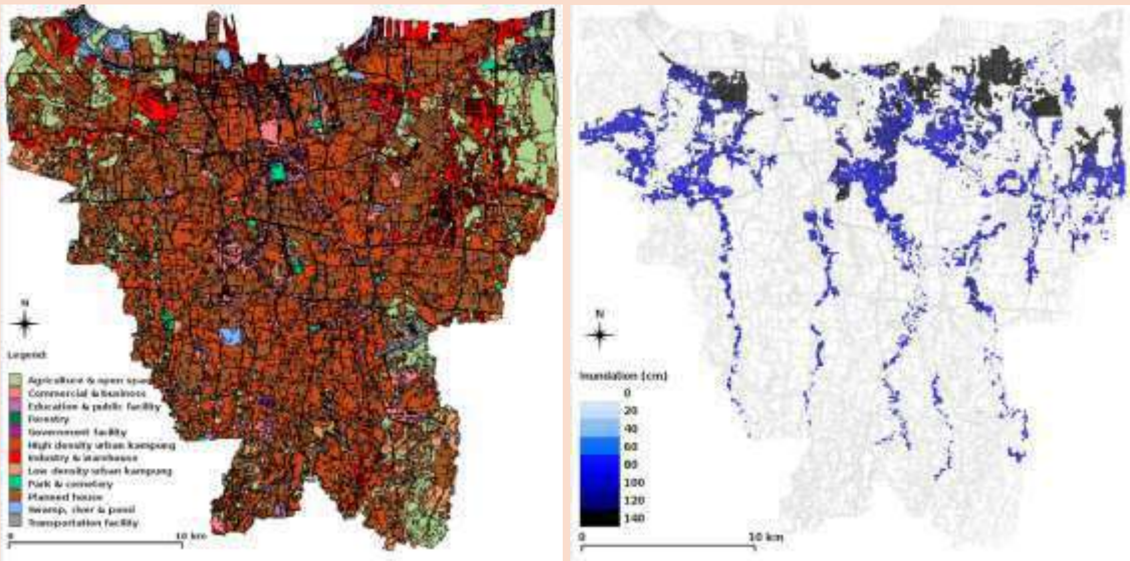
Mainstreaming climate resilience into land use regulations proves highly effective

The international development community recognised the need to strengthen climate resilience through spatial planning as of prime importance. The ***New Urban Agenda (NUA)*** links environmentally sustainable and resilient urban development to planning and urban spatial development management (NUA, paragraphs 72, 77, 80, 81, 93, 94, 95, 96, 98, 99, 102, 111, 113, and 117). **Spatial planning primarily contributes to climate resilience through preserving and reviving natural coping ecosystems**. As Alejandro Iza, Director of the Environmental Law Centre, stated at the COP 23: "As the impacts of climate change gradually increase, there is a need to provide effective tools to ensure the integrity of ecosystems and livelihoods... Land use planning should be one of these tools" (IUCN, 2017). ***Guiding Principles for City Climate Action Planning, UN HABITAT***, stress that urban climate action integrated into long-term urban planning processes increases the effectiveness of adaptation strategies.

More specifically, **land use regulations are a highly effective** way of ensuring that natural ecosystems are protected from urban development encroachments. Indeed, various city development plans have low binding capacity in developing Asian countries due to a high degree of informality and weak enforcement systems. Over 55% of Bangladesh's population, 54% of Nepal's and 38% of Philippines populations live in informal settlements (World Bank, 2014). These countries' cities' Master Plans and other urban development plans rarely include consultations with informal communities, which makes urban development plans disconnected from the reality and hardly enforceable. Land use regulations are usually legally binding and better enforced. Legal penalties for violations of land use regulations typically involve a court-order injunction, criminal fines or civil lawsuits depending on a country's system. In **Thailand**, land use plans and other land use controls are enacted under the Town Planning Act (1975) and are further regulated by sub-regulations and planning laws such as The Land Development Act (2000) and The Building Control Act (1979). However, spatial plans both regional and urban level are not enacted under laws and regulations (CPD- Bangkok, n.d.).
In India, urban land use regulations take the form of Urban Land (Ceiling and Regulation) Act adopted in 1976. Non-compliance with land use laws, such as FARS, building height limitations etc. leads to heavy fines and, if timely identified, construction permissions are declined.

The land use regulations instrument has been used by a number of Western countries, such as Canada and the Netherlands, to preserve urban green and blue areas and reduce climate vulnerability in cities. **The Asian region, while most affected by climate change and extreme weather events, however still presents only a few selected examples**. In most Asian cases, urban development happens at the expense of natural ecosystems rather than in line with them, both in urban and peri-urban areas.

Jakarta faces land subsidence as a result of compaction due to loading from new skyscrapers in sensitive areas along with an increased groundwater extraction. As a result, the city is sinking 10 times faster than the Java Sea is rising (Short, 2015). About 40% of Jakarta now lies below the sea level, North Jakarta being most affected. Natural aquifers are not replenished despite heavy rains and the abundance of rivers. Indeed, over 97% of Jakarta is covered by concrete and asphalt surfaces. Ardhasena Sopalheluwakan, Indonesian climate scientist, claims that reintroducing mangroves and rejuvenating reservoirs in the old city would be the best way of addressing the issue (Kimmelman, 2017).



2: Jakarta's official land use plan 2002. There are hardly any green and blue spaces to counter the effects of inundation. The second map of Jakarta shows the modelled hazard zones for a 50-year flood return period. (Budiyono, et al., 2015)

Climate sensitive land use measures

Climate sensitive land use measures can be looked at in three major categories: land use zoning, land use planning and building by-laws and regulations. While solutions are very tailored to a specific local context, generic land use guidelines may prove helpful:

Land use zoning helps identify and protect natural ecosystems by categorising land into specific uses and specify what is and is not allowed within each category. It can hence reflect climate threats in specific areas (e.g. low lying areas prone to floods or soil subsidence) and direct uses that will both reduce human vulnerabilities and allow each ecosystem play most useful role for the city.

Land use planning can incorporate:

- Identifying and securing community spaces to be used as refuge areas: open spaces in earthquake prone zones, raised areas in flood or cyclone prone zones, etc;
- Mixed land use and high density compact development in low risk areas while limiting development in low rise zones;
- Floodway fringe zones – parks and open spaces, detention ponds wetlands, urban forests, etc.

- Defining FARs, ground coverage ratios, setbacks and building heights taking into account changing climate and rainfall patterns.

Building by-laws and regulations may need to include:

- Relocations/replacement of highly unsafe structures to climate proof and affordable engineered housing
- Retrofitting measures in existing buildings to increase climate resilience.

An example of climate sensitive land use regulations would be a zoning by-law restricting development along a coast based on risk of erosion due to projected sea level rise and more frequent typhoons, or massing and clustering a built-up area and pavement surfaces to minimize the UHI effect. In parallel, green building codes, improved watershed management and land use practices that absorb and store water can increase the ability of an urban region to cope with water stress (Otero & Richardson, 2012). A variety of statutory and non-statutory measures – by-laws, tax incentives, information and guidance to developers – may be applied to control how land is used.

Climate sensitive land use regulations: overview of advancements in Asian countries

An initial screening of 26 countries in East, South and South-East Asia showed that only 10 countries had adopted climate resilient urban planning through national policies and only 5 had incorporated climate resilience into land use regulations: Singapore, South Korea and Taiwan among high income countries; China and the Philippines among lower middle and middle income countries. The Global Climate Risk Index 2017 however points out that low and middle income countries are at a higher risks than high income countries, which leads to two conclusions: countries that adopted a climate sensitive spatial planning approach are ripping the benefits of it while countries that follow a more ad hoc and structural measures oriented approach are exposed to more climate vulnerabilities, and this despite having to an extent comparable climatic conditions with the first category of countries.

Region	Country	Is climate resilience mainstreamed into spatial planning?	Is climate resilience mainstreamed into land use planning?	Income Group (World Bank)	Climate Risk Index- Rank (Germanwatch CRI, 2017)
East Asia					
	China	yes	yes	Upper middle income	23
	Japan	yes	no	High income	36
	Mongolia	no	no	Lower middle income	59
	South Korea	yes	yes	High income	135
	Taiwan	yes	yes	High income	NA
South Asia					
	Afghanistan	no	no	Low income	28
	Bangladesh	no	no	Lower middle income	35
	Bhutan	no	no	Lower middle income	87
	India	no	no	Lower middle income	4
	Maldives	yes	no	Upper middle income	NA
	Nepal	no	no	Low income	42
	Pakistan	no	no	Lower middle income	11
	Sri Lanka	no	no	Lower middle income	98
Southeast Asia					
	Brunei	no	no	High income	135
	Cambodia	no	no	Lower middle income	48
	Indonesia	yes (limited)	yes (limited)	Lower middle income	39
	Laos	no	no	Lower middle income	87
	Malaysia	yes	yes	Upper middle income	132
	Myanmar	yes	yes	Lower middle income	13
	Philippines	yes	yes	Lower middle income	5
	Singapore	yes	yes	High income	135
	Thailand	no	no	Upper middle income	53
	Vietnam	partially	no	Lower middle income	29

resilience into urban planning policies and land use regulations

Climate sensitive land use regulations: successful case studies from Asia

Looking at the limited number of countries that address climate threats with special planning / land use regulations solutions, one could question the extent to which the approach works. The following few examples demonstrate its high effectiveness.

Taiwan

Till early 2000s, Taiwanese cities have relied on engineering solutions to combat floods caused by typhoons. Policy support went for structural solutions such as dykes instead of natural retention ponds even though various laws, acts, regulations and decrees included planning tools as adaptation measures (Lin, 2015). In 2009, Typhoon Morakot brought a 50-hour continuous rainfall at 1,623 mm daily, which caused 623 deaths and USD 6,2 billion worth economic damages. The disasters occurred despite the country had heavily invested into structural adaptation measures**.** Devastating effects of typhoons Morakot in 2009 and Fanapi in 2010 generated a policy shift towards spatial planning solutions such as water retention ponds, adaptive land use plans or waterfront landscape projects (Wen, 2014). As a result, Taiwan's Council for Economic Planning and Development developed **national climate adaptation policy guidelines with a focus on non-structural interventions in 2012**. The objective was to incorporate climate adaptation into relevant laws, regulations and procedures at all levels of spatial planning. Measures included:

- Revising national spatial plans in light of climate change projections;
- Incorporating the concept of an environmentally sensitive area into the demarcation and management of national conservation areas;
- Establishing a land use performance control and management system for conservation areas and increasing the cities' managing efficiency and adaptive capacity in flood control by improving permeability, establishing metropolitan blue and green belts and detention basins;
- Regularly monitoring changes in land-use and land cover, and renewing geographic information system (GIS) databases;
- Constantly monitoring weaknesses and deficiencies of climate change adaptation in current spatial planning.

In addition, land use control is also addressed through a variety of **natural resources management laws**, such as the Tap Water Act, drinking water management statutes, the Soil and Water Conservation Act, the Slope Land Conservation and Utilization Act, the Forest Law and the Environmental Impact Assessment Act (Lin, 2015). Some specific projects taken across Taiwan since 2012 are: initiatives to establish a disaster catalogue and ecosystem conservation database, promoting and educating stakeholders about slope-land conservation and disaster prevention, watershed management and recovery through ecosystem conservation (Huang & Lee, 2015).

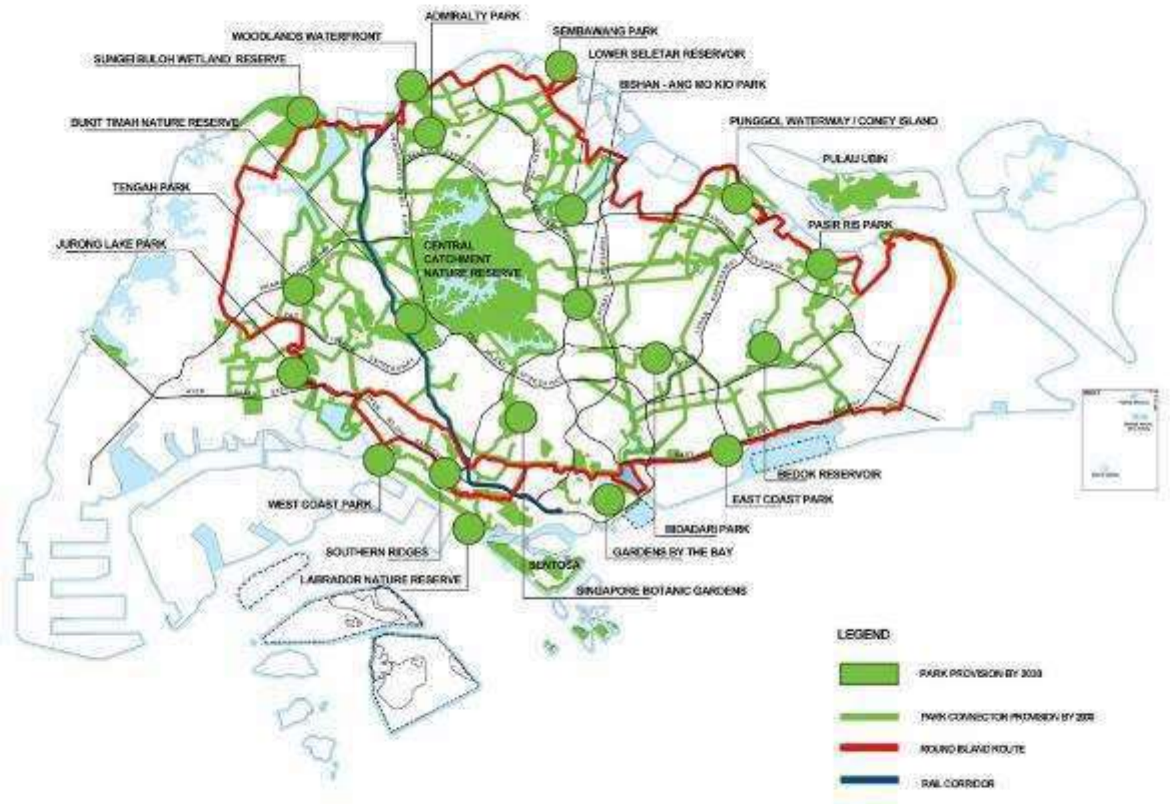
Looking at the outcomes of such measures, Taiwan has achieved better climate resilience than when it focused on structural solutions only. The 2015 typhoon Soudelor, comparable to typhoon Morakot in intensity, generated 10 times less deaths and USD 3.84 billion in damages.

Singapore

Town planning was legislated in 1959 and a dedicated planning body – Urban Redevelopment Authority – was established in 1974 to oversee physical planning, preparation of a long-term development plan, Master Plan, and implementation of the development control. All spatial planning related plans and regulations integrated ecological urbanism and green strategies to achieve climate resilience and sustainability from as early as the 1960s. Some examples of **land use measures** taken in Singapore towards climate resilience are:

- **Protecting and expanding biodiversity areas and natural reserves**. The green cover of Singapore increased from 36% in the 1980s to 47% now (Senthilingam, 2016). The water catchment area also expanded to as much as 2/3 of the country by 2011.
- **Landscaping for Urban Spaces and High-rises (LUSH) program** combines green initiatives to strengthen Singapore's identity as a tropical *City in a Garden*, this along with a high density development. Under the LUSH initiative, new buildings, such as JEM in Jurong, provide landscaped areas equivalent to the development site area (URA, 2018). This counters UHI, provides cooler local environments and increases pervious surfaces to capture rain water runoff.
- The **Active, Beautiful, Clean Waters (ABC Waters) program** builds community spaces around water bodies, integrates canals with the urban landscape, and improves water quality by using natural cleansing features. For example, at the Bishan-Ang Mo Kio Parka, large concrete drain was transformed into a natural river integrated with the adjacent park. After redevelopment, the naturalised river's carrying capacity increased by 40%. The river system now accommodates fluctuating water levels and protects surrounding built up areas from flooding during heavy precipitations (Zheng, 2017)
- In 2005, the Building and Construction Authority (BCA) launched a **Green Mark ating scheme** to assess buildings' environmental performance. BCA set a target to achieve these standards for 80% of Singapore's buildings by 2030. The 3rd Green Building Masterplan, published in 2014, encourages building owners and tenants to become more energy-efficient. Incentives such as gross-floor-area bonuses and financing are used to encourage the adoption of sustainable practices (SSB, 2015). Developments with land size of 0,2 ha or more have to implement on-site measures, such as detention tanks and green roofs, to slow down runoff entering the public drainage system.

Singapore's integrated land use policy increased the green cover by 1/3 between 1986 and 2007 (NParks , 2016). Singapore reduced its flood prone area from 3,178 ha in 1970s to only 34 ha in 2013 (IWRM, 2014). The ND Gain index, which ranks countries on their ability to leverage investments and convert them to climate adaptation actions, places Singapore on the top of the list (ND-GAIN, 2018).



4: Singapore's green and blue spaces – land use plan 2030.

The Philippines

The Philippines is the 5th most affected by extreme weather events country (2015 Global Climate Risk Index). After the super typhoon in 2006 (more than 2500 causalities), the Philippines institutionalized mainstreaming of climate change into national policy-making, planning, and other decision-making processes of the government through the Climate Change Act of 2009. Simultaneously, the government integrated the country's climate adaptation and disaster risk reduction goals by enacting them in the Disaster Risk Reduction and Management Act of 2010. Specifically, this national legislation dictated that climate change and DRR must be mainstreamed into the national and local governments units' (LGUs) development decision-making and planning process (Cuevas, et al., 2015). Subsequently, in 2013, the National Climate Change Commission (NCCC) developed supplementary **Comprehensive Land Use Plans (CLUP) guidelines that require cities to incorporate climate change and disaster risk reduction into local land use plans obligatorily**. The CLUP – a long-term plan for 10 to 15 years – is to be submitted to the review of the Housing and Land Use Regulation Board (HLURB) every 10 years. Alongside, the Comprehensive Development Plan – a medium term plan for 3 to 6 years – is to be submitted to the Department of Interior and Local Governments (DILG).

CLUP climate sensitive land use measures include:

- Protecting people and investments from hazards by selecting safe sites for development: taking into consideration setbacks from flood lines, prohibiting development in hazard prone areas, restricting development in environmentally critical zones.

- Protecting and managing valuable natural resources and environmental processes: demarcating natural ecosystems and applying standards or guidelines to preserve them; controlling development density and protecting underground water from septic discharges and landfills contamination (Deocariza, n.d.);
- Protecting critical facilities (schools, hospitals, public buildings) through spatial planning: e.g. elevate them or prohibit their construction in hazard-prone areas;
- Removing or relocating buildings from floodplains to safer grounds with government acquisition/buying out of properties, especially those in hazard prone areas (Deocariza, n.d.).

The model was first tested in the province of Albay, which is highly prone to climate related disasters. As a result of good governance and local leadership, forest cover in the province increased by 88% and the coastal mangrove cover increased from 700 ha to 2,400 ha in the last 7 years, thereby creating a crucial buffer between the land and the sea (Pearsall, 2017). The Albay LGU played an active role in setting up best practice examples for other provinces and proved successful: Albay stood against subsequent typhoons without reporting any casualties. A surge in private investments and increased revenue from eco- tourism has followed.

5: Typhoon effects in Albay 2006, CLUP guidebook and sample impact area map for sea level rise as in the CLUP guidelines.

Benefits of the approach over engineering solutions

A *climate sensitive spatial planning first* approach has a number of valuable advantages over a *structural solutions first* approach: it is significantly less cost intensive and brings a number of important co-benefits.

Cost effectiveness of spatial planning solutions

Structural climate resilience measures require heavy public investments, implementation time and technical capacity. Jakarta proposed a Giant Sea Wall is estimated to cost up to USD 40 billion and require 30 years to build and create a vast man-made lagoon. The financial model includes a mix of public funds, international soft loans and private investments. The required funding hasn't been disbursed due to a number of controversies related to a poor implementation record of such projects, corruption and financial constraints in the country (Sherwell, 2016). Experts claim that it is an unnecessary intervention and non-structural measures would serve the city better (Sherwell, 2016). Non-structural solutions require much lesser capital investments while generating long-term outcomes. These are hence to be seen as most financially viable solutions, especially in the context of low to middle income countries.

Sustainability quotient

Engineering solutions such as dams, flood walls etc. are often invasive and damage blue ecosystems. They use high embodied energy construction materials such as cement and steel. Non-structural measures are in better agreement with the essence of sustainable development, being more reversible and, by definition, environment friendly. Climate impacts bear a degree of uncertainty and a greater flexibility of resilience strategies is particularly advantageous for long term sustainability.

Public realm, health and wellbeing

Land use tools not only regulate the use of physical spaces but also influence a city's economic and social development. The built environment shapes and structures everyday life of its citizens. When nature based solutions are adopted through land use regulations, these add green and blue spaces to the urban environment. Green public spaces play a critical role in cooling cities, and provide safe routes for walking and cycling as well as places for physical activity, social interaction and recreation. In fact, WHO recommends a minimum of 9m2 of green space per person for adequate mental and physical health balance of urban citizens. These green spaces along with a well-designed built environment offer innovative approaches to increasing the quality of urban settings, enhancing local resilience and promoting sustainable lifestyles, improving both the health and well-being of urban residents. To share a few examples:

- **Shanghai** is one of the largest metropolitan areas in the world with a territory of 6,340 km2 and a population of over 24 million. It is often referred to as an urban canyon, consisting of numerous narrow streets surrounded by tall buildings. Rapid urbanization and expansion have produced a strong UHI effect reaching 7°Celsius more than in surrounding rural areas. As a mitigation strategy, the city planned greenbelts in the downtown areas. Urban greenery per capita increased to 12,5 m2 in 2008 from 1,0 m2 in 1990, making Shanghai stand above the WHO recommended 9 m2. The shade provided by trees and bushes has reduced the heat island effect by dropping the average temperature in the city by 5%. By 2020, Shanghai's land use plan envisions 30% of the city being covered with greenery (UCCRN, 2011).

- In **Seoul**, the government removed the Cheonggye highway built over the river and instead built a sunken, natural corridor of park space along the river in 2005. Opening up the stream

6: Cheonggyecheon Stream Restoration Project, before and after. Source: (MDPI, 2016) and installing the park cooled the surrounding area in the city by 3.6° C and significantly reduced air and water pollution, dropping local levels of airborne particulate matter by about 20%. The revived stream provides flood protection for up to a 200-year flood event and can sustain a flow rate of 118mm/hr. The park attracts over 60,000 daily visitors now and has boosted the local economy with tourists' inflow (Nicodemus, 2016).

Beautification of cities
Natural ecosystems not only create a more climate resilient environment, but primarily create **livable places** desirable for businesses to settle in, for tourists to visit and for citizens to connect with and take care of. Singapore, for example, is the second most visited destination in Asia (Hui, 2017).

Reduced greenhouse gas emissions and energy consumption
Protecting natural ecosystems in a high density urban environment usually means gradually embracing a **compact and transit oriented urban development model**, which encompasses all related benefits such as a reduced number of private vehicles or a reduced use of air conditioners (APTA, 2007).

Economic and livelihood opportunities
Revised land use zoning and regulations give an opportunity to identify land for a range of economic activities that complement sustainable urban development. These could be urban farming, informal activities on land parcels that are otherwise too risky for habitats. On a much larger scale, private investment can be invited into land parcels that are in low risk zones for mixed use and high-density developments within city boundaries.

Challenges associated with implementing climate sensitive land use regulations

A. Technical challenge: existing settlements in disaster prone areas

In most Asian cities, built developments have already cropped up on high risk zones. Introducing land use planning climate resilience solutions will often come to planning relocations with all the challenges and cost it encompasses. Indeed, over 50% of Asia-Pacific's urban population lives in cities and towns that are located in low-lying, coastal or riparian areas. In Ho Chi Minh City, over 25% of the population is currently affected by extreme storms, and this could climb to over 60% by 2050. During the 2011 floods, 1/3 of Bangkok's population was directly affected, which included 2/3 of the city's poor.

Climate risk prone zones are most often populated by the urban poor, most likely to live in low-lying areas, on steep slopes, in ravines, etc. They lack resources and, often, information to prevent and mitigate disaster related damages. During the 2011 flash flood in Cagayan de Oro (Philippines), 95% of the city's deaths and housing damages affected informal settlers (UN-HABITAT, 2014).

Resettlements related to climate responsive land use regulations are hence a very sensitive social challenge. It needs to be approached in a long term, holistic and sensitive manner, which requires sustained political support and private investments. Both are often lacking at present in developing Asian countries.

B. Bottom up challenges: lack of awareness and empowerment

Lack of citizen awareness results in a lack of a public demand

Awareness of climate change is overall very low in developing Asia. As per a recent poll, in North America, Europe and Japan, over 90% of the respondents said to be aware of climate change. In India and Bangladesh, however, over 60% adults have never heard of it (Leiserowitz & Howe, 2015). Lack of comprehensive public data on climate projections and consequences. For example, in Asian countries, UHI assessments are mainly conducted in cities where long-term data records are available. There is a lack of research on increasing thermal burdens related to reducing natural ecosystems in cities in rapidly urbanising and populating countries, such as India and Philippines (ADB, 2017).

Awareness about potential land use solutions for climate resilience is even lower. Concerns over low incomes, unstable housing, health and education take the frontline and linkages with these challenges and climate resilience are not understood. Supporting NGOs and CSOs hence rarely advocate for climate resilience.

Finally, local media coverage is majorly confined to traditional disaster reporting of casualties. There is little contextual reporting on why these natural disasters are happening more frequently and how effectively spatial planning can palliate them. Media's role in reporting climate stories remains largely untapped (Shah, 2016).

All these matters combined create a very **low recognition environment for decision makers** who'd want to make spatial planning interventions.

Low empowerment of civil society

Negotiating land use decisions requires co-operation at different institutional and stakeholder levels. **In developing Asian countries, the civil society is often a hardly empowered stakeholder** in comparison with real estate investors, big businesses and elected politicians. The later tend to actively advocate for their interests, which don't always match the interests of vulnerable communities. Referring back to Chennai, real estate developers successfully lobbied local decision makers and were allowed to build upon essential ecosystems such as Pallikarnai marsh or the Velachery lake-bed (which became the Phoenix mall) despite protests by civil society groups (Anuradha, 2016). Another example: the Kolkata High Court ordered that East Kolkata Wetlands are to be preserved for fishing and farming in 1992. This ruling has not been enforced till today. Illegal developments are instead coming up over the wetlands. "A local environment society has alleged a nexus between political leaders and developers leading to inaction in safeguarding the water bodies. In some cases, the government authorities themselves built slum rehabilitation dwellings on the wetlands only to evict them later in anti-encroachment drives and hand over the land to developers" (Anuradha, 2016). This situation makes climate sensitive land use regulations very difficult to put forward.

C. Top down challenges: limited decision maker capacity and political will

Limited capacity and expertise

Climate resilience is a relatively new concept at the urban planning level in developing Asian countries. Manipulating it requires urban local bodies to have specific technical know-how and data, which is often not dedicatedly collected and systemised. A few pioneering international programs, such as Capacity Development for Adaptation to Climate Change & GHG Mitigation (C3D+), 100 Resilient Cities or, formerly, the Asian Cities Climate Change Resilience Network (ACCCRN) help improve national research and training and government agencies' institutions' technical capacity. These programs include risk mapping and data collection activities, climate proofing city plans, raising general awareness.

Data availability and its accuracy at the local level remain a challenge. Broad aspects of climate change in Asia are for example simulated by the Atmosphere Ocean Global Circulation Models (AOGCM), however uncertainty remains and data is not localised enough. Asian region has a very complex topography and marine influences, local climate changes hence vary significantly from regional trends (IPCC, 2007). There is a clear need for a more localised climate data to enable a better climate sensitive local planning.

Lack of political motivation

Spatial planning's de facto strong connection to short-term electoral cycles obstructs its whole purpose, which is to prevent risks and ensure resilience in the long run. Short-term electoral mandates push local politicians to demonstrate tangible results in order to increase re-election chances. Land use regulations protecting natural eco-systems are seen as less tangible actions compared to engineering solutions: installing pumping stations in low lying areas, construction of embankments, etc.

Political economy is another determining component when it comes to a spatial planning approach to climate resilience. It is a commonplace scenario that personal interests influence approvals of construction proposals. Developing countries' public sector administrations often receive inadequate pays, long duty hours, interference from political organisations and outdated reporting arrangements. Coupled with relatively weak checks and balances systems, these factors significantly contribute to the political economy factor.

To illustrate, nearly 900 million, or over 1 in 4 people, across 16 countries in Asia including some of its biggest economies such as China and India are estimated to have paid a bribe to access a public service. Transparency International representatives blame low civil service salaries coupled by systems that allows little or no access to redress mechanisms as main reasons behind this situation. (Goswami, 2017). The matter is all the more magnified when it comes to attributing large real estate development contracts. This is how natural ecosystems are further and further encroached upon.

Solutions to overcome challenges related to mainstreaming climate resilience into land use regulations

As demonstrated above, mainstreaming climate resilience into spatial planning and land use regulations is an essential approach, yet hardly taken forward by concerned national and local authorities. The reason is that it requires **making key institutional and policy shifts**. The international development community vastly supports climate resilience with internal, external, grant, loan and investment funding. To leverage maximum benefits from this effort and achieve more tangible results on the ground, it needs to help mainstream the approach. Five major ways of doing so can be listed: 1. Raise awareness and build capacity; 2. Build local leadership for climate resilience; 3. Generate public demand for climate resilience; 4. tailored financial support; and 5. Build upon existing national and international efforts.

1. Raise awareness and build capacity

Both citizens and decision makers are insufficiently aware of the scale of climate threats as well as of the role land use can play in mitigating these, especially in in small and medium size cities. A number of international agreements and annual events contribute to raising such an awareness, however a more **dedicated effort needs to be made with a focus on the national and sub-national levels in partnership with governments and on the grass root level in partnership with relevant NGOs**. In Canada, workshops and training sessions are frequently used as a mechanism to stimulate local climate adaptation. These typically bring together experts in climate science and adaptation with community leaders, municipal staff and the general public. Goals of these workshops vary, and may include, for example, identifying priorities, setting the stage for ongoing collaboration and dialogue for adaptation capacity (Warren, 2014).

Building municipal staff’s capacity requires a very tailored approach given the fact that municipalities are often heavily understaffed and can hardly participate in dedicated trainings. A **hands on cooperation between experts and local authorities** have revealed to produce best on the ground outcomes. For example, the 100 Resilient Cities (100 RC) program typically introduces a Chief Resilience Officer (CRO) in partner cities, usually a local influencer well connected to key local decision makers and stakeholders. Local leaders and administration also have access to technical assistance and training as per their specific requirements (The Rockefeller Foundation, 2017)

2. Strengthen the top down approach: build local leadership for urban climate resilience

The importance of an incentivizing system to foster local political and decision maker leadership for climate resilience cannot be over-estimated. Yet, it is nearly never a direct component of a national or an international climate resilience program. The international community has however a number of effective instruments to increase visibility of highly performing politicians, both at the national and at the international level.

The **Mayor of Surabaya** (Indonesia), Tri Rismaharini, won several national, regional and international awards after she successfully transformed one of the most neglected cities of the country – earlier called *Concrete Dumb* - through a series of highly attractive public parks, good practices in solid waste managements, improved education and tackled infrastructure challenges through public participation. She converted bare land and selected gas stations' locations into green public spaces by doing so making 20% of Surabaya's territory green. This intervention played two major functions: the city was no longer affected by floods during heavy rains and public parks greatly contributed to reducing social segregation and improving safety. Indeed, parks were strategically located to connect high and low income areas. Public participation has won the city a number of environmental awards. Such a leadership brought two strategic outcomes: Mayor Tri Rismaharini is a continuously re-elected Mayor since 2010, hence harnessing personal career benefits from her strong stand for the environment and for social justice; in addition, her leadership attracted attention and motivated Mayors of other Indonesian cities to follow her path (IE Singapore, 2016).

7: Surabaya before and after (public space and riverside revitalisation), source: Surabaya city government

3. Strengthen the bottom up approach: generate citizen demand

Political mandates – typically 3 to 5 years – are far shorter than the timeframe to be considered when building climate resilience through spatial planning – from 10 to 50 years. **Citizen ownership is the most effective way to ensure a beneficial intervention will continue beyond a potential political change**. Building such an ownership implies involving citizens at all stages of the planning and implementation process. In particular, communication between local authorities and citizens needs to take a shift so that citizens value less 'visible' spatial planning interventions by doing so rewarding decision makers by their support and so that citizens can convey their concerns and priorities in an impactful manner. Organizing **dedicated trainings for the media** on how to better understand and cover climate matters in the urban context is, for example, a very effective way to both reach out to citizens and incentivise politicians.

Batticaloa, a coastal city of Sri Lanka, is a highly flood prone. A 2010 UN-Habitat project encouraged cooperation between local authorities and residents. The later participated in the development of a green belt near the sea as a protective buffer against natural disasters and a recreational area for the communities. "By being directly involved in decision making about what facilities should be prioritized and the type of vegetation to support, they developed a much greater sense of ownership over the project, including a protected public space that is better suited to their needs" (UN-HABITAT, 2014, p. 44).

8: Google earth imagery in 2008 and 2018 showing increased green cover along coastal line zone that is most prone to tsunamis and sea level rise in Batticaloa.

Organised citizen feedback is another example of effective communication: Citizen charters is an example of a widely used user satisfaction rating system assessing the quality of municipal services. In Bangalore, the Citizens' Report Card (CRC) was first initiated by a civil society organisation – Public Affairs Center – in 1993 to monitor government services in terms of efficiency and accountability. Since then, the CRC has been adopted and tested in several developing countries such as Pakistan, Philippines or Tanzania (World Bank, 2013). These charters and public feedbacks have demonstrated that such measures could hold the public sector performance more accountable (UNESCAP, 2015, p. 165).

Online social spaces are a valuable addition to conventional physical ways of connecting with citizens. Social media pages in the local language have widely paid off in terms engaging citizens. For example, the municipality of Hat Yai, Thailand, launched a page *I love Hat Yai*. On a regional scale, the World Water Monitoring Challenge encourages people to record their local water quality and share results (www.worldwatermonitoringday.org).

4. Incentivise through funding attribution systems

Allocation of national and international funding is both a key component and a key instrument of rightly sequencing planning and engineering solutions. Local governments show an overwhelming interest for funding opportunities and tend to largely tailor their urban interventions to funding access conditions. Here, funding entities and schemes could make a major difference in terms of helping cities first recurring to non-structural solutions through special planning and land use regulations, and only then identifying structural/engineering solutions required in complement to special planning rather than instead of it. Project finance could for example be linked to the necessity of an engineering project after the targeted outcome related non-structural solutions have applied. This approach will strengthen municipal finance, save very limited national and international resources, and even help avoid harmful infrastructure projects come to life.

5. Build upon existing national and international efforts

As demonstrated in this paper, **climate resilience needs to be part of planning efforts and can hardly be achieved when tackled as a stand-alone subject**. In ACCCRN's monitoring and evaluation report, it was acknowledged that the program overlooked the importance of national policy context for the engaged cities. "More supportive policy environments (as in Vietnam) have stimulated better uptake of UCCR than less-well oriented environments (as in India). The weaker awareness of the policy and governance contexts for UCCR in the earlier stages of the Initiative hindered progress" (Verulam Associates, 2014, p. 70).

Yet, many key urban development programs don't include climate resilience provisions. For example, the Indian Smart Cities mission and AMRUT mission cover 600 Indian cities and are allocated a USD 22,5 billion budget. These major programs do not have dedicated climate resilience provisions despite high vulnerability of many covered cities, however one can identify entry points to bring the matter into these existing schemes, as was done by Chennai, Guwahati, Bhubaneswar and Vishakhapatnam. This appears to be driven by the cities' experiences of past disaster events (Jogesh, et al., 2017).

Such a mainstreaming can also be a form of cross-sectoral policy integration. The expected benefits of mainstreaming climate adaptation into existing development activities include avoided policy conflicts, reduced risks and vulnerability, greater efficiency compared to managing adaptation separately and leveraging the much larger financial flows in common sectors affected by climate risks than the scarce resources available for financing adaptation solely (Lebel, et al., 2012). There are a few positive cases emerging in Asia in this context.

Indonesia's Mid-term National Development Plan for both 2009-2014 and 2015-2019 have included climate adaptation and disaster risk reduction (DRR) as part of development policy priorities. The latest development plan (2017) added improved spatial planning, enhanced organisational and institutional mechanisms, and better human resources as the foundation for cities' climate resilience. As a result, 122 districts and cities in Indonesia have already developed their contingency plans for multiple hazards.

Similarly, the **Malaysian National Policy on Climate Change** calls for climate-proof and climate-resilient development, and envisions the integration of climate measures into DRR policies, plans, programmes and projects. (Lassa & Sembiring, 2017).

Climate resilience reflected in land use calls for inter departmental communication and coordination. Complementary responsibilities typically lie within different Ministries and agencies. In Thailand for example, the Department of Local Administration, Ministry of Interior, plays a key role in mainstreaming national policies into the local level, however it does not include climate resilience experts and coordination with the Office of National Resources, Environmental Policy and Planning (ONEP), Ministry of Natural Resources and Environment, does not take place often enough. International programs needs to systematically include the institutional component into all cooperation and technical assistance programs.

8. Conclusion

In conclusion, a major approach shift is required to successfully tackle urban climate resilience in Asia. As a first and fundamental step, climate sensitive land use regulations need to support spatial planning that protects and revives urban and peri-urban natural ecosystems. As a second step, structural solutions can build upon the laid foundation. Reverse the order and the city is condemned to endless heavy expenses while facing increasing climate threats. Respect the order and the city has all chances to create a healthy living environment while mitigating and adapting to climate threats to a good extent, by doing so attracting economic opportunities. Each stakeholder – be it the international development community, national and sub-national governments, businesses or civil society – need to carry their part of contribution and responsibility in this process.

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Addressing climate change in European spatial planning

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ABSTRACT:

Since the year 2000, spatial planning systems and territorial governance in European countries have been visibly transformed and adapted due to different issues. The most profound changes have been the product of the new political-economic context, stemming from neoliberal political orientations in the own European countries. Additionally, although the European Union does not have direct competence in national planning, the several EU directives in different policy sectors, have definitely shaped European spatial planning. Furthermore, the challenges brought about by the evident risks associated with climate change have also become an important factor of change, turning the confrontation to these risks as an important policy objective.

The main aim of the study is to investigate how climate change related issues have modified the European planning field. The study will answer two main questions. The first refers to how formal spatial planning systems in Europe, represented by the institutions and instruments that are established by law, have included climate change-related issues. Addresses the actual planning practice, the second questions explores the extent to which planning instruments are used to achieve the objectives implemented to tackle the risks associated with climate change.

To answer these questions, the present study uses data gathered by the COMPASS project (Comparative Analysis of Territorial Governance and Spatial Planning Systems in Europe). COMPASS was commissioned by ESPON (European Territorial Observatory Network) to investigate the most significant trends in territorial governance and spatial planning systems across 32 European countries. This includes the 28 EU member states and the 4 associated countries. The period under study was the 2000-2016 period.

The study found that the way the countries address climate change is very mixed. Some countries have included climate change related objectives in the legal definition of spatial planning, while others have created specific instruments that fight the associated risks from different perspectives. Countries which count with a mature spatial planning system and more stable conditions have incorporated climate change issues in a more thorough and comprehensive way. Furthermore, among the 14 sectoral policies under study, environmental policies showed to have the highest degree of integration with spatial planning.

A methodological approach to measure interrelations between urban form and flood-related risks in Kampala, Uganda

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Keywords: Urban form, Climate Change Risk, Spatial Equity

This paper[i] aims to examine the interrelations of spatial characteristics to the often-unjust distribution of climate change risk and vulnerabilities and develop a methodological approach for Kampala to redress this situation. The research intends to increase the understanding of spatial equity and proposes a method to quantify it in environments of limited preceding research and data availability to support better-informed policy and spatial intervention strategies.

1. Introduction

Fifty per cent of the world population is already living in cities. By 2050, it is expected, that more than two-thirds will live in urban settlements. The growth will mostly occur in African countries where one billion people live at present. More than four billion people are expected to live in Africa by the end of the century and thus make up more than one-third of the world's population (United Nations 2015).

This rapid growth steadily increases the importance of sustainability in urban planning while it also contributes to rising spatial injustice, mostly in sub-Saharan Africa (SSA). Access to land, services, employment opportunities and therefore also the city itself vary strongly between different income and social groups (Parnell and Walawage 2010). These gaps are significant and disadvantage the already most vulnerable groups even more, specifically under the increasing threat of climate change and its accompanying risks. The understanding thereof as well as realising which factors positively or negatively influence spatial equity is crucial for tackling these inequalities.

This paper analyses the specific situation in the capital of Uganda, Kampala, and the distribution of flood-related urban risks to investigate this spatial injustice, as well as its driving forces and consequences. It results in a methodology which attempts to establish a relationship between internal and external spatial characteristics of settlements and their correlation with the level of spatial equity within. Answering the following research questions is central to the study:

- How can the quantification of risk exposure, adaptive capacity and sensitivity can be simplified and carried out at small-scale spatial resolutions and locations with limited data?
- Which spatial characteristics of urban form are measurable with restricted spatial data and correlate with social vulnerability?

The objective is to expand the existing literature by applying it to the dynamic context of urban Uganda. Additionally, existing approaches, as well as newly developed methods are integrated by retrieving various spatial indicators from GIS data/aerial photos and relating them to statistical data (e.g., vulnerability, socio-economic profiles) and qualitative results of household studies. The anticipated outcome of the research is an improved understanding of urban dynamics, justice, and accessibility, specifically in the context of Kampala, and to build a better basis for informed policy decisions, as well as spatial interventions. Even if the methodology is context-specific, generalisations can be made for other urban areas in sub-Saharan Africa and assist in the quantification of socio-spatial inequalities in the field of climate change.

2. Background

The global population continues to increase rapidly and is mostly concentrated in the urban areas of the global south. More specifically, the African continent is experiencing the highest population rise in the present century. Adding to the pressure on cities by more residents and spatial expansion, climate change further stresses these urban systems. Cities became the centre of the current development and sustainability debates. Their importance is widely acknowledged and continuously highlighted by international and national institutions around the world, representing a central aspect in the Sustainable Development Goals (SDGs) of the United Nations. SDG 11 focuses on making "cities and human settlements inclusive, safe, resilient and sustainable" while the city itself functions as the arena for achieving nearly all the other goals (UN 2015, p. 14).

The questions arise, what this development will mean for the population within cities and how it can be managed and steered into a sustainable direction. The report 'Our common future' already highlighted spatial injustice in 1987, together with the necessity to identify the most vulnerable groups and tackle the social and environmental risks which accompany the population surge (WCED). However, more than three decades went by, and even if sustainability is a primary concern nowadays, more people than ever before are living in risk-prone circumstances, and environmental depletion does not slow down either (Adger 2006; Brecht et al. 2013; UN-Habitat 2014; UN 2015 & 2016).

With urban areas as the primary habitat of the world's population, fast urbanisation patterns in sub-Saharan Africa (SSA) increase the demographic pressure, while climate change stresses the cities, and their adaptation is challenging because the responsible institutions often lack resources and capacity to tackle the rising complexity and quantity of issues (Pieterse and Parnell 2010; Myers 2016). In 'Africa's Urban Revolution', Parnell and Pieterse emphasise the general growth which occurs in both urban and rural areas but its strong concentration in urban agglomerations. This development is not only about the increase of the number of residents but comes along with "severe overcrowding, lack of sanitation, constant threat of bodily harm and abuse" and is "linked to the structural poverty and systemic exclusion experienced by a large proportion of the urban population in most African cities". Unequally distributed pressures on age, income and gender groups result in negative externalities on health, productivity and economic behaviour (Pieterse and Parnell 2010; Bartlett 2008; Fainstein 2010). Furthermore, climate change and global environmental change are leading to more rural-urban and/or trans-national migration of climate refugees, unequal distribution of land, hazard risks for settlements in the shape of floods, landslides, droughts or heat waves, to just name a few which highlights the "dynamic processes and the interplay" of these elements (Parnell and Walawage 2010).

However, inequality does not only exist amongst different social groups within the cities but also on the global scale. Climate change itself is a global challenge, mainly induced by the industrialised countries while the most impoverished countries contributed the least but suffer the most from its consequences (Althor et al. 2016). The suffering is further intensified due to a widespread lack of adaptive capacity, meaning the "potential, capability, or ability of a system to adapt to climate change stimuli or their effects or impacts" (IPCC 2001).

Parnell and Walawage (2010) further stress the importance in these complex circumstances of creating the capacity to ensure urban resilience so that the livelihood of everyone in the city is not negatively affected by the broader global demographic and environmental processes. Another important aspect is the interplay between the social and ecological systems and their cultural understanding which varies fundamentally between the western and most societies in SSA. While the dominant western notion sees them as separate entities, in most SSA cultures nature and society are interwoven. The consequences of the development in industrialised nations lead to the destruction of locally much higher valued ecosystems, while differing perceptions result in complications in cooperation, the transfer of 'knowledge' and coping mechanisms (Myers 2016).

All these issues emphasise the plethora of challenges which cities in SSA are facing. Tackling them will be one of the critical tasks for policy makers and planners of the coming decades. Starting with the predominant injustice and its spatiality in urban agglomerations, this research tries to contribute to the understanding thereof by looking at ways to quantify the interrelation between urban form and social vulnerability with a focus on risk exposure and adaptive capacity. UN-Habitat (2014) called the development in SSA cities an "urbanisation of poverty". This led to plenty of unplanned and underserviced settlements with fundamental and increasing material injustice and lack of opportunities between them and their affluent neighbourhoods. Understanding these different settlements patterns and their integration in the urban fabric will be the core of the analysis of urban form, while the varying level and types of risk exposure and the interdependence between social variables and adaptive capacity will serve as comparative values.

Urban form, defined by Williams as "the physical characteristics that make up built-up areas, including the shape, size, density and configuration of settlements" (2014, p. 6) is moving towards the centre of interest in the sustainability debate, while its importance on the social and ecological risk exposure is further emphasised (Jabareen 2006; Hillier 2009; Louf and Barthelemy 2014; Fragkias et al. 2013; Oliveira et al. 2014; Pelling and Wisner 2009 and others). Myers adds to the definition of urban form, in his words *cityshape*, that in the context of SSA it is the physical as well as the "socially and culturally produced environment" (2016, p. 19), highlighting non-spatial characteristics. Jane Jacobs already described the strong interrelation between the built environment and social dynamics of cities in 'The death and life of great American cities' (1961), where she states that cities should be a place for people, even if that is often not the case (anymore). Building upon Jacobs' perspective, Gehl (2010) further embraces the interconnection of urban form and social life, sustainability and health through variables of density, compactness, and diversity while also highlighting its relation to risk (e.g., traffic accidents, robbery). Additionally, he argues that high-quality urban space can fuel interaction and social inclusion, and therefore a higher sense of community which again can lead to better cooperation and assistance in case of disaster regardless of their type or scale. He also states the importance of shared urban space since overpopulation and rising poverty put pressure on the livelihood of people (Gehl 2010). Jacobs continues to describe the impact of being better interconnected on adaptive capacity, further supporting the interrelation between the spatial and social dynamics of cities.

The issue of justice in cities, in which context this research is situated, was famously put into focus by Susan Fainstein in 'Just Cities'. She gives a broad overview of different notions of justice, how it can be conceptualised and quantified and also states that injustice rises and the poor, mostly women and children, represent the most vulnerable groups (2010). This link between poverty and vulnerability in the field of environmental risks was further studied by UN-Habitat (2014), naming the lack of decision-making power and resources, mostly in time of disasters, as the primary reasons. They also emphasise the disproportionate distribution of risk exposure among different age and gender groups (see also Bartlett 2008).

What do urban risks or vulnerability mean and what do they encompass? Brooks (2003) distinguishes generally between social and biophysical vulnerability. Social vulnerability includes everything related to the human and is the focus of this research, while biophysical vulnerability focuses on the ecosystem and biophysical environment. Risk, on the other hand, is normally composed of different types of hazards, their occurrence and scale, but has numerous definitions which are further discussed below. The last two aspects are adaptive capacity as the "potential, capability, or ability of a system to adapt to climate stimuli or their effects or impacts (IPCC 2001, p. 881) and sensitivity as "how affected a system is after being exposed to the stress" (Engle 2011, p. 649, compare to Adger 2006 and IPCC 2001).

The proposed methodology in the case study of Kampala aims to measure the key elements – urban form, climate change related risk exposure, adaptive capacity and sensitivity – with a view to understanding their interplay in the context of socio-spatial justice as shaping elements of urbanisation and livelihoods. The example of Kampala provides a compelling case, due to its fast urbanisation and current as well as predicted spatial expansion but early development stage in comparison with other Eastern African cities (Karolien et al. 2012; UN-Habitat 2014). At the same time, it experiences severe climate change-related consequences, and has high levels of informality, low levels of land tenure security and building regulations, basic service provision and faces institutional challenges which further complicate the situation (Karolien et al. 2012; Nyakaana et al. 2008; Insunju 2016; Richmond et al. 2018; UN-Habitat 2014). Therefore, it is an interesting case study to analyse itself while its comparability to many other cities in SSA provides the opportunity to transfer and apply the same approach in other geographical contexts.

2.1 Urban form

The first central concept is urban form. It can mainly be conceptualised as the built embodiment of urban society, generally divided in macro, meso- and micro-scale (city, settlement/neighbourhood, building) and is constituted by different layers, including street networks, build environment, and land use/division (Pont and Haupt 2009; Oliveira 2016; Hillier 2009). Two different levels of urban form are distinguished to measure urban form. Firstly, the city level (macro scale) includes the demarcation of the urban agglomeration and is necessary to understand larger interrelations, e.g. the accessibility to the economic centres or differences between core and peripheral areas. The second level is the settlement area (including both meso- and micro-scale), which looks more at the built environment and includes built density, space allocations, proximities, or the density of street intersection. The measurable characteristics of the latter are divided into the three layers. There are various claims about the interrelations of urban form and sustainability. For example, they state that smaller or denser more interconnected cities might be more sustainable (see for example Adolphe 2001, Oliveira 2014, Jabareen 2006, Fragkias et al. 2013; Dave 2010; Louf 2014). The latter would be interesting to analyse in Kampala, but this would require partly non-available data. Also, due to the overall performance of cities as systems (i.e. emission, GDP) they would only produce compelling results if compared with other cities.

2.2 Social vulnerability

The second central concept is social vulnerability. There are countless definitions of vulnerability and its constituting parts, mainly depending on the time, context and background of academic research. Therefore, it is crucial to define the various parts of social vulnerability and conceptualise them in a coherent and commonly agreed upon manner. To start with, vulnerability is conceptualised in a broader context than either "the amount of (potential) damage caused to a system by a particular climate-related event or hazard" or as the "state that exists within a system before it encounters a hazard event" (Jones and Boer 2003 and Allen 2003 in Brooks 2003). Currently, the most accepted definition follows the latter. Furthermore, a distinction between different types of vulnerability can be made, even if there is no consensus on the actual separations or terminology. The most common types which can be found in the context of urban climate change vulnerability are social (also referred to as human) and biophysical (or natural) vulnerability. However, various studies also examine, for example, economic or institutional vulnerability (Brooks 2003). Vulnerability, in general, is defined by Adger (2006), building upon the definition of the Intergovernmental Panel on Climate Change (IPCC) as the "state of susceptibility to harm from exposure to stresses associated with environmental and social change and from the absence to adapt". In the case of social vulnerability, the system which is vulnerable encompasses all socially connected elements, while biophysical vulnerability can be defined as the vulnerability of the natural environment to climate change-related stressors. A quick overview of the definitions of the constituting elements (Table 1) is provided, together with a diagram showing its connections (Fig. 1).

Hazard	While there are also different types of hazards, the focus here is on natural hazards, which can be defined as "physical manifestations of climatic variability or change" (Brooks 2003, p. 3). The primary natural hazards are cyclones, floods, earthquakes and landslides (Adger 2006; Brecht 2013).
(Hazard) event	A hazard describes the initial stressor / physical manifestation of climate change, while an event is the more precise occurrence of a hazard which takes the exposure of the system into account (Adger 2006; Brecht 2013).
Disaster	A disaster takes the probability into account and further incorporates the consequences of events of natural hazards (Adger 2007; GIZ 2014).
Risk	The combined outcome of exposure, the sensitivity of a system and its adaptive capacity. As higher the vulnerability in general or risk exposure and sensitivity, as higher the risk. As stronger the adaptive capacity, as lower the risk (Adger 2007; Cardona et al. 2012; Dickson et al. 2012; Brecht 2013; GIZ 2014; Pelling 2016).
Risk exposure	"Character, magnitude, and rate of change and variation in the climate. Typical exposure factors include temperature, precipitation, evapotranspiration and climatic water balance, as well as extreme events such as heavy rain and meteorological drought" (GIZ 2014, p. 21).
Adaptive capacity	No generally applicable definition exists, as the adaptive capacity dependent heavily on the type of hazard, environment, and system which is looked at. However, often constituting or influencing elements are generally resources, knowledge, institutions, and the economy (Adger 2006; Adger 2007; GIZ 2014).
Sensitivity	"Degree to which a system is adversely or beneficially affected by a given climate change exposure […and] shaped by natural and/or physical attributes of the system including topography, the capacity of different soil types to resist erosion, land cover type. But it also refers to human activities which affect the physical constitution of a system" (GIZ 2014, p. 21).

Table 1: Definitions of social vulnerability elements

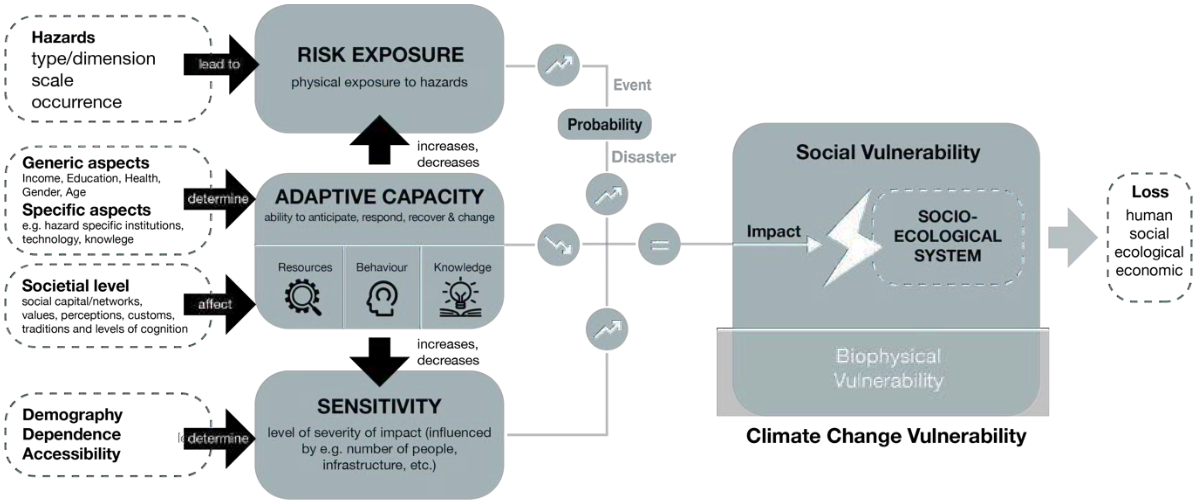

Figure 1: Conceptualisation of vulnerability and its connections (Author 2018)

2.3 Flood-related risks in Kampala

The focus of this research is on Kampala, the capital of Uganda. While it is the second least urbanised country in Eastern Africa (2011: 31.2%; UN-Habitat 2014, pp. 147-150), the urbanisation rate is significant in comparison to other countries in sub-Saharan Africa, and even more at a global level. These developments lead to an assumed current urban population of Kampala of somewhere between 1.6 and 2 million (1.66 m in 2011) and predictions of about 100,000 new urban inhabitants which lead to an expected population of 3.5 m by 2025 (UN-Habitat 2014). This high urbanisation rate leads to a sprawling urban agglomeration even outside the jurisdictional boundary of the Kampala Capital City Authority and furthermore to densification and (formal as well as 'informal') infill in areas which are either due to their soil texture and/or proximity to flooding areas, not suitable for residential areas (Karolien et al. 2012; Nyakaana et al. 2008).

In 2009 only 9.1 % of the national population was living below the poverty line, one of the lowest in Eastern Africa (UN-Habitat 2014). However, the countrywide number of people who are living in self-planned settlements increased from 1.5 m in 1990 to 2.5 m in 2007 (UN-Habitat 2014). These self-planned settlements are often experiencing the most severe livelihood challenges, are situated in inappropriate and inaccessible locations and lack access to basic services and critical infrastructure (UN-Habitat 2007). Nyakaana et al. (2008) furthermore point out that growth brings about a "lack of infrastructure, social services and poses planning and environmental problems" and emphasise the interrelationships between population, development and environmental issues (UN-Habitat 2014). While the Kampala Structure Plan was prepared in 1972 and mainly implemented, it catered essentially for the European and Asian residential and economic areas and did not consider the less privileged society. A revised plan from 1994 tried to cope with these arising challenges but was only partly realised and let to the evolution of more self-planned settlements without much institutional steering (UN-Habitat 2007, pp. 9-10).

The Poverty Probability Index was applied amongst others in Uganda with a globally standardised assessment method and highlights the comparatively high national poverty while pointing out the missing overall access to facilities as well as basic sanitary instalments (Schreiner 2012a, Richmond 2018). It also shows the unequal distribution of poverty over age, with an intense concentration in the age groups under 29 (Schreiner 2012b, detailed in Cannon et al. 2014). A more in-depth study of the most marginalised groups (street children, 'squatters', 'slum' dwellers) further stresses various deficiencies and challenges sorted according to their significance: flooding and infrastructure access; pollution; health issues (mainly related to the aforementioned); sanitary facilities; and social networks (Dimanin 2102). These rising pressures on the urban population of Kampala are strongly linked to the increasing climate change impacts Uganda is experiencing (MoGLSD 2017; Mabasi 2009). While the climate of Uganda always led to floods and droughts in the past with accompanying consequences for livelihoods, infrastructure and the economy, recent changes intensify these pressures. The average temperature of Uganda is expected to rise by 1.5 °C until 2027 and up to 4.3 °C until the 2080s. More frequent and extreme rainfalls are projected as well. However, they are more difficult to quantify. While the rising temperatures will have substantial effects on "water resources, food security, natural resource management, human health, settlement and infrastructure" and lead to more heat waves (MoGLSD 2017, p. 12), the rising rainfalls will result in even more flooding events which will be simultaneously more severe.

The occurrence of a variety of disasters increased in the last decades in the whole of Eastern Africa (UN-Habitat 2014, pp. 160-162). Osuteye et al. (2017) attempted to compare the number and severity in countries of sub-Saharan Africa and counted 14 natural disasters in Uganda between 2010 and 2015 which led to over 700 deaths and affected more than 1 million people. While these numbers are higher in several other countries, Uganda has a comparatively low overall population which leads to 1 in 40 of the national population being affected by disasters. These statistics show the significance of natural disasters and the tremendous effect they have on lives and national development in general. Furthermore, they compare different types of events and how many houses were destroyed or damaged. In the case of Uganda, floods (5,595), hailstorms (1,786) and landslides (1,663) are by far the highest numbers (Osuteye et al., p. 26). While hailstorms can barely be avoided and only dealt with through better adaptation, the severity of floods and landslides is largely influenced by the infrastructure, spatial location and built environment, which will be further discussed below.

UN-Habitat prepared two expansive vulnerability assessments of Kampala (2009 and 2011) in which they highlight floods and related risks as the primary stressors, but also analyse which factors contribute to the severity of, and sensitivity to disasters. They point out the importance of better and more detailed vulnerability assessments and how they increase understanding and thereby permit better adaptation measures. In the second assessment, more detailed measurements and spatial distributions of vulnerability were undertaken which led to a country-wide and Kampala-specific scoring. While this method cannot thoroughly assess and predict the vulnerability to future disasters, it provides a good overview of how and where people are most affected. The compound vulnerability score is constituted of descriptive information like the elevation and slope of the environment, combined with climate prediction data (rainfall, sea level changes) and are overlaid with the population and infrastructure (roads, hospitals, schools, health facilities) at risk (UN-Habitat 2011).

This confirms that from experience flood-related risks prove to be the highest challenge for Kampala and are, therefore, the focus of this study (Fig. 2). The direct risks include the destruction of property due to flooding, as well as landslides as results of heavy rains and more spatially concentrated floods. The secondary effects are more difficult to assess but include rising water-spread diseases (Malaria, Dysentery, Cholera), pollution due to inadequate waste management (Mukama et al. 2016) and its distribution during floods and resulting challenges after the destruction of critical infrastructure or the temporal inaccessibility (KCCA 2016).

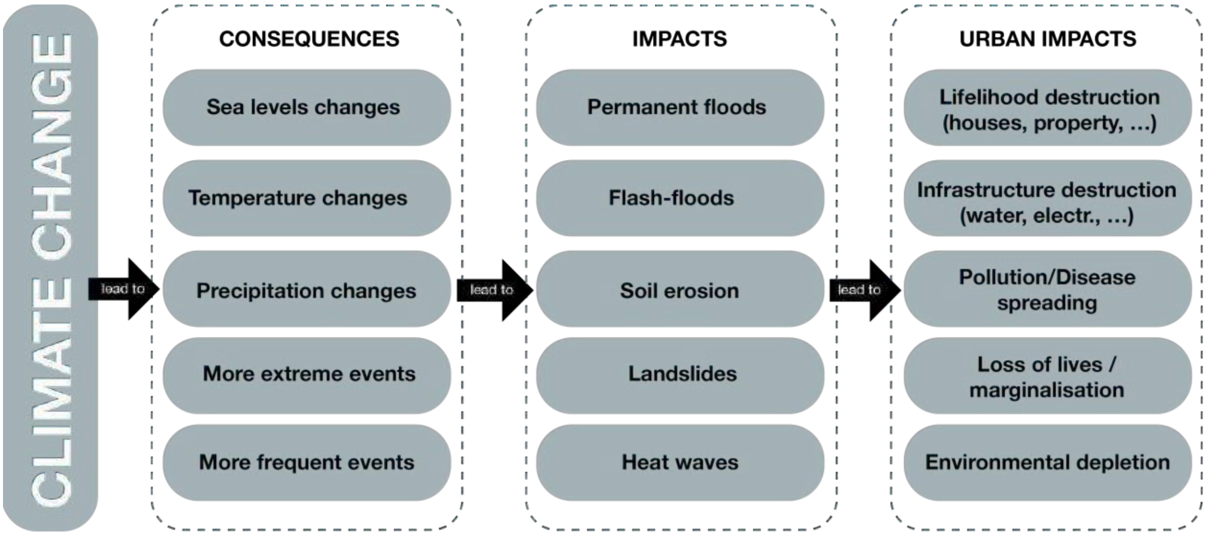

Figure 2: Climate Change impacts on urban Kampala (Author 2018)

Why are so many people living in areas which are affected by these disasters? Isunju et al. 2015 blame the overall population growth and rural-urban migration in combination with unclear boundaries and land-ownership, as well as the "long-term failure of government regimes to enforce development control" (p. 276) which led to a large number of people encroaching on wetlands. In a study of several of these affected communities, Isunju et al. found that over 55 % were female and over two thirds 30 years and younger, which again shows the unequal exposure to disaster risks. Additionally, the majority (73.3 %) of the surveyed households were only earning between 40 and 120 USD (assumed conversion rate of 1 USD = 2,500 UGX in 2015) and nearly half without secondary education. Furthermore, the perception of vulnerability to hazards was enumerated and shows that more than 50 per cent perceive themselves as very vulnerable to disease vectors and floods (Isunju et al. 2015; Isunju 2016). Lastly, there is a risk of floods negatively affecting the water quality of both tap water and even more well water which, combined with the rising water shortages endanger the water provision for the (mostly poor) population while contributing to the spread of diseases due to poisoned water and less preventive sanitary actions in times of clean water scarcity (Godfrey et al. 2003).

While a strong interrelation between the risk exposure to floods and the socio-economic characteristics of the affected population seems to exist, proving it requires an improved method to distinguish the flood-prone areas – an endeavour which is always challenging in environments of less detailed databases and due to its predictive character. Different approaches have been developed and applied to model run-off water and the effects of land use changes on the Murchison Bay Catchment area (catchment area of Lake Victoria incorporating most of central Kampala). However, limitations of the underlying data and spatial inaccuracies make them only attractive as a basis but insufficient to produce a more comprehensive representation (Fura 2013; Anaba et al. 2017). Therefore, the most promising approach is currently the overlay of three layers, including the elevation and slope of the topographical, its distance to the next flood-prone area as distinguished by the Municipality and the soil type.

3. Methodology

In order to measure and compare the various elements mentioned above, they are translated into concepts, variables and indicators (Table 2). The four main concepts of urban form, risk exposure, adaptive capacity and sensitivity are subdivided into several variables whose definitions are included in the operationalisation table. Each of these variables is further divided into one or several measurable indicators. These indicators are further defined by the following attributes[ii]:

The measurement level (1) is generally divided into two groups because the jurisdictional boundaries do not represent spatial-functional relationships. Therefore, the Greater Kampala Metropolitan Area (GKMA) and the Selected Areas (SA) are studied with two different grid sizes of 500 x 500 m and 100 x 100 m respectively. These were chosen for the study on city and neighbourhood level. The 500 x 500-meter grid spans over the whole populated area of the GKMA. The 100 x 100-meter grid is used for the in-depth study of the SA. Both cell-sizes are chosen to establish a balance between large enough cells to guarantee a certain level of representativeness while still being small enough to distinguish high-resolution differences in the urban fabric.

Another indicator attribute is the unit (2) which represents the type of the final value and forms the basis for the ensuing normalisation. The indicator type (3) distinguishes between descriptive and performance indicators. Descriptive indicators describe a certain situation without giving any indication about a negative or positive impact on the overall score, while the value of the performance indicators has either a positive or negative impact. The shown distinction is based on the literature; however, the expert interviews attempt to give a more locally-adapted understanding and can lead to minor changes of the categorisation.

Limitations of the current methodology are the risk modelling. A more advanced risk modelling method would result in more elaborated findings and could bring more differentiated interrelations to light. Lastly, due to broad conceptualisations of adaptive capacity, indicators which better describe the social networks or available resources and access to information could further enhance the comprehensiveness. However, this would require an in-depth study of the studied households through a specialised household survey which could not be conducted as part of this research. While the variety of selected and measurable indicators should be able to draw a comprehensive picture of the actual situation, these limitations need to be considered and provide a potential for further studies when more information is available.

CONCEPTS	VARIABLES	INDICATORS	INDICATOR SOURCE
1 URBAN FORM	1.1 Street Network	Centrality	Hillier 2009; Patterson 2016
		Integration (Space Syntax)	Hillier 2009; Oliveira 2016; Ratti 2004
		Choice (Space Syntax)	Hillier 2009; Oliveira 2016; Ratti 2004
		Depth Distance (Space Syntax)	Hillier 2009; Oliveira 2016; Ratti 2004
		Accessibility to economic centres	Dadashpoor and Rostami 2017; Dony et al. 2015; Goswami and Lall 2016; Kanuganti et al. 2016
		Accessibility to educational facilities	Dadashpoor and Rostami 2017; Dony et al. 2015; Goswami and Lall 2016; Kanuganti

CONCEPTS	VARIABLES	INDICATORS	INDICATOR SOURCE
			et al. 2016
		Accessibility to health institutions	Dadashpoor and Rostami 2017; Dony et al. 2015; Goswami and Lall 2016; Kanuganti et al. 2016
		Accessibility to public transport nodes	Dadashpoor and Rostami 2017; Dony et al. 2015; Goswami and Lall 2016; Kanuganti et al. 2016
		KM of primary roads per sqkm	UN-Habitat 2016
		KM of secondary roads per sqkm	adapted from UN-Habitat 2016
		KM of paved roads per sqkm	adapted from UN-Habitat 2016
		KM of unpaved roads per sqkm	adapted from UN-Habitat 2016
		Number of nodes per sqkm	UN-Habitat 2016
	1.2 Built Environment	Building density	Adolphe 2001; Hillier 2009; Jacobs 1961; Pont and Haupt 2009; UN-Habitat 2016
		Site occupancy index	Adolphe 2001; Hillier 2009; Jacobs 1961; Pont and Haupt 2009
		Average plot size	Hillier 2009; Jacobs 1961; Pont and Haupt 2009
		Average building size	Hillier 2009; Jacobs 1961; Pont and Haupt 2009
		Building proximity	Adoplhe 2000, Dadashpoor and Rostami 2017, Dave 2010
	1.3 Land Use	Amount public space	Adoplhe 2000, Dadashpoor and Rostami 2017, Jacobs 1961, Pont and Haupt 2009
		Amount green space	Adoplhe 2000, Dadashpoor and Rostami 2017, Jacobs 1961, Pont and Haupt 2009
		Percentage of mixed functions	Adoplhe 2000, Dadashpoor and Rostami 2017, Jacobs 1961, Pont and Haupt 2009
		Settlement type	EARF research project
2 RISK EXPOSURE	2.1 Probability	Elevation	UN-Habitat 2011
		Slope	UN-Habitat 2011
		Distance to flood prone area	UN-Habitat 2011
		Disaster occurrence in last 2 years	EARF research project
	2.2 Secondary Risks	Number of malaria cases	adapted from UN Pulse Lab
		Number of typhoid cases	adapted from UN Pulse Lab
		Number of dysentery cases	adapted from UN Pulse Lab
3 ADAPTIVE CAPACITY	3.1 Resources	Household income	Adger 2006; Adger 2007; ARCC 2013; Weis et al. 2016
	3.2 Behaviour	Social integration	Adger 2006; Adger 2007; ARCC 2013; Weis et al. 2016
		Perception of risk	EARF research project
		Level of 'formality'	Adger 2006; Adger 2007; Cordona et al. 2012; Haas 2017
	3.3 Knowledge and Information	No. of active institutions	Adger 2006; Adger 2007; Williams et al. 2015
		Internet use	Adger 2006; Adger 2007; Williams et al. 2015
		Level of education	Adger 2006; Adger 2007; ARCC 2013; Weis et al. 2016
4 SENSITIVITY	4.1 Human sensitivity	Population density	Hillier 2009; Jacobs 1961; Pont and Haupt 2009
		Gender	Adger 2006; Adger 2007; Cordona et al. 2012
		Age	Adger 2006; Adger 2007; Cordona et al. 2012
	4.2 Building sensitivity	Built floor quality	Adger 2007; Dickson et al. 2012; Dodman et al. 2015; Elrich-Barr et al. 2014; Jones 2010; Schreiner 2012
		Built wall quality	Adger 2007; Dickson et al. 2012; Dodman et al. 2015; Elrich-Barr et al. 2014; Jones 2010; Schreiner 2012
		No. of rooms	Adger 2007; Dickson et al. 2012; Dodman et al. 2015; Elrich-Barr et al. 2014; Jones 2010; Schreiner 2012
	4.3 Infrastructure sensitivity	Road sensitivity	EEA 2016; Engle 2011; Isunju 2016; Weis 2016
		Water provision sensitivity	EEA 2016; Engle 2011; Isunju 2016; Weis 2016
		Educational facility sensitivity	EEA 2016; Engle 2011; Isunju 2016; Weis 2016
		Health institution sensitivity	EEA 2016; Engle 2011; Isunju 2016; Weis 2016
		Religious institution sensitivity	EEA 2016; Engle 2011; Isunju 2016; Weis 2016

4. Application

Before the methodology can be used, several steps need to be undertaken. They include defining the sample selection and size. Furthermore, the application can be divided into data assessment, which includes underlying steps and calculations, and the analysis, which interprets the resulting variables.

4.1 Sample size and selection

The spatial analysis is conducted at two levels, firstly the GKMA and secondly the SA. The latter is selected through a two-step sample process. As a first step, the EARF research team established a purposive sample of some parishes to cover a wide variety of land development patterns. Two corridors were distinguished: one from the centre to the north-west (along Hoima Road), and one to the east (along Jinja Road). For the household survey which was carried out as part of the research compendium, about 2800 households were enumerated which are equally distributed over eight strata (four different residential housing types and core and peripheral locations). Inside these, the households were selected through a random generation of coordinates. The enumerators started off from these coordinates and then approached the closest household.

In the second step, areas were selected inside these corridors through another purposive sample for the in-depth analysis of this thesis. This selection was done based upon a broad coverage of the different housing types, levels of centrality and vulnerability and distances to flood-prone areas, as well as the availability of in-depth spatial data. The data collection method is a mixed-method approach using existing quantitative secondary data and semi-structured expert interviews, observations to distinguish the public transport nodes, as well as the conducted EARF household survey. These strategies were chosen to garner a broad data set of both quantitative and qualitative data to understand the distribution and prevalence of risk and its interrelation with urban form. Furthermore, the interviews are used to weigh the various indicators according to their importance to achieve a representative weighting as part of the aggregation process. This process is done through a participatory multi-criteria decision analysis which lets the participants compare and assign values for each indicator in comparison to the other indicators in the same sub-group[iii] (Scott 2005, pp. 705-706). Lastly, papers and reports which focus on the climate change related risk improve the data input for the analysis of the data. The gathered qualitative data mainly assist the interpretation of the quantitative findings while also supporting the process of quantitative data collection as well as the focus, selection and weighting of the secondary data indicators.

The collected secondary quantitative data comes from various sources. Firstly numerous information from governmental institutions: i.e. the jurisdictional boundaries, the national household survey of 2014 as well as the flood-prone areas. Secondly, information produced as part of the EARF project is integrated: mainly the different housing typologies and the household survey. Additionally, other data sets are imputed from a range of recent datasets and reports which examine one particular issue in detail: amongst others, the reports on the vulnerability of Kampala (UN-Habitat 2011) and the World Bank report on economic centres (Goswami and Lall 2016). Lastly, for quantifying urban form and accessibility to various facilities, in-depth spatial data is required which is mainly collected from OpenStreetMap and extended through own mapping.

4.2 Data assessment

The conducted data assessment of the spatial elements consists of mainly four different parts:

1. Assigning existing geo-referenced data to cells.
2. Incorporating various types of spatial analysis and including basic calculations like counting the number of buildings or the length of streets per cell.
3. The Urban Network Analyst Toolbox for ArcGIS of the City Form Lab is used to calculate integration, choice and depth distance, based on infrastructure data from OpenStreetMap.
4. The Variable-width Floating Catchment Area (VFCA) method which builds upon the Two-step Floating Catchment Area Method (2SFCA) is used to calculate accessibility to economic centres, different facilities or functions.

The latter method was originally developed to calculate the accessibility of the population to health facilities. However, Dony et al. (2015) adapted the methodology to include other types of functions and takes varying weights or levels of attractiveness into consideration (in their case for example the size and number of amenities of parks). It is therefore seen as the most appropriate method to calculate accessibility to various functions which differ between their characteristics. As an example, this research calculates the accessibility to public transport nodes. However, one node just serves a few city-wide transport modes while others also cater for national or international routes. Therefore, an adapted weighting is required to take these differences into consideration. Lastly, the VFCA like the 2SFCA depends on the selection of the calculation method of distances. For this, different approaches exist, amongst other the Euclidean distance, the time-distance or network distance (Kanuganti et al. 2016). The Euclidean distance is chosen[iv] and measured through the Network Analyst Toolbox of ArcGIS.

4.3 Data analysis

The resulting geo-referenced quantitative data of the selected areas allow for regression analyses to distinguish patterns and understand which factors are interrelated. Through the qualitative data of the interviews and previous reports and articles, the quantitative results can be further explained, interpreted and situated into the larger context of risk distribution and the resulting spatial (in-)justice. To be able to compare all data with varying units, the values are normalised before further analysis after which each value is represented by a number between 0 and 1. Furthermore, to reduce the number of indicators to a manageable size and eradicate non-essential ones, two steps are undertaken. First, a redundancy analysis is conducted to identify indicators which nearly completely correlate and, therefore, mainly provide the same information. Secondly, the various indicators are aggregated to compound scores for each variable to simplify the comparison and regression analysis.

Afterwards, mainly two analysis approaches are applied. In the first step, the Ordinary Least Squares (OLS; Hutcheson 2011) method is applied, which distinguishes the unknown factors in a linear regression. This means, that for example the compound score of urban form of each cell is compared to the variables of risk exposure, adaptive capacity and sensitivity and the impact value of each aggregated indicator are calculated based on the minimal average coefficient of determination (R^2). Based on the findings of the OLS analysis, the most significant factors can be distinguished and further studied individually through selected multiple regression analyses. This regression analysis is conducted in several steps and afterwards scaled down. This anticipated regression analysis is conducted in several steps and afterwards scaled down. The general formula of the OLS-regression is as follows:

$$\mathbf{y^1 = ß^1x_i^1 + ß^2x_i^2 + \ldots + ß^px_i^p + \varepsilon_i}$$

In the first two separate analyses, the aggregated scores of the two concepts (Urban Form and Flood-related urban risks) represent the $\mathbf{y^1}$ on the left and the aggregated variable scores constitute the $\mathbf{x_i^p}$ values on the right with the objective to distinguish the broader $\mathbf{ß^p}$ values. Afterwards, a more detailed analysis is conducted which looks at the different variable interrelations independently by again keeping the two concept scores as $\mathbf{y^1}$ but splitting the variables into the constituting indicators. The latter has the objective to distinguish the strongest correlations and simultaneously exclude possible non-correlated indicators from further analysis. Lastly, the strongest correlations are studied by multiple regression analysis to investigate them in greater depth.

As a second step, a classification of the cells is undertaken in order to distinguish patterns and expand the findings to the whole city based on shared characteristics. This is done through a Principal Component Analysis, which combines correlating elements and combines them with linearly unrelated aspects and therefore creates a categorisation based on similarity and difference of all input values. The method can be best understood by imagining a coordinate system in which the principal component axis represents the first correlating elements and every further mostly unrelated component results in a perpendicular axis to the first one. The same process is repeated for each element until all axes are situated in relation to each other and the individual studied subjects are located in a multi-dimension coordinate system. This distribution then leads to a categorisation which best represents the similarities and differences of the various input variables.

The expected outcomes are an indication of the interrelations of various sub-variables as well as the interdependency of particular factors to all other relevant ones. Furthermore, the Principal Component Analysis shall lead to a classification of the studied cells and therefore visualises patterns and can allow generalisations up to a certain degree for the whole urban area of Kampala. Therefore, the outcomes of the study are partly descriptive and partly prescriptive. Some outcomes solely represent already existing information in combined and more detailed manners, while others, like specific interrelations between factors, give an indication about expectable developments in the future and how one might affect another one and therefore also where and what kind of interventions might be most fruitful to anticipate further marginalisation and spatial inequalities.

5. Conclusion

This methodological approach to measure risk exposure, adaptive capacity and sensitivity and contrast it with urban form, allows for a quantification of spatial climate change injustice in the context of limited data availability and needs considerably less information and technological resources than existing approaches. However, it results in spatial pattern distinction and assists to better understand the social and environmental urban development. Furthermore, whenever new data becomes available or information is updated (spatial information), the model can be extended and adapted to make temporal studies and analyse how the urban areas develop over time.

However, the current limitations of the methodology are on the one hand the flood-risk model and secondly the assessment of social networks as part of the adaptive capacity. However, the findings should be able to paint a better picture of Kampala's current situation while also helping to understand the spatial injustice of climate change consequences in similar urban contexts of SSA. Based on the results of the analysis, which is currently conducted, better and more precise policy decisions and spatial interventions can be developed by the responsible organisations and their success assessed over time.

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[i] This paper builds upon and contains sections of the author's master thesis research at the Institute for Housing and Urban Development Studies (IHS), Erasmus University Rotterdam, and is integrated in the broader research project 'Spatial Inequality in Times of Urban Transition', conducted by the IHS, the Development Planning Unit (University College London) and IPE Tripleline and is funded by the British Government's East Africa Research Fund.

[ii] Indicator attributes are not included due to the scope of paper but available upon request.

[iii] The most important indicator gets a score of 100 points, and other indicators are compared to the first and given scores according to the relative importance.

[iv] Euclidean distance, defined as the distance in meters by using the existing network in the shortest possible way, does not consider varying infrastructure densities and time-distance. Therefore, it is challenging to select the right network-distance due to strongly varying modes of transport. Even if different qualities and sizes of roads (e.g., paved/unpaved) are not accounted for, it appears to be most accurate under the given circumstances.

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London and Climate Change

A zero carbon city for 2050 – achievable or just hot air?

Dr Chris GOSSOP

Abstract

London is about to have a new spatial development strategy that will take it towards the 2050s. This third version of the London Plan is the vision of Mayor Sadiq Khan, and it stems from the establishment of the Greater London Authority in 2000. The target for the environment is of a zero carbon city by 2050. This paper analyses the policies and proposals that underlie that target, focussing on the challenge for housing. That challenge is formidable. For one thing, London is set to grow from its present population level of 8.7 million to possibly 11.1 million by 2050 which adds to the scale of what needs to be done. For another, as the independent Committee on Climate Change has warned, progress on securing greenhouse gas (GHG) emissions across the UK has stalled and we need a steeper trajectory if national and international targets are to be met.

Some four fifths of current emissions result from London's buildings – its 3.4 million homes in particular. The draft Plan charts a 'zero carbon pathway' that combines national measures – such as the decarbonisation of the gas grid – with increased action at the London level on - energy efficiency, renewables and local, decentralised energy production. New build properties will need to be zero carbon from the start and the current 'performance gap' will need to be greatly reduced to enable that. But it will be harder still to achieve the effective retrofitting of the millions of existing properties, many of which perform poorly in energy terms. This will require a step change in terms of implementation beyond anything that has been achieved so far. Can the new London Plan succeed? This paper addresses these matters, looking both at the policy base and at some encouraging achievements on the ground.

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Introduction

London is preparing a new spatial development strategy that will take it towards 2050. By that date, according to Mayor Sadiq Khan, London is to be a zero carbon city. That will have profound implications for the way Londoners live, work and travel; it will also necessitate big improvements in energy efficiency in buildings and changes in the sources of energy and the way that energy is used (*The Mayor of London, 2017*).

It entails the city becoming decarbonised within the next three decades, moving from the present 38 megatons of greenhouse gases (GHG) emitted annually (about seven per cent of the UK's total emissions) to near zero by 2050. Some four fifths of that total comes from London's buildings, primarily its 3.4 million homes, and it is on housing, both present and future, that this paper concentrates.

The emerging London Plan, the third such plan since the Greater London Authority (GLA) was established in 2000, is of key importance for the transformation of London's housing stock, guiding both the housing to be built and the stock that will have to be upgraded. As will be reviewed below, progress right across the United Kingdom on pushing energy efficiency higher has stalled in recent years, casting doubt on whether London's own aspirations are realistic ones.

Also, current ways of boosting efficiency are not always giving us the progress that we need, as is seen in the reality of the 'performance gap'. However, new ways of securing energy efficient properties have emerged and these approaches will also be described. The paper concludes with some comments about the likely effectiveness of the new London Plan in helping realise the zero carbon aim. Will the Plan's policies, together with other related action be enough?

Context – The UK's housing stock

The UK has some 25 million homes. These have the oldest age profile in the European Union with some 60% being built before 1960 and only 10% in the twenty years between 1991 and 2020 (*BPIE, 2011*). One of the fastest periods of growth was in the inter-war years when many millions of, typically, semi-detached dwellings were built, creating the low density suburbs which form a major part of most urban areas today and, in London's case, are so evident from the flight paths serving Heathrow. While such housing provided an attractive and comfortable environment for its new occupants (and continues to do so today), these properties, and, even more so, the terraced housing of the nineteenth century, are notoriously 'leaky' in energy terms. They are a product of the coal era and cheap fuel for keeping families warm through the British winter.

While winter comfort is now provided mainly through gas central heating and upgraded insulation, the higher temperatures expected today mean that such properties are typically costly to heat and significant emitters of GHGs; overall, they remain some of the most expensive homes to heat in Europe (*The Guardian, 2013).* The English Housing Survey confirmed that the majority of the least energy efficient homes were the oldest ones, built before 1919 (*HM Government, 2013*).

Context – The Energy Efficiency Agenda

The 1973 oil crisis was a wake up call and it led eventually to improved insulation standards for new housing. Forty Years on the Government's English Housing Survey was able to report a significant rise in average energy ratings from 46 in 2001 to 60 in 2013, based on the Standard Assessment Procedure (SAP) ratings used in the UK to assess and compare energy and environmental performance in dwellings. Over this period there had been an almost doubling of the number of homes with cavity wall insulation from 5.8 million (39%) to 10.8 million (68%) and, similarly, in the proportion that were fully double glazed from 51% to 80% (*HM Government, 2013*).

Improvements in energy performance have also resulted from changes to the UK's building regulations, and from technological advances, notably the condensing gas boiler with its 90% efficiency (also suitable for retrofit). The 21st century has seen moves at European level to measure and certify the performance of buildings – through the EU's Energy Performance of Buildings Directive; one outcome of this is the Energy Performance Certificate (EPC) required in the UK for all newly built properties and as part of the documentation in property sales (*Mashford, K. 2016*).

Other innovations in the UK included the 2006 Code for Sustainable Homes with its six code levels spanning levels of performance beyond the requirements of Part L of the Building Regulations, Level 6 being a 'zero carbon home'). (Communities and Local Government 2006*).* However, while the intention had been to drive 'a step change in sustainable building practice', in 2015 the Code was withdrawn by the Government as a deregulatory measure.

The Committee on Climate Change

A further driver of improvements was the UK's Climate Change Act 2008 which committed the UK Government to reducing GHG emissions by at least 80% on 1990 levels by 2050. It set legally binding carbon budgets, each capping UK GHG levels emitted over a five year period. These budgets are the responsibility of the independent Committee on Climate Change (CCC) which has steered the first five such budgets, taking the UK up to 2032.

However, this June, this highly respected Committee found itself having to issue a severe warning to the UK Government that the UK is not on course to meet the fourth or fifth carbon budgets, taking us to 2023-2027 and 2028-2032 respectively, despite the legal requirement to meet them (*CCC, 2018*). The CCC acknowledged that, since 2008, the UK had seen a rapid reduction in emissions from the electricity sector as coal fired plant is retired and as renewables become mainstream. However, that success 'masks a marked failure to decarbonise other sectors, notably transport, agriculture and buildings'; in the last five years, emission reductions in these areas had stalled. In its 2018 Progress Report to Parliament it sets out four key messages for Government – see also the 'Infographic' below.

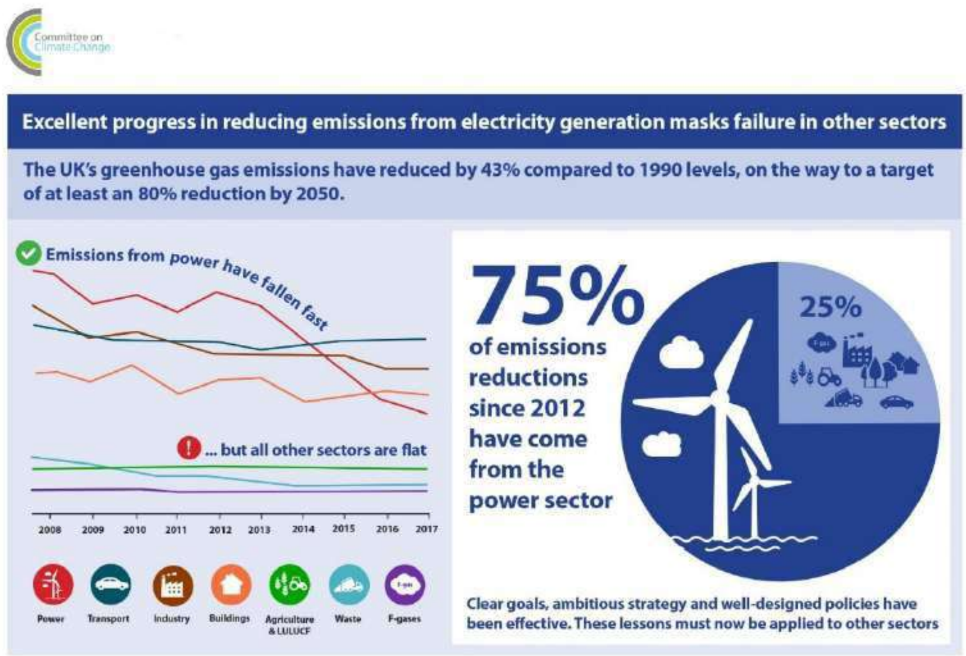
First, Government needed to support 'the simple, low cost options'. In terms of the energy and buildings sector, the withdrawal of incentives had cut home insulation schemes to 5% of their 2012 level, while the Government had failed to provide a route to market for cheap onshore wind. The whole economy cost of meeting the legally binding targets would be higher without cost-effective measures in every sector.

Secondly, they should 'commit to effective regulation and strict enforcement'. Tougher long-term standards for construction, for example, would cut emissions, while driving consumer demand, innovation and cost reduction. And, as with motor vehicles, the proper enforcement of regulations would safeguard the consumer when (in this case) property emissions exceeded the quoted test-cycle numbers.

Thirdly, they needed to end 'the chopping and changing of policy'. In recent years, important programmes had been cancelled at short notice. These included Zero Carbon Homes and the Carbon Capture and Storage (CCS) commercialisation programme. A consistent policy environment was needed to keep investor risk low, reduce the costs of capital and give businesses the confidence to build the necessary supply chains.

Fourthly, they should act now to keep long term options open. That 80% reduction in emissions had always implied the need for new national infrastructure – for example, to transport and store CO_2 or to provide decarbonised heat, and the deeper Paris Agreement made such steps even more important. The Government needed to show that it was serious about the long term need for new technologies such as carbon capture, and the electrification of heat.

Overall, the Government needed to learn quickly from its mistakes and by the end of 2018 introduce concrete policies to secure, among other things, improvements in residential energy efficiency, a deployment pathway for CCS and new incentives to people to buy electric vehicles. Such action was now urgent in order to meet the UK's legally binding climate change targets and the obligations of the Paris Agreement (*CCC, 2018*).



The Way Ahead for London?

Those four messages are notable for their emphasis on buildings and energy policy. And recent news, principally on the Government's decision to scrap the proposed Swansea Bay tidal barrage (*BBC News, 2018*) - ironically made on the same day as Parliament announced a go ahead for the third Heathrow runway (*BBC News 2018*)- casts doubt on the Government's commitment to respond properly to the very long term responsibilities of the Climate Change Act.

The CCC was in no doubt that big improvements in the energy efficiency of our buildings would have a necessary part to play in meeting budget targets. It commended the ambition set out in the Government's Clean Growth Strategy published in October 2017 but expressed disappointment that there were 'few new specific policies to deliver real emissions reduction' (*CCC, 2018*).

In the meantime, the Mayor of London is planning five year carbon budgets for London as a way of driving action towards his zero carbon target for 2050; these would align with the CCC's carbon budgets. His draft policies for the building sector cover both new build and retrofit (*Mayor of London 2017*).

New Build for London - Density

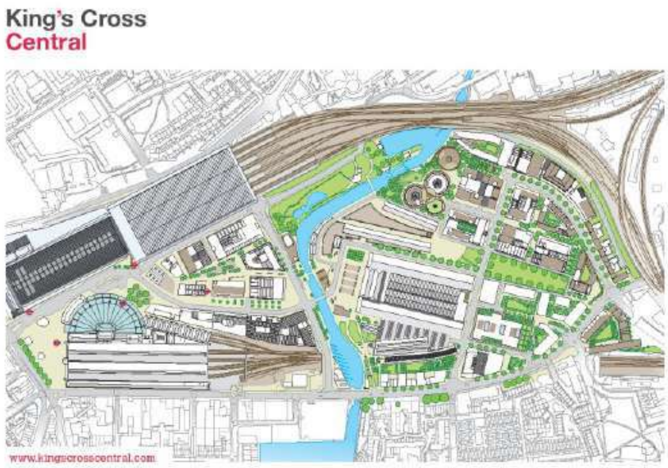
By 2050 London will need some 1.3 million new homes (together with some ten million m^2 of new schools, hospitals and workplaces). The Green Belt and London's Parks and other designated Open Spaces will remain in place and these new buildings will typically be built at a high density, on previously used brown field land. While draft Policy D6 of the new London Plan is now about optimising density rather than specifying appropriate density ranges (as in the first London Plan), in practice, the current high (for the UK) densities of recent development are likely to prevail. This is the continuing response of the market to the general shortage of land; the low densities typical of the pre-war period are very clearly at an end.

Draft Policy D6 indicates that the optimum density of a site should be determined by a design led approach whereby the appropriate form and scale of new development is established through a design process that takes account of the surrounding built form, proximity and access to services and infrastructural capacity, particularly public transport.

In practice, much of the new housing, and often the workplaces, will continue to be concentrated in the designated Opportunity Areas (for example at King's Cross), and other growth areas which are places of high accessibility for public transport. As electric buses gradually replace diesel and as the electricity supply is progressively decarbonised we can look forward to both better air quality and a reduction in GHG emissions from transport; that sector is currently responsible for some 20% of overall GHG emissions across London. And these concentrated areas are often especially suitable for locally based energy systems generally associated with lower GHG emissions. King's Cross is a notable example.

Case Study 1. King's Cross – an energy efficient Urban Quarter for London

King's Cross is one of the largest and most challenging urban regeneration projects in Europe. It is a recognised standard setter for masterplanning and integrated transport planning, and for the creation of a new London quarter reaching new heights in terms of urban design and sustainability. Structured around its two railway terminals, King's Cross and St Pancras International, and bisected by the Grand Union Canal, it will accommodate upwards of 20,000 workplaces and some 2000 homes, plus the student accommodation associated with the new base for the University of the Arts (see drawing to right). These uses are served by the King's Cross Energy Centre with its Combined Heat and Power Plant (CHP) supplying both electricity and hot water via a network of district heating pipes.



This system provides for some 80% of the quarter's electricity needs and 99% of its heating and this means that the individual developments - a mixture of new build and refurbished historic buildings - have no need for conventional boilers. All this work is being completed to high sustainability standards; by 2016, seven of the King's Cross buildings had been delivered certified as either Outstanding or Excellent under the BREEAM assessment scheme. Sustainability measures other than the CHP system, include much use of photovoltaic panels and green roofs. The aim is to reduce carbon emissions by at least 50% relative to 2005 levels. (King's Cross Central Limited Partnership, 2016/17)

New Build – the Energy Hierarchy

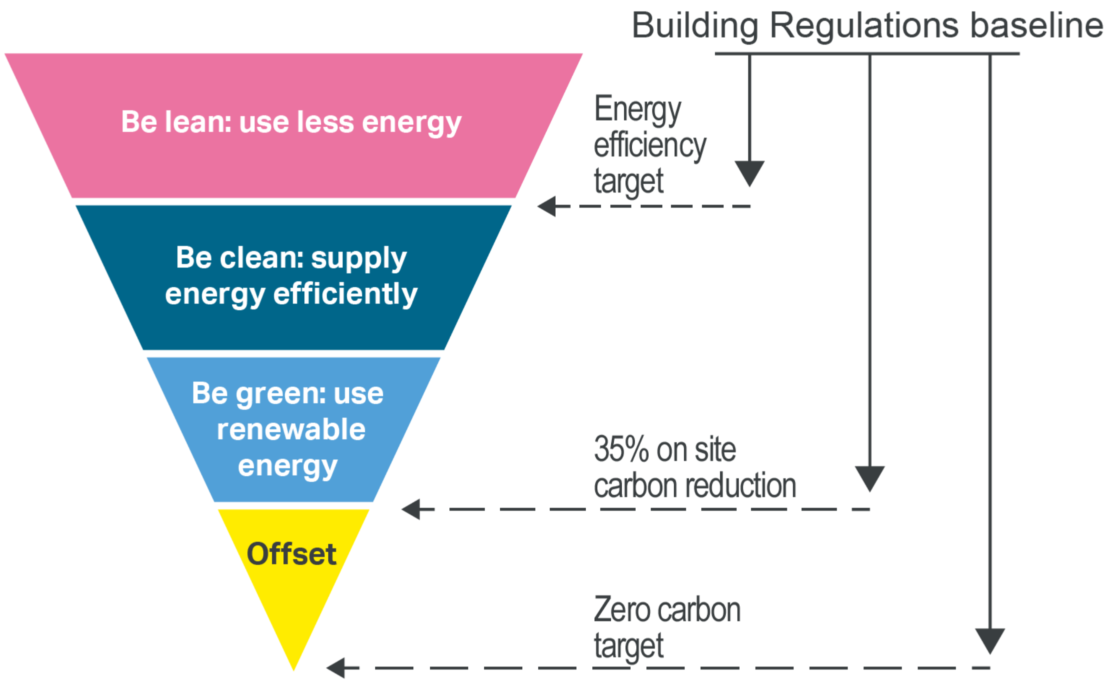
The Building Regulations Part L establish the required baseline for carbon emissions from new buildings in England and Wales. Successive iterations to Part L have raised the required performance under this baseline, the intention being to ratchet up standards over time in the light of technological advance and improved building practices.

For some time, London has sought to go further, the 2011 London Plan specifying a trajectory to zero carbon development and building in a target for a 35% improvement beyond Part L. This reflects the Mayor's responsibilities under the 2007 amendments to the Act that established the GLA which gave him the duty 'to contribute towards the mitigation of, or adaptation to, climate change in the United Kingdom'. A related responsibility (embodied in Policy S11 of the draft new London Plan) is to improve London's air quality and to reduce the concentrations of harmful emissions, notably in 'hot spot' areas where human health is particularly at risk.

Policy S12 of the draft Plan requires all major development to meet the zero carbon target. It is to be met in three ways, as shown in the GLA's energy hierarchy reproduced below (Mayor of London 2017, Figure 9.2). The first way is through energy efficiency measures (be lean), the second is through an efficient and low carbon energy supply (be clean) and the third is to include renewable energy (be green). Any residual emissions are to be offset into the particular borough's ringfenced carbon offset funds.

The hierarchy is based on a minimum level of onsite carbon reduction of 35% beyond that specified in Part L of the Building Regulations (2013 iteration). Residential developments are to aim for a 10% reduction towards that 35% through **be lean** measures, the aim for non-residential being 15%. GLA commissioned research found that those be lean targets are technically achievable and that in the case of the domestic sector 'they would help lock in long term carbon reductions based on an improved building fabric' (Mayor of London, 2017) .

The Energy Hierarchy – Draft London Plan, Figure 9.2



Source: Greater London Authority

Be Lean and the Performance Gap

But are those 'technically achievable' targets actually achieved in practice? Studies undertaken in the UK on behalf of Innovate UK on almost 4000 new dwellings provided initial indications that energy in use was typically some two to four times that predicted. This discrepancy between predicted and operational performance is widely recognised and is now referred to as '**the performance gap'**. One of its main sources derives from the *realisation* of the building - its translation from drawing, through to contractual requirements, and then to physical form. This can result from a range of factors, including: 'accidental' design changes, for example from product and material substitution; lack of precision in construction; and poor communication of design intent. Getting this right will require a major change of culture and practice across the construction sector.

Closing the performance gap will require better testing and verification methods so that building performance can be checked by all the stakeholders – against what has been specified at the design stage - and those delivering the buildings thus held to account. (*Mashford. K, 2016*).

Be clean – energy supply

After minimising demand through energy efficiency, the next stage in applying the energy hierarchy is to **be clean** through utilising energy generated from clean low carbon and renewable sources, such as waste heat and solar. Currently London sources about 95% of its energy from outside the GLA boundary. As the UK's remaining coal fired power stations are shut down and as increasing quantities of renewables come on stream, the UK's national electricity grid is progressively becoming decarbonised. However, as is the case with the country as a whole, London still remains heavily dependent on natural gas as its main energy source, especially for winter heating. While much cleaner than coal, gas burning remains a significant source of GHGs as well as contributing to nitrogen dioxide levels in the capital.

The London Plan seeks a shift from this reliance on gas to a more diverse range of low and zero carbon sources. This will align to moves nationally to change the way we heat our homes as we switch away from the use of natural gas. The options are to use a decarbonised alternative, using hydrogen or biogas in the present gas grid, to electrify our heating, or to develop heat networks; there are pros and cons for each of these choices and the likelihood is that a combination will be required. And, if we are to secure a cost effective transition, such change will need to be coupled with measures to reduce energy demand. (*Energy Research Partnership, 2017*).

In addressing how the future city should be heated, the new London Plan places considerable emphasis on the important role that decentralised energy could play in many of London's denser areas. As has long been practised on the European continent – and already in a few places in the UK, including London - these green or waste resources can be brought together and connected to buildings through district heating. That heat can come from a range of places – for example from industrial processes and through the recycling of waste - and can also be associated with local electricity generation through combined heat and power (CHP) systems. UK examples include the use of geothermal energy in buildings in central Southampton and energy recovery from trains on the London Underground *(TfL 2015)*

The new draft London Plan seeks to promote the development of heat networks through encouraging future proofed building designs for communal heating and requiring the energy masterplans needed for major schemes to identify decentralised energy opportunities (Policy S13). Where feasible, developments should connect to existing heat networks and/or areas prioritised for heat networks by the London Boroughs – these are areas identified for growth and regeneration and with high heat densities .

Heat pumps are seen as the technology that can increasingly serve as the energy source for district heating. Compared to present options such as the gas engine, heat pumps save more carbon over the medium to long term and they need have no adverse impacts in respect of air quality.

Be Green – Renewable energy

The third part of the equation to reach towards zero carbon levels is to fit renewables to individual houses, or collectively. There is greatest scope for photovoltaic panels (PV). Countering the earlier savage cuts in the government's feed-in tarif, technological advances, coupled with reducing costs from manufacturing at scale and the introduction of battery storage, have improved the competitiveness of solar electricity, and made PV a serious proposition for many householders. Solar thermal installations to produce hot water can also be attractive.

This installation of panels on buildings, and the use of roofspace generally, is one component of the Mayor's draft Solar Action Plan for London which would also embrace publicly owned buildings and land, including railway land. His target is a tenfold increase in solar generation beyond the scope of existing programmes – reaching 1 Gigawatt by 2030 and 2 Gigawatts by 2050 (*Mayor of London, 2018*).

Carbon Offsets

Returning to the GLA's energy hierarchy, the final component covers any shortfall between Building Regulations compliance plus the minimum 35% figure and zero carbon. In those circumstances, developers are required to make a cash in lieu payment to the carbon offset fund of the local planning authority concerned. In the case of Camden Council, for example, this enables grants to be paid for renewables and energy efficiency measures to residents and landlords, community groups and businesses (*Camden Council, 2017*).

The offset sum is calculated by subtracting the regulated carbon savings – the total of be lean, clean and green - from the target savings, multiplying this first by 30 (years) and then by a carbon offset price to reach the required cash in lieu contribution. At present, the GLA continues to recommend boroughs to use the nationally recognised non-traded price of £95 per tonne, the viability of which has been tested through the Local Plan process.

Retrofitting London's homes

So far this paper has concentrated on the new housing that London will need to accommodate to cope with growth up to 2050 and restricting that to zero carbon will be a major responsibility for the planners and everyone else involved. However, beyond that challenge there is the even bigger one of retrofitting the existing housing stock so that it can be made significantly more energy efficient, as well as more comfortable for those poorer occupants who cannot at present afford to heat their homes properly.

The vast majority of London's present 3.4 million homes are likely to still exist in 2050 and its upgrading represents London's largest single challenge in moving towards the zero carbon goal. How do we achieve this in practice? We already know what has to be done. The main things are insulation that really works, active thermal mass to absorb temperature gain, effective draught proofing to keep the heat in and heat recovery from ventilation (*Dunster.W.2018*).

But just as we have been designing new properties for good energy performance but failed to achieve that performance in use, the same has happened with refurbishment and retrofit. To achieve significant improvements at scale we need a professional approach embracing: proper knowledge of the pattern of energy use before refurbishment (the base line); validating the improvements made to fabric and services during the works; and monitoring the delivered performance so as to verify it (*Mashford.K, 2016*). We also need many more accredited firms with the range of skills able to tackle this work across the many types and ages of housing they will encounter. These will include properties in conservation areas where architectural considerations, such as ornate detailing, will often preclude external insulation, especially to front elevations.

But why should those responsible for the buildings – especially the private owners and landlords - choose to invest in complex and often disruptive building works where the pay back may be several years in the future? As mentioned earlier this last five years has been a period of little apparent interest by central government in energy efficiency matters, leaving householders with limited incentive to invest. Instead, inspiration has had to come from other bodies and from committed individuals to demonstrate what can be done. The SuperHomes network is a prime example of this.

Case Study 2 - SuperHomes

SuperHomes, has brought together a community of dedicated homeowners who have succeeded in reducing their CO_2 emissions by at least 60% and were willing to share their experience with others through open house events and web exchanges. To date the UK wide network is about 200 houses strong, about half of which are in London. The programme has enabled several thousand people to visit their local SuperHome and to benefit from the practical advice from the owners in considering their own improvements (*National Energy Foundation, 2018).*

Open Day for a SuperHome

London is of course an international city, well connected to the European mainland and well able to exchange ideas with its neighbours on technological advancement. As an incoming idea, Energiesprong is a Dutch Government supported approach to whole house refurbishment that is guaranteed to secure significant energy savings.

Case Study 3 Energiesprong

This Dutch approach to mass refurbishment features customised, off site manufactured walls and roofs pre-fitted with windows and doors, and a new energy system including renewables. Each renovation takes just a week with no need for the occupants to move out. With the cost covered long term by the guaranteed energy savings, these 'new look' retrofits aim to secure the upgrading of whole terraces, streets and blocks, regenerating entire neighbourhoods.

Energiesprong UK seeks to bring this Dutch approach to the UK, London included. Founded in July 2015 as a group of social housing providers, construction companies, trade bodies and expert organisations, this new body aims for refurbishment solutions that provide: guaranteed performance over 30 years; financial viability for both landlords and tenants; and desirability – in terms of limited disruption, aesthetics and comfort levels, and enhanced asset value.

As in The Netherlands, the starting challenge in the countries that are seeking to adopt Energiesprong is to bring down the unit cost through industrialised mass roll out and volume

Some of the first ten Energiesprong homes in

Nottingham, England – Melius Homes

prefabrication. Already, the first UK scheme, in Nottingham, is up and running. Ten 1960s homes have been refurbished through a partnership between the City Council, Nottingham City Housing (the management organisation, Melius Homes (the contractor) and Energiesprong UK, aided by funding through two EU programmes. In addition to super thick insulation for the walls and solar roofs, the upgraded houses come equipped with battery storage and ground source heat pumps (*Smith.A.2018*).

London will soon follow suit with a further ten hard to heat homes built between 1950 and 1980. As with the Nottingham project, this pilot will be supported by the EU, in this case under the Transition Zero programme; the purpose of that support is to help deliver the right market conditions for net-zero energy refurbishment in the UK.

In terms of future scaling up, Energiesprong UK currently envisages a programme of 5000 refurbishments, while an analysis by the Energy Saving Trust suggests that London has some 250,000 properties that would lend themselves to this sort of upgrading.

One of the beauties of Energiesprong is that it looks at real life performance over a long period and not just at modelled performance. And those desired outcomes – for example, perhaps maintaining a temperature of 21 degrees C in the main living room, 18 degrees elsewhere have to be delivered to the tenants. So to be viable for the providers the building has to perform as specified and there is no room for the sort of performance gap which so often afflicts the new and retrofitted homes delivered under the present ways of working. If that gap can be eliminated or reduced substantially, the approach can make a big contribution to the upgrading of our older housing stock and to reductions in emissions.

Discussion

There is no doubt that it will be a massive challenge for London to attain zero carbon by 2050. A level higher, the same goes for the United Kingdom and for the world's nations, the vast majority of which are signed up to the Paris Agreement. As the Climate Change Committee has revealed in its rebuke to the UK Government, it is all too easy to 'get your eye off the ball' for something as apparently far off as climate change, to forget about, or to put off the awkward decision, or perhaps leave it to the next administration! But this imperative isn't that far off, and already important deadlines have been missed.

To focus back on London, and London's housing, several of the necessary ingredients are in place, at least. There is a Plan with a requirement for zero carbon housing and, while this is challenging , we know what has to be done. The Passiv House approach is one way to achieve this and architect Bill Dunster has detailed another (*Dunster.W, 2018*). Now, all new houses need to be built to zero carbon standards.

What is worrying though is the apparent persistence of the 'performance gap' and the evidence that we may be achieving rather less than we thought we were achieving. As stated earlier this has to be comprehensively addressed and one fundamental is a change of culture and practice across the construction sector. While it is being developed initially for the social rented sector and for major refurbishment, the Energiesprong approach with its pre-fabrication and special funding mechanism may be of wider application.

The first examples of Energiesprong renovated homes are now being delivered in the UK and the initial results are promising. Rather than just another pilot this is an industrial scale programme with potential to make a big, area wide, impression on retrofit – and on some of London's least energy efficient social housing. At the same time this is comparatively modern housing with plenty of space around it for the cranes needed to install those pre-fabricated walls and roofs. There are question marks about how it would work in more densely developed areas characterised by bumper to bumper kerbside parking, and in areas of Victorian era terraced housing with thin walled rear extensions which would be complicated to envelope. Clearly, there is much variation in the existing stock and each type of area will require its own retrofit solution.

It might be argued that the scale and complexity of the retrofit task for London is such as to suggest that, beyond a certain 'lower hanging fruit' level we might concentrate instead on another part of the energy hierarchy - **be clean -** in which the supply is decarbonised. However, that other part which entails moving away completely from the use of natural gas is itself hugely complicated and it is a challenge for which we do not yet have a complete answer. By pursuing a scaled up energy efficiency programme London can reduce its overall energy demand in buildings as an essential part in the transition to low carbon heat.

And that **be clean** part of the agenda will itself be multi-stranded. It will involve a combination of action at national level – moving towards reuse of the gas grid using hydrogen (with a small contribution from biomethane) and local decision making on decentralised heating, with a likely special role for heat pumps.

There is much more that would need to be done; bringing down buildings emissions across the capital will be a huge organisational task. And it will be essential to work closely with residents on these solutions so that families and individuals can help to reduce demand (and themselves save money) making use of smart technology and better knowledge.

To achieve a zero carbon London by 2050 would, of course, require many more strands of action than are described in this paper. But the housing sector is one of the more challenging and, if London can succeed on this complex front, there is every reason to believe that the other ones would be manageable too; the decarbonisation necessary for zero carbon buildings would work across to other areas too, notably transport.

If London is to succeed in this goal both with the housing sector and overall, this is going to require massive commitment and working together on the part of the local authorities, other relevant organisations and the people of London. It will also require close working with UK Government departments and progress on the key decisions and actions called for by the CCC to get the UK back on course to meet the legally binding fourth and fifth carbon budgets, covering the period up to 2032. The five year carbon budgets being considered for London by the Mayor will align with these and will be another indicator of progress towards the 2050 goal.

It should become clear within the next year or two whether the budgets up to 2032 are going to be met. If the answer is positive, then one can be optimistic about the 2050 zero carbon city. But, if we are still falling seriously short, we remain in 'just hot air' territory, and getting back on track will be significantly more difficult.

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Measuring CO_2 emissions - implications for spatial development

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1. Introduction

The effects of climate change can be felt in all spheres of contemporary life, often exacerbating existing challenges. Extreme weather requires that we reconsider risk management, with the development both of immediate responses and long-term strategies. Steps to mitigate the effects of climate change are being taken at the local, national and global levels. However, they are widely considered insufficient (Solomon et al. 2009). Only one of the four scenarios presented in a 2014 Report by the IPCC (RCP2.6) assumes a moderate increase in global surface temperature (1.5°C) by the end of the century (2100), compared to before the industrial revolution (1850-1900). Even this scenario predicts that many regions of the world will be vulnerable to extreme atmospheric events. The other scenarios, especially the continuation of business-as-usual, project much higher levels of uncertainty and risk.

This paper summarises the results of measurements of CO2 emissions on the campus of Lodz University of Technology in Poland between March and April in 2012, 2014 and 2016. The concentrations of CO2 were measured as a function of temperature, air pressure and wind speed. The measurements also considered the season and the time of day. This data was combined with an analysis of urban development, enabling assessment of the actual emissions relative to the architectural surroundings. These included tall, isolated buildings and denser, lower structures, parking lots and streets, greenery (neighbourhood parks and lawns), a nearby power plant and an electrical power and heating plant. In the next section, the rationale for measuring CO2 will be explained and the precedents for doing so internationally and in Poland will be examined. The case study of Lodz University of Technology campus B will then be presented. The measurement methods and the results will be discussed, followed by conclusions which will also point to avenues for future research.

2. Green House Gasses emissions - research rationale and precedents

Over 97% of scientists recognise that human activities are an important cause of climate change, through the emission of greenhouse gases (GHG). International accords such as the Paris UNFCCC Agreement of December 2015 reflect the widespread consensus that the current and predicted consequences of global warming should not be ignored. Research relating to GHG emissions, including systems for monitoring and protecting air quality, has therefore gathered pace worldwide.

2.1. *Role of GHG emissions*

According to an IPCC Report (2014, p.10), in order to limit human-induced warming to 2°C relative to 1861-1880 the cumulative CO2 emissions from all anthropogenic sources since 1870 should remain less than 2900 Gt CO2. Since 1900 Gt CO2 had already been released by 2011, the probability of achieving this goal has been estimated at around 66%. Global climate change has been strongly associated with the emission of GHGs, of which CO2 is the most important (IPCC 2014). Analysis shows that the most common coal isotope in the atmosphere has an atomic weight of 12 (12C). Carbon-12 can be absorbed by plants during photosynthesis and is also released when fossil fuels (which consist of organic matter) are burnt. The observable decrease in 13C atoms in the atmosphere is seen by some as proof that human activity has had an impact on CO2 concentrations (Burch, Harris 2014, pp. 134-135).

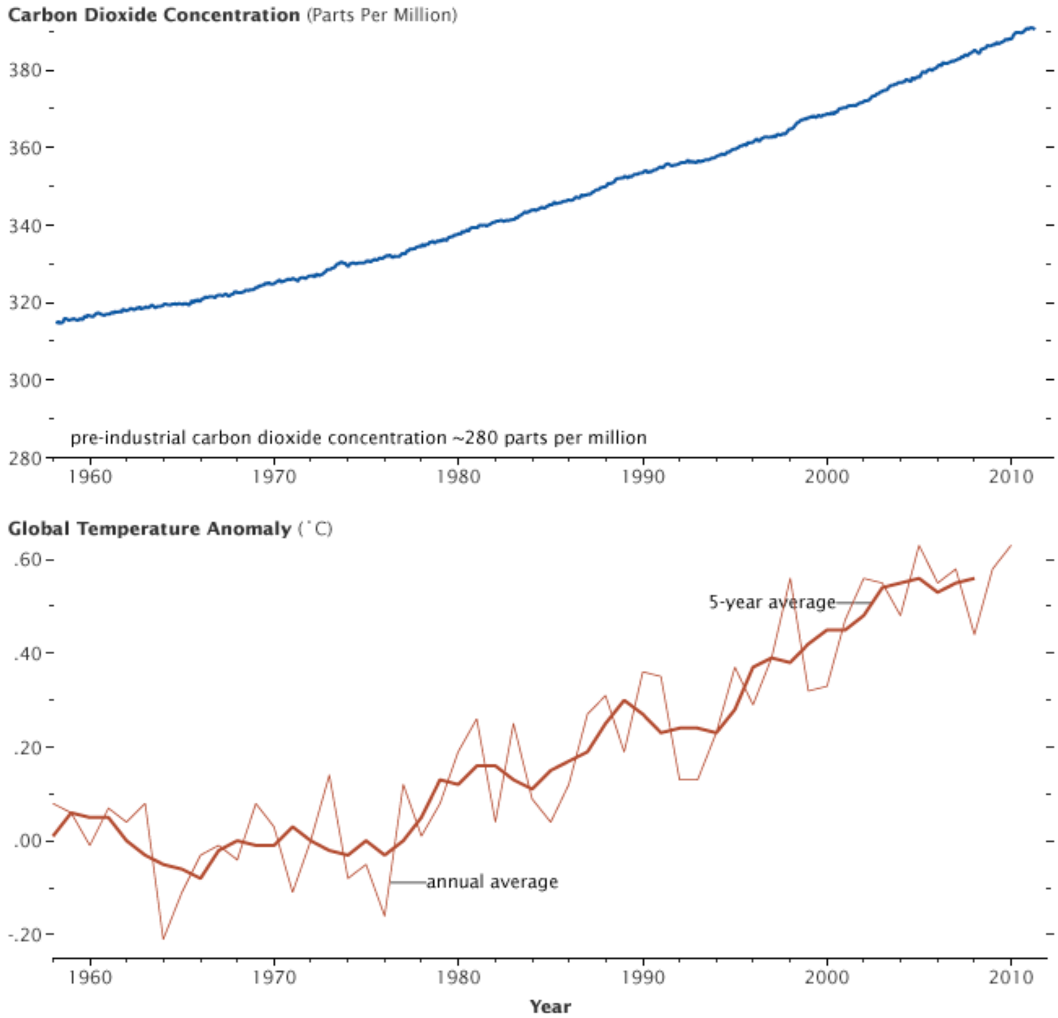

Figure 1.Changes in the concentration of carbon dioxide and Global Temperature Anomalies (source: https://earthobservatory.nasa.gov/Features/CarbonCycle/page5.php, data 2011, access 12.07.2018).

The United Nations Framework Convention on Climate Change (UNFCCC) in 1992 was the first global agreement regarding the reduction of GHG emissions. In the Kyoto Protocol of 1997, signatory governments agreed to comply with rules constraining the emission of GHG, including carbon dioxide. In 2016, the United Nations Framework Convention on Climate Change adopted the Paris agreement, which aims to mitigate the effects of GHG emissions, assist adaptation to climate change and finance the transformation process starting from 2020. The signatories of the agreement aim to keep 'the global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius.'

In Poland, the Environment Protection Law regulates issues relating to air quality, such as the conditions of energy production and the release of substances into the atmosphere. The principal regulation defines limits for NO2, SO2, O3, CO and particulate matter PM10. The law does not require measurements of CO2. Protection of air is defined as keeping the emission of pollutants below the defined limits and reducing them to levels considered not to be harmful to human health. Since the law does not recognise carbon dioxide as having a direct negative impact on human health, it is not covered by State Environmental Monitoring. In the environment protection law approved before EU accession in 1999-2001, the Polish parliament adopted the regulations of the European Union. This law has since been considerably updated, including adjustments in line with the regulations of Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe. The law defines emissions as *'substances or energy such as heat,* *noise, vibrations or electromagnetic fields introduced directly or indirectly into the atmosphere, water, soil or earth as a result of human activity.'*

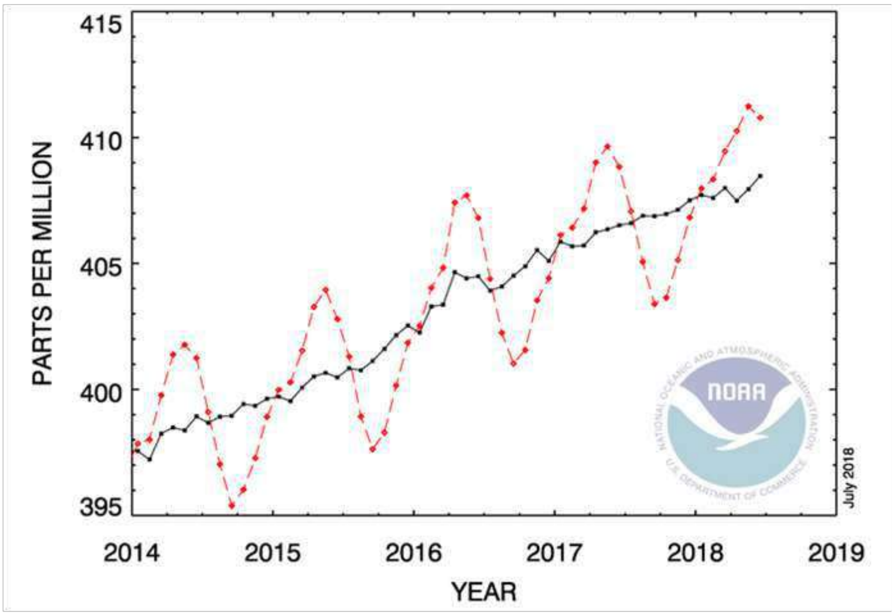

Figure 2. Recent monthly mean C0$_2$ at Manua Loa, June 2018: 410.79 ppm, June 2017: 408.84 ppm, source https://www.esrl.noaa.gov/gmd/ccgg/trends/index.html accessed 12.07.2018

2.2. CO_2 measurements

The Mauna Loa observatory in Hawaii has performed systematic measurements of atmospheric CO2 concentrations since 1955. A yearly rise has been recorded from around 315 particles ppm in 1958 to over 380 ppm in 2006 (after the data of SCRIPPS Institution of Oceanography: https://scripps.ucsd.edu, accessed 12.07.2018) up to around 408 ppm in 2017 (Fig. 2). Systematic measurements of CO2 concentrations in the atmosphere in Poland began in September 1994, at the KASLAB laboratory located in the IMGW meteorological observatory of Kasprowy Wierch in the Tatra Mountains. This is the only station to have kept such a long record of GHG concentrations in Central and Eastern Europe. Until 1996 it analysed air samples on a weekly basis. Since then, an automatic gas chromatograph (HP 5890) has been used (Chmura et al 2008).

3. Emissions and ambient concentration

Another indicator used to quantify levels of pollution is *'immission'* (Cichowicz et al. 2017) or ambient concentration, defined as a 'measure of environmental quality indicating the amount of pollutants found per unit volume in different environmental media' (https://unstats.un.org/unsd/environmentgl/gesform.asp?getitem=106…). It requires taking into account multiple emissions from diverse sources and comparing them with the permissible levels (Cichowicz et al. 2017).
Heating systems are a commonly recognised source of air pollution and GHGs. Smaller facilities, which serve individual households, buildings or close neighbourhoods, emit pollutants exclusively during the heating season. They are usually privately-owned are often called 'low emission' heat sources due to the actual height of the facilities (Adamczyk et al. 2017). The lack of compulsory emission controls constrains the measurement of emissions from these facilities. Moreover, the actual emissions depend on weather conditions and the availability of local fuel. For district facilities, which emit all year round, estimates of emissions are possible based on the amount of fuel used.
Transportation is another major source of pollutants and GHGs. particularly in the centres of large cities, leads to lower air quality. Measurements by the Central Statistical Office show that CO2 emissions from transportation in Poland increased from 26,403.76 thousand Mg in 2000 to 46,465.74 thousand Mg in 2010 (CSO 2012).

Ambient concentrations of CO2 show daily, seasonal and annual cycles depending on the use of local heating sources and road transportation. The location of emission sources does not influence concentrations at the district scale.

Figure 3. Measurement points in campus B

4. Case study

Measurements of ambient concentrations of CO2 were taken on campus B of Lodz University of Technology. This area is located in the southern part of the university, adjacent to Archbishop Klepacz park. Wólczanska Street, Wróblewskiego Street and Politechniki Avenue surround it on the remaining sides (Fig. 3). The municipal power plant EC2 stands to the south-west of the campus site. The 16 ha plot includes the historical nineteenth-century textile factory of Schweikert, complemented by several newer structures. In total, there are 19 buildings in this part of the campus.

While most of the site is paved and used as access roads and parking lots, there are also green areas, in the form of expansive lawns with some trees and bushes. The most densely built-up zone is in the eastern part of the site, and contains the most significant post-industrial development – a building home to three faculties: the Centre of Diagnostics and Laser Therapy of Lodz University of Technology, the Institute of Turbomachinery and the Faculty of Process and Environmental Engineering. The Dean's Office of the latter faculty features the lowest density of development in its surroundings and the highest share of pervious surfaces and vegetation. The construction of a huge sport centre next to Politechniki Avenue took place in 2017, after the measurements had been taken and so did not affect the results (Fig. 4).

Measurements were carried out at points located at the corners of each of the buildings in March and April of 2012, 2014 and 2016. The much smaller and more irregular structures on the eastern side of the site meant that more measurement points were used (Fig. 3). In March of both 2012, 2014 and in 2016, 83 measurement points were used. In April of both years, three more locations were included: two points along Politechniki Avenue and one in Wróblewskiego Street.

Figure 4: Changes to the physical development of Campus B in years 2011, 2013, 2015 and 2017. source http://mapa.lodz.pl*, accessed 01.07.2018*

5. Measurement methods

Measurements were taken using a VEGA-GC micro chromatograph (Pollution S.p.A., Italy), according to the method developed by Cichowicz (Cichowicz and Wielgosiński 2015a, Cichowicz and Wielgosiński 2015b). The VEGA-GC micro chromatograph is suitable for analyses in the field. It consists of a computer module, a tank with a carrier gas (helium), a pump for samples and two batteries. Two parallel columns can be used. A thermal conductivity detector (TCD) enables sample analysis at a minimum concentration of 500 ppb (0.005 ppm) for 6 to 300 s, depending on the type of gas. Measurements of carbon dioxide concentrations were performed at 90 s intervals on a PPQ-packed column, installed in the VEGA-GC micro chromatograph. Before the actual measurements, the chromatograph was calibrated using a test gas. Fig. 5 presents the calibration curve.

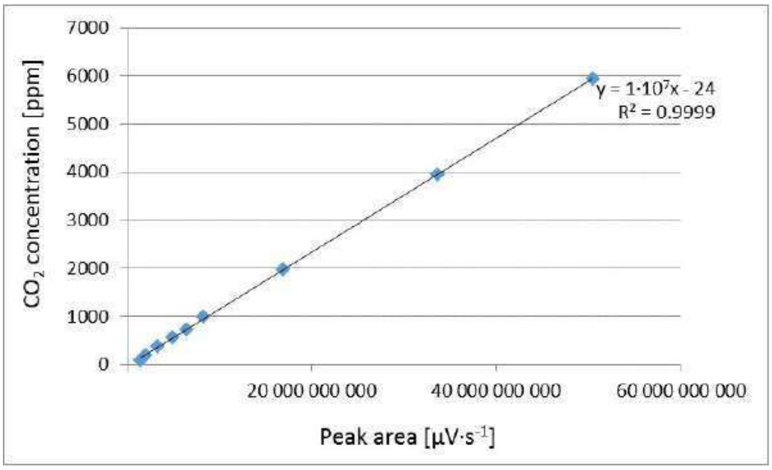

Figure 5: Plot of the calibration curve for carbon dioxide.

Once the batteries had been charged and inserted, a portable bottle with the carrier gas (helium) was installed. The operator then started the system and connected the MC2 and MC-Plan to tune the device. The operator launched the program for CO_2 measurement and headed to point number 1. While the measurements were being performed, the device was directed towards open space (the pavement).

Table 1: Weather data. Source: http://freemeteo.com/, accessed 12.07.2018

Date / Feature	**20.03.12**	**02.04.12**	**23.04.12**	**25.04.12**	**20.03.14**	**03.04.14**	**24.04.14**	**28.04.14**	**21.03.16**	**04.04.16**	**22.04.16**	**25.04.16**
Temperature [°C]	9-13	7	9-13	15	11-15	8-19	8-19	13-16	6	20-21	8-9	6-8
Cloudiness	slightly overcast	partly overcast	partly overcast	cloudless	slightly overcast	cloudless	cloudless	partly overcast	partly overcast	Cloudless	partly overcast	slightly overcast
Wind flow velocity [km/h]	22-31	26-30	9-15	13-19	17-33	6-13	17-21	6-17	17-26	19-20	22-26	11-13
Wind direction	W	W	SW	SW	W	W	W	SW	E	W	E	E
Pressure [hPa]	1031.2	1005.1	1008.1	1005.8	1018.5	1005.1	1019.8	1009.1	1011.0	1009.0	1013.5	1006.2
Relative humidity [%]	53-70	49-53	51-81	44-82	55-72	40-57	46-64	72-94	71-76	31-37	47-57	42-61

An external GPS device was used to record the date, time and coordinates of all points. The carbon dioxide measurements were compared with a map showing the Floor Area Ratio (FAR) and Building Coverage Ratio (BCR). The relationships between the measurements and the FAR and BCR values were examined. The FAR and BCR values were defined for units associated with each specific zone of the campus, including overhang on the ground floor in the external perimeter.

Data from the weather station in the Władyslaw Reymont airport in Lodz were used to determine the meteorological conditions when the measurements were taken [21]. The station is approximately 5 km in a straight line from campus B. Table 1 summarises the meteorological data recorded at the Lodz-Lublinek station when the measurements were taken.

ArcGIS 10.3 was used to visualise the results. A TNT surface was generated based on the recorded points, with the Z parameter describing the CO_2 concentration (Fig. 7). Due to the irregular distribution of measurement points the surface is distorted, which influences the quality of the visualisation. Moreover, the resulting image does not take into account the volume of the buildings. The same symbology has been assigned to all six images, using equal intervals and the most extreme data spectrum, from April 2012. The background base map was provided by the Municipal Surveying Office and shows the site in 2012.

6. Carbon dioxide ambient concentrations - results and discussion

The ambient concentrations of carbon dioxide were measured in relation to two collector streets: Politechniki Avenue and Wólczańska Street (Fig. 6). The distance from these two linear emitters was assumed to impact the levels of CO2 in the air. In order to verify this assumption, the values associated with the measurement points were aggregated in four buffer zones: 0-50, 50-100, 100-150 and 150-200. Arithmetic means of the carbon dioxide concentrations were calculated for each of these zones. As a result, the impact of transport emissions on GHG levels could be observed.

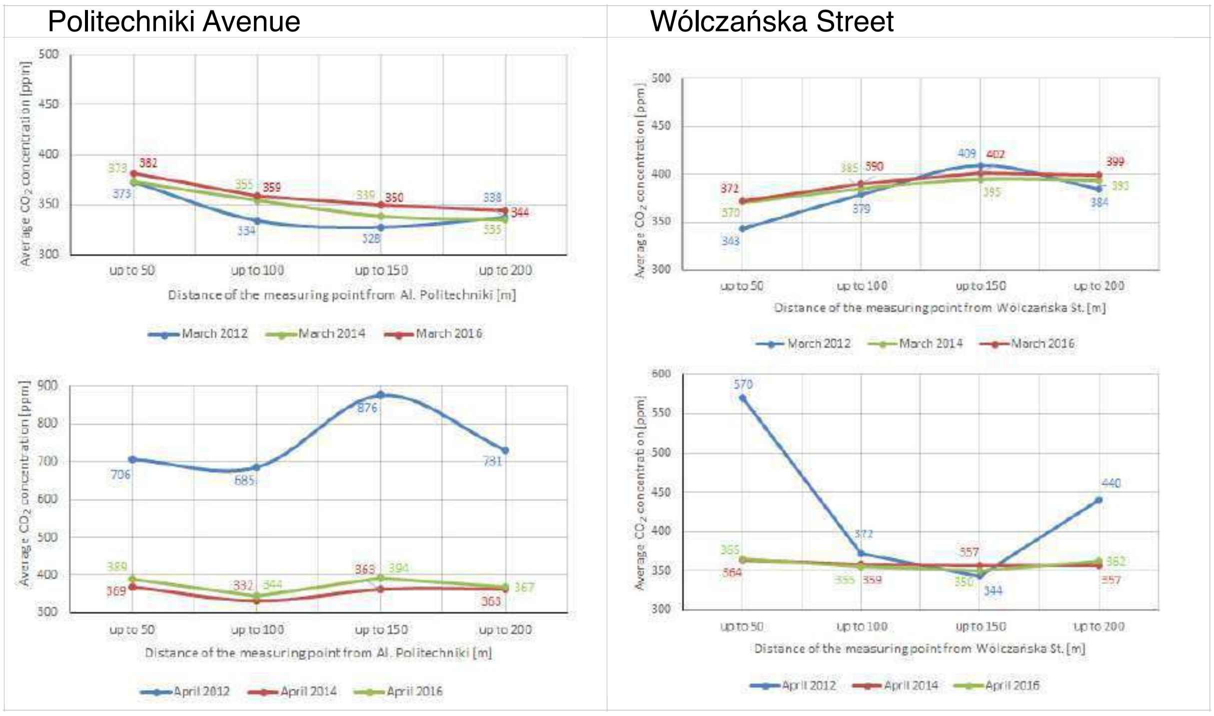

Figure 6: Average CO_2 concentration [ppm] in March and April 2012, 2014 and 2016 in relation to Politechniki Avenue and Wólczańska Street

The structures of the buildings in the vicinity of Politechniki Avenue required fewer measurement points than those next to Wólczańska Street. The average concentration of CO2 in the buffer zone adjacent to Politechniki Avenue in March 2012 and 2014 was 373 ppm. In April 2012 it rose to 706 ppm and in 2014 it was 369 ppm. In March 2012 and 2014 the values decreased with further distances from Politechniki Avenue. In March 2012 and 2014 the levels of CO2 rose as the distance of the measuring point from Wólczańska Street increased. In April 2012, the ambient concentration of CO2 grew with the distance from Politechniki Avenue and decreased with greater distances from Wólczańska Street. In April 2014, the average levels of carbon dioxide varied irrespective of the distance from Politechniki Avenue. The range of values remained the same. In April 2014, the levels lowered with increasing distances from Wólczańska Street (Cichowicz and Wielgosiński 2015b). The measurements were repeated in the same months of 2016.

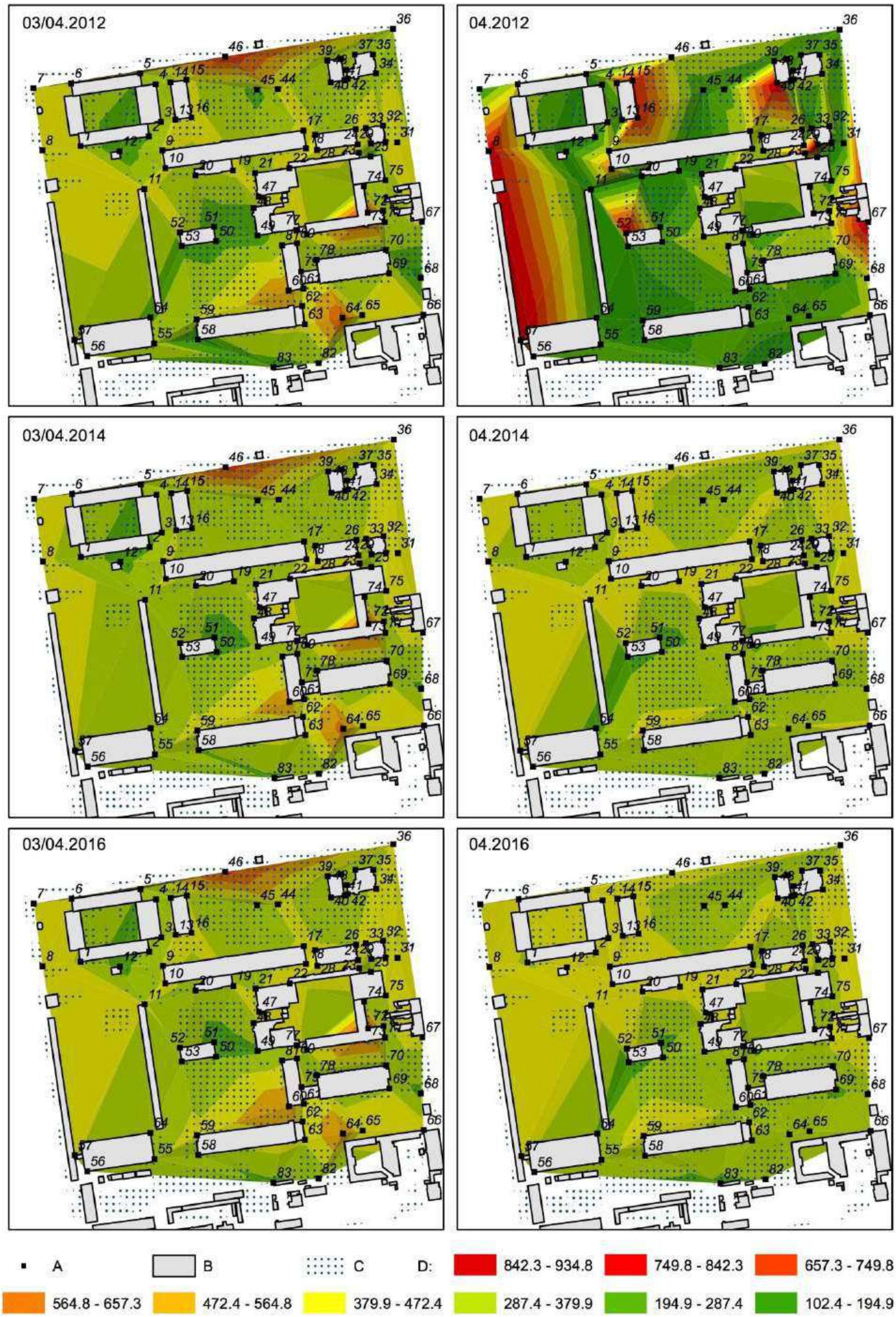

Figure 7: CO_2 concentration [ppm] in March and April 2012, 2014 and 2016

The variations in the levels of carbon dioxide observed in this study (Fig. 7) may result from a combination of several factors. Firstly, there is the obvious impact of street traffic both on Politechniki Avenue and on Wólczańska Street. In March, before the growing season, the impact of street traffic is more linear. In April, due to the appearance of vegetation and photosynthesis, large amounts of CO2 are absorbed (Allen 1990). This lowers the overall levels of this gas in the air. Another factor influencing emissions inside the campus is the circulation of cars within the campus, especially in the student and staff parking lots (Figs. 3 and 4). The direction of the wind, which during the measurements was mostly West and South West, may have carried some CO2 from the parking lots next to the old sports hall and the crossing of Politechniki Avenue and Radwańska Street nearby. This is probably the reason for the higher levels of CO2 in the Northern part of the campus. During the vegetation period, this difference does not occur because CO2 is absorbed by trees in Klepacza Park, north of the campus. A third element which could have affected CO2 levels is building density (Cichowicz and Wielgosiński 2015a). In general, the highest CO2 concentrations overlapped with the impermeable surfaces of the parking lots and pavements. This correlation was shifted due to the wind. The greatest differences in the CO2 levels in April 2012 may have resulted from the fact that the highest wind velocity and the lowest temperatures were recorded during this period. Our measurements demonstrate the impact of transportation emissions and of internal traffic circulation within the site and confirm the results of parallel research (Idso, Idso, Balling 2013, Nemitz et al. 2002, Gurney et al. 2012, Vogt et al. 2006). Other factors which may have had an influence the ambient concentrations of CO2 include the arrangement of the built structures, the amount of vegetation in surrounding areas and the distances between the buildings. Empty spaces form corridors which increase the displacement of air and therefore of pollutants (Chang et al. 2003). Emissions from the power plant and the electrical power and heating plant did not directly influence the results (Cichowicz 2018, Wielgosiński et al. 2018).

7. Conclusions and future research perspectives

The results of this study confirm a spatial correlation between the ambient concentrations of CO2 and the distribution of pavements and vegetation. This information could be used not only to improve the organisation of Campus B of Lodz University of Technology, but also to inform wider efforts to reduce greenhouse gas emissions in urban areas. Our results confirm empirically the influence of transportation arrangements on ambient CO2 concentrations. Transportation is estimated to contribute around 13 percent of total GHG emissions (Metz et al. 2007, p.52). The influence of corridors between buildings and of empty pathways between vegetation areas was also noted. In order to reduce emissions, transportation habits should first be changed, by encouraging the use of public transport and soft modes, such as walking and cycling, instead of individual vehicles. This would also require fewer on-surface parking lots. The hard surfaces should be rearranged and pavements replaced with more permeable solutions. The impact of the arrangement of various forms of built structure and the distribution of voids should be further analysed.
The gas micro-chromatograph provides exact records of carbon dioxide levels. Analyses of ambient concentrations of CO2 should be continued and improved by adding more measurement points distributed more regularly, in the form of a grid. This would eliminate visualisation distortions and improve the legibility of the outcomes.

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The role of regional planning for spatial climate mitigation actions

Regional governance of land use and transportation in the US, Canada and Germany

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Abstract:

The multi-level governance of land use and transportation shift into focus when trying to reduce carbon emissions from commuting. To reduce travel distances between home and work, experts suggest urban containment and transit-oriented development as spatial development strategies. However, land use and transportation are governed differently in nations across the globe making the implementation of these strategies challenging and regionally unique. Therefore this paper seeks to understand and compare the regional capacities to govern land use and transportation in Seattle (USA), Stuttgart (Germany), and Vancouver (Canada).

1. Introduction

Reducing the carbon footprint of urbanized areas is one of the key challenges for urban planners in the 21st century. Within the climate mitigation discourse, several sectors are relevant for reducing GHG emissions, including energy supply and efficiency, transportation, land use, and waste (Verbücheln & Dähner, 2016; DIFU, 2011; Boswell, et.al, 2012). Each sector has varying potentials for emissions-savings. For instance in Seattle, Vancouver and Stuttgart, transportation emissions account for between 18% and 50% of total emissions. These emissions can partly be reduced through better fuel efficiency and an increase in electric vehicles, but there are underpinning land use patterns that (re)create the need for transportation. Especially at the city-wide and regional level, the mix and density of activities impact the demand for transportation (Banister & Jillian, 2009, p. 58; Pizzaro, 2009; DIFU, 2011; IPCC, 2014, p. 947; SKKK, 2014). To reduce distances between jobs and housing, climate action plans suggest spatial development strategies such as urban containment and transit-oriented development. Theoretically, these strategies should be implemented at the regional level (IPCC, 2014, p. 959) but this can be a difficult task given multi-agency settings with non-aligned organizational responsibilities (IPCC, 2014; Fröhlich & Knieling, 2013; Brunnengräber, 2013; Boswell et al., 2012; Heinen, 2018). Therefore, the question is: What are the legal and organizational capacities at the regional (US-metropolitan) level to actually implement urban containment and transit-oriented development?

Comparing the metro-regions of Vancouver (British Columbia, Canada), Seattle (Washington State, USA) and Stuttgart (Baden-Württemberg, Germany), this paper examines land use and transportation governance at the metropolitan regional level. Particularly, the paper tries to understand the regional governance capacities, based on the planning system, to make integrated decisions in an effort to implement urban containment and transit-oriented development. The following sections examine the national and state climate efforts, review the statutory responsibilities of the metropolitan (regional) planning organizations, and analyze their commitment to climate action and the leveraged planning mechanisms. The paper will conclude by discussing implementation challenges and opportunities based in the planning system.

2. Method

The analysis focusses on three administrative regions from the federal[1] states of Canada, Germany, and the USA. Seattle, Stuttgart, and Vancouver are best-case scenarios with a climate commitment for almost 10 years (see Table 1 for selection criteria). The three cases are comparable because of their similarities in population in the core cities and administrative regions (See Table 2 for data). This paper presents the results of a review of official government documents. Interviews with planners and elected officials to gather further insights will be conducted in August and September 2018 and will be published in a forthcoming paper. For this paper, the author analyzed climate action, growth management (land use), and transportation plans at all levels of government as well as state and federal laws in all three countries. For the climate action plans, the review focused on land use and transportation related mitigation actions and is not a comprehensive review of actions in all sectors. Within the other documents, a particular focus was placed on climate objectives, urban containment, and transit-oriented development as well as funding for transit infrastructure.

Selection Criteria	**Explanation**
1) State government (*Landesebene*, Province) is committed to climate action.	E.g. has adopted GHG emission reduction targets or has signed the Under 2 MOU Coalition.
2) Region or core city has had a Climate Action Plan for at least 5 years.	This allows examining the actual implementation of actions committed in the Climate Action Plans.
3) Core city has more than 500,000 residents and regional administrative area covers more than 2 million people but less than 5 million.	This establishes commonalities in the scale of spatial issues. Furthermore, the ratio between core-city population and administrative region population often impacts voting within the regional organization. This ensures similarities in interest representations at the regional level.
4) There is some form of state planning legislation (Growth Management/ *Raumplanung*).	States without growth management usually delegate all land use authority to the local level, thus having no regional government with any land use authority.
5) The region is growing not shrinking.	Shrinking regions have many other challenges and face different planning conditions (population loss, financial constraint, vacancies of buildings and neighborhoods).

Table 1: Explanation of case study selection criteria

Core-City	**Country**	**State** (Province, *Bundesland*)	**Population 2010/2011 (Pop)**			**% of pop in core-city to admin. region**	**Area (in km²)**	
			Core-City	**Admin. region (MPO)**	**Statistical region** (MSA, CMA, statistische Regionen)		**City**	**Admin. Region**
Stuttgart	Germany	Baden-Württemberg	585.890	2.668.439	3.914.359	22%	207	3.654
Vancouver	Canada	British Vancouver	603.502	2.313.328	2.313.328	26%	115	2.883
Seattle	USA	Washington State	608.660	3.690.866	3.439.809	16%	217	16.534

Table 2: Data on Regions
(Sources: US Census 2010, Destatis - Statistisches Bundesamt 2011, Statistics Canada 2011)

3. National and state climate support

In each country we find very different starting conditions for climate mitigation actions (Table 3). While the federal governments in Canada and Germany support climate action through various measures, the US regions rely on mostly voluntary local and regional actions. For instance, the Pan-Canadian Framework (GoC 2016a) includes $25 billion set aside for investment in public transit (GoC 2016b, p. 13f.). Germany's National Transportation Program (Bundesverkehrswegeplan) commits 42% of the EUR 240 billion in funding for rail projects over the next 12 years (G-BVWP 2030; Klimaschutzplan 2050, p. 55). For the United States, there is currently no federal monetary support and most recently, under the current Trump Administration, the United States has withdrawn from the Paris Climate Agreement (in effect by 2020; Romo & Parkes 2017). In response to the national shift away from climate commitment, 2500 US businesses, government entities, and organizations signed the "We are still in" initiatives, including 9 US states of which one is Washington State (which itself has set emission targets as early as 2008).

Climate Action Plans at	Vancouver, BC, CA	Seattle, WA, USA	Stuttgart, BW, DE
Federal-level	Pan-Canadian Framework on Clean Growth and Climate Change (2016)	NO	G-Klimaschutzplan 2050 (2016)
State-level (Provinces, *Länder*)	Climate Leadership Plan (BC CAP 2016; update to 2008 CAP)	NO (Executive orders Inslee 2014, Gregoire 2008)	Integriertes Energie- und Klimaschutzkonzept Baden-Württemberg (BW IEKK 2014)
Regional-level	NO (MV-Climate 2050-DP is underway)	NO	NO (Adaptation strategy VRS Klima 2016)
Core-city	Greenest City Action Plan (2012, new plan 2015)	Seattle Climate Action Plan (2013, new plan underway)	Klimaschutzkonzept (updates since 1997)

Table 3: Climate Action Plans (CAPs) by level of government

In the US context, state governments are usually very conscientious of local rights and avoid any infringement of the land use and zoning responsibilities of the local level. For instance, Washington State only committed state agencies to meet legislative GHG reduction targets (see RCW 70.235.020, 050 and 060; see Table 4), whereas British Columbia (BC) committed all levels of governments to reducing emissions (Bill 44 (2)(1)(a) and (b); see Table 4). In BC, the communities and regional districts are legally required to include targets, policies and actions to reduce greenhouse gas emissions in Official Development Plan and Regional Growth Strategies (Local Government Act Sections 473 and 429; Vancouver Charter 652.01). In addition, BC engages its local governments through the BC Climate Action Charter (BCCAC), a voluntary agreement which 187 of the 190 communities in BC have signed (BC CSCD 2018a). Signing the agreement is incentivized by funding through the Climate Action Revenue Incentive Program (CARIP; BC CSCD 2018b).

In Germany, climate action is voluntary for communities (G-Klimaschutzplan 2050, p. 77). The federal government does encourage communities with the German "National Climate Initiative". Since 2008, over 3,000 communities received a total of EUR 560 million for over 12.500 projects to create climate action plans and implement climate actions such as installing bike racks and switching to LED street lights (G-Klimaschutz 2018a). Baden-Württemberg finances 35 regional and countywide energy consulting agencies for home-owners (BW KEA 2018), funds increased energy efficiencies of public buildings at the local level (Program Klimaschutz Plus), and authorizes regional planning organizations to determine locations for wind energy plants and for other energy related facilities (BW Drucksache 15/3842, Artikel 2, §11; BW IEKK 2014, p. 145)

	Vancouver, BC, CA	Seattle, WA, USA	Stuttgart, BW, DE
Base-line year	2007	1990	1990
Relevant for	All public sector organizations (with state financial support to locals)	State agencies	All public sector organizations (with state financial support to locals)
Law at state level	BC Bill 44 (2)(1)(a) and (b) (2007)	RCW 70.235.020, 050 and 060 (2008)	§4 in BW Drucksache 15/3842 (2013)
Reduction targets…			
… by 2020	33%	to 1990 levels	25%
… by 2035	n/a	25%	n/a
… by 2050	80%	50%	90%
Estimated % emissions of transportation (F-Federal, S-State, R-Regional)	23% (F) 37% (14% personal + 23% commercial vehicles) (S)	50% (R)	18% (F)

Table 4: State-level GHG Reduction Targets and estimated emissions in transportation (Sources: BC CAP 2016, p. 14; G-Klimaschutz in ahlen 2017, p. 37; PSCAA Strategic Plan 2014, p. 21; PSRC Vision 2040, p. 40)

In the transportation sector, Washington State is committed to climate mitigation but the implementation support for regions and communities is significantly lower than in Baden-Württemberg and BC. For example, the expansion of the regional transit systems is supported by state financing in BC and Baden-Württemberg, whereas it is supported by a regional tax levy in Seattle (WSDOT – VMT MPO Report 2011, p. 5; BC CAP 2016, p. 5 and p. 18; Sound Transit 2018; BW ÖPNV-Pakt 2014). In an effort to reduce emissions from transportation, the Washington State legislature set benchmarks (not requirements) to reduce vehicle miles travelled across the state by 18% by 2020 (RCW 47.01.440). As the agency responsible for building and funding federal and state roads, the Washington State Department of Transportation (WSDOT) funds transit with only 6.3% of a total operating and capital budget of $ 5.7 billion (WSDOT-Budget 2017, pp. 7, 40, and 64). In contrast, Baden-Württemberg is allocating 60% of transport funding for transit and bike infrastructure and 40% for regular road projects (BW IEKK 2014, p. 104; *Ma nahme* 69).

Overall, for communities in the Vancouver and Stuttgart regions there is strong support by state (and partly federal) government through regulations, funding and programs for climate action. While there is an intention at the state level in Washington State to reduce GHG emissions and Vehicle Miles Travelled, the available implementation support appears to be significantly lower. Washington State is pursuing other actions like capping emissions from large emitters and reduce emissions from state government operation but when it comes to implementing compact urban development (urban containment) and transit-oriented development, the responsibility is seen at the local level. While zoning is also a local responsibility in Canada and Germany, communities in these countries have financial and institutional support for implementation.

4. Legal (statutory) responsibilities of regional planning

When it comes to reducing emissions by implementing transit-oriented development and urban containment, regional and metropolitan planning organizations are key actors to facilitate coordination across communities in a region. The following table (Table 5), highlights the statutory responsibilities and services (*Aufgaben/ Handlungskompetenzen*) provided by the three regional planning organizations. All three agencies are responsible for Broad Planning (growth management, spatial planning/ *Raumplanung*)[2]; Metro Vancouver bundles together the most additional services and PSRC the least.

		Broad Planning/ Growth Management/ Spatial Planning	Transportation Planning	Transit Operation	Water	Sewer	Waste	Housing	Parks	Clean Air	Economic Development
Vancouver region	**Metro Vancouver**	x			x	x	x	x	x	x	
	Trans Link		x	x							
Seattle region (Puget Sound)	**Puget Sound Regional District**	x	x								x
	Sound Transit			x							
	Other agencies				x	x	x	x		x	
Stuttgart region	**Verband Region Stuttgart**	x	x	(x)			x		x		x
	Deutsche Bahn AG			x							
	Stuttgarter Straßenbahn AG			x							

Table 5: Services provided by regional agency (statutory responsibilities)

4.1 Metro Vancouver and regional planning in British Columbia

Metro Vancouver is responsible for growth management, water, sewer and drainage, air quality management as well as housing (MV-Board Strategy, p. 6). Furthermore, Metro Vancouver approves the use of federal gas tax funds (Greater Vancouver Regional Fund), approximately $130 million per year (MV-Climate 2050-DP, p. 34). As a 2007 merger of previously separate organizations, each entity still has its own governing board composed of elected representatives from each participating municipality in the service areas. As a regional district under BC law, Metro Vancouver prepares regional growth strategies (RGS) in cooperation with 21 municipalities, one treaty first nation, one electoral area for matters that “spill across local government boundaries” (BC RGS Guide 2005, p. 33 and p. 15). The intent of BC’s “interactive planning system” is to foster local autonomy and achieve agreement between communities and the regional district. Prior to an RGS taking effect, each community has to accept the RGS and potential disputes have to be resolved through a set of state-defined procedures (BC RGS Guide 2005, pp. 2 and 17-20). For implementation of an RGS, municipalities have to include Regional Context Statements (RCS) with their Official Community Plan (also called Official Development Plan) which relates the local to the regional strategy.

4.2 Puget Sound Regional Council and metropolitan planning in Washington State

Puget Sound Regional Council (PSRC) is the designated Metropolitan Planning Organization (MPO by federal law) and the transportation planning organization (state law) of the Seattle region for the counties of King, Kitsap, Pierce, and Snohomish and the 86 local jurisdictions in these counties (PSRC – Plan Review 2014, p. v). Based on federal and state law, its primary responsibility is to plan the regional transportation system and to ensure cooperation between the state and local jurisdictions (USC 23 Sec 134; RCW 47.80.010). MPOs across the United States select regionally significant transportation projects within urbanized areas for federal transportation funding. Additionally, MPOs can be imbued with more powers if the state decides to grant them or if the locals decide to defer powers. The PSRC’s board of locally elected officials decided to develop a regional growth strategy as the multicounty planning policy (Vision 2040 adopted 2008, Vision 2050 underway). Based in state law, multicounty planning policies establish a framework for county and city comprehensive plans (RCW 36.70A.100; RCW 36.70A.210 (1) and (7)) but cannot “alter the land-use powers of cities” (RCW 36.70A.210). For implementation of an RGS, PSRC can certify aspects of local and county plans (RCW 47.80.023, PSRC-Plan Review 2014, p. v).

4.3 Verband Region Stuttgart and regional planning in Baden-Württemberg

The Verband Region Stuttgart (VRS) is responsible for growth management (*Raumplanung*), open space planning (*Landschaftsrahmenplan*), transportation planning, waste management, economic development, and tourism marketing (GVRS §3(1)(1)-(7)). The VRS is governed by a board of 80 regionally elected officials (GVRS §8 und §12) and encompasses the city of Stuttgart and 178 local jurisdictions in 5 counties. Within Germany, VRS is in a special position as it has extensive authority for transportation planning and is governed by a body of regionally elected officials. VRS prepares the regional plan (*Regionalplan*) in collaboration with communities and the state government (ROG §7 and 13). Once finalized the regional plan is approved by the state (Fürst 2010, p. 71).

Additionally, VRS participates in the development of statewide goals, and participates in sectoral planning (Goppel 2005, p. 566; Fürst 2010, pp. 96f.). In Germany, regional planning acts as an intermediary between local and state interests (Schmitz 2005, 965). While the local governments control zoning and implementation of the land-use component of plans, the state controls sectoral agencies and infrastructure investments (Fürst 2010, p. 76; see Buehler and Schmidt for more detail). For implementation, VRS works with municipalities through the *Fl chennutzungsplan* (Land Use Map prior to zoning code development) and with the state through specific procedures (*Raumordnungs- and Planfeststellungsverfahren;* ROG §15; Fürst 2010, p. 166)

5. Organizational capacity to regulate land use and transportation to mitigate climate change

Despite not having specific climate action plans[3], all three organizations include GHG reduction as primary objectives in their regional growth strategies (*Regionalplan*) and other plans (see Table 6 for a list). The three regional growth strategies promote development and mobility patterns that focus new growth within compact and complete centers along transit corridors[4] in existing communities. To achieve this, the recommended strategies include urban containment[5] and transit-oriented development.[6]

	Metro Vancouver	**PSRC**	**VRS**
Regional Plans: Growth Strategies (Regionalplan)	Regional Growth Strategy: Metro Vancouver 2040 – Shaping our Future (MV-RGS 2011)	Vision 2040	VRS-Regionalplan 2009
Regional Transportation Plans		Transportation 2040 (includes 4-Part GHG Strategy)	VRS-Verkehrsplan 2016
Air Quality Plan	Integrated Air Quality and Greenhouse Gas Management Plan (MV Air Quality 2011)		
Others	Regional Parks Plan; Board Strategy 2015-2018		VRS-Klimaatlas 2008; VRS Klima 2016

Table 6: Plans at regional planning organization containing climate objectives

In all regions, there has been a prior commitment to this type of development (PSRC Vision 2040, p. 15; VRS-Regionalplan 2009; MV-RGS 2011). With increasing concerns over climate change, the three regional planning agencies stress the importance of reducing vehicle miles travelled by changing development and mobility patterns. However, the implementation of these changes looks very different across all three regions. In all cases, implementation depends to some extent on transit providers and local jurisdictions, but the legal planning frameworks provide different mechanisms to ensure plan consistency, solve disagreements, and provide financial resources for transit investments.

5.1 Implementation for Metro Vancouver

> "Metro Vancouver and its member municipalities are working to reduce GHGs by focusing growth in a network of transit-oriented urban centres and building compact, complete communities that offer amenities close to home." (MV-Climate 2050-DP 2018, p. 45)

In implementing the regional growth strategy, Metro Vancouver relies on its member jurisdictions' land use and zoning authority and on TransLink for long-term investments in transit and regional roads (MV-Climate 2050-DP 2018, p. 18 and 35; MV-RGS 2011, p. 52; TL 2018). Metro Vancouver can work with municipalities through the Regional Land Use Designation Map which is part of the RGS (MV-RGS 2011, p. 46). Within their Regional Context Statement, municipalities have to interpret the Regional Land Use Designation Map for their own Official Community Plan and identify the Urban Containment Boundary, Frequent Transit Development Areas and Urban Centers (MV-RGS 2011, p. 9). Furthermore, Metro Vancouver does have direct authority over sewer and water extensions, therefore in implementing the RGS they do "not allow connections to regional sewerage services to lands with a Rural, Agricultural or Conservation and Recreation regional land use designation" with a few exceptions (MV-RGS 2011, p. 14).

Metro Vancouver works with TransLink through the authorization of federal gas tax funds and by commenting on TransLink's transportation plans (MV-RGS 2011, p. 53; MV-FGT 2016, pp. FGT 6). But overall TransLink has a multitude of funding sources including property taxes, fuel tax, charges and fees, and a tax on parking rights (Part 3 of TransLink Act). TransLink works toward integrating land use and transportation decisions and references climate objectives at the Metro Vancouver and state level without setting out its own climate objectives (TL-RTS 2013, p. 2, 3 and 14). The performance measures (headline targets) of the agency are to make "it possible to make half of all trips by walking, cycling and transit; and […] to reduce the distances people drive by one-third" (TL-RTS 2013, p. 14).

5.2 Implementation at Puget Sound Regional Council

> "The region will focus growth within already urbanized areas to create walkable, compact, and transit-oriented communities that maintain unique local character. […] Rural and natural resource lands will continue to be permanent and vital parts of the region." (PSRC Vision 2040, p. xi)

For implementation, PSRC relies on communities, counties, and Sound Transit (the transit provider in the region). PSRC voluntarily set up a certification process for county and community comprehensive plans that go beyond the conformity requirements of state law (PSRC – Plan Review 2014, p. v). By state law, PSRC can certify if the transportation component of local plans is consistent with the regional transportation plan (RCW 47.80.023). Based on an internal agency policy, PSRC can also certify countywide planning policies which are usually developed by the counties in cooperation with communities but that do not alter the land use powers of communities (PSRC – Policy 2003, p. 1; PSRC's Interlocal Agreement 1993, p. 10f.; RCW 36.70A.210). To establish the consistency of countywide policies, local comprehensive plans and Vision 2040, PSRC set up their own procedures engaging communities early in their planning process (PSRC-Plan Review 2014, p. iv; WAC 468-86-150). Only jurisdictions with certified plans are eligible to apply for funding for transportation projects (PSRC Vision 2040, pp. 29f).

Additionally, PSRC can use its powers in the transportation sector by prioritizing investment in pedestrian, bicycle and transit-oriented facilities in urbanized area (PSRC Vision 2040 Goals MPP-T-11 to 16 and MPP-EN-21 and 23 on pp. 41 and 83). For the implementation of the long-range transportation plan, PSRC selects projects proposed by local governments for funding and adds the selected projects to the Transportation Improvement Program (USC 24 Sec 134). Furthermore, PSRC engaged its communities and Sound Transit in the Growing Transit Communities effort. This was a 2-year planning effort funded under the Obama administration's Sustainable Communities Initiative that created a transit-oriented development strategy for the region, identified new corridors and stations, and identified land use changes (PSRC-GTC 2013). Communities are committed to implementing the Growing Transit Communities effort through the Regional Compact – a voluntary memorandum of understanding among participating communities. As part of implementing Growing Transit Communities, Sound Transit will build 62 miles of new rail between 2021 and 2035. Funding for the new rail construction was approved by voters in 2016 who agreed to a slight increase in sales and property taxes (Sound Transit 2018). Furthermore, Sound Transit also has the Transit Oriented Development Program which coordinates the development of land near transit stations on Sound Transit owned land with community zoned land.

5.3 Implementation at Verband Region Stuttgart

> "The regional plan is a key mechanism to protect open spaces to bring fresh air into the communities, to foster compact urban development along transit corridors and to identify wind energy sites" (own translation; VRS-Klimaatlas 2008, p. 5 and 10).

VRS operates within the *Raumordnungsgesetz* (Federal Spatial Planning Law) which stresses the importance of preserving open spaces and concentrating development in urban and rural centers (ROG §2(2)(2))[7]. From the state level the regional planning organization is charged with two tasks regarding climate mitigation: to increase wind energy production (reserve land for wind energy) and to help foster compact urban patterns that reduce VMT (BW IEKK 2014, p. 101). The implementation of regional plans is a collaborative process between state-run sectoral agencies, the regional planning organization, and local communities. The *Gegenstromprinzip* is supposed to achieve a balance of statewide and local interests (ROG §1(3)). While it is mandatory (§4 Abs. 1 ROG) for sectoral agencies to comply with regional and state-wide plans, there are procedures for variances because sectoral plans (and local zoning codes) do have strong autonomy in the German constitution (Art. 65 GG (constitution); see also Fürst, 2010, p. 48f; §14 and §15 ROG). Therefore when preparing more detailed plans like *Fl chennutzungspl ne* and transportation studies, there is an extensive set of legally defined procedures to ensure coordination across levels and sectors of government (Fürst 2010, p. 137). A core concern is to make decisions that balance the various interests of using space in a way that will better the region overall. Coordination is mandatory across levels (vertical) and sectors (horizontal) of government.

Expanding the transit network has been an issue in the Stuttgart region since 1996 (VRS-Verkehrsplan 2016, p. 18). In an effort to increase transit ridership by 20% by 2025, the state government, VRS, county governments and the city of Stuttgart formed the "ÖPNV – Pakt" (transit alliance) in 2014 (BW ÖPNV Pakt 2014). The efforts primarily focus on increasing the service and reliability of the existing lines, adding park and ride stations, and improving the multi-modal infrastructure of the last mile of getting to and from the train stations. The transportation plan also stresses the need to more rigorously align developed land with existing infrastructure and to increase density and mix of uses along existing transit corridors (VRS-Verkehrsplan 2016, p. 22). To identify future transportation projects, the transportation plan assesses the emissions of 10 potential scenarios for the development of the transportation system (VRS-Verkehrsplan 2016, p. 64). The implementation of the project is the responsibility of Deutsche Bahn AG and Stuttgarter Straßenbahn AG.

6. Implementation challenges and opportunities for regional planning organizations

When it comes to implementation of urban containment and transit-oriented development to reduce GHG emissions, all three regional agencies rely on the land use and zoning powers of local governments and transit operators for transit expansions. While VRS and PSRC have control over transportation planning, Metro Vancouver almost entirely depends on TransLink for planning and implementation. For Metro Vancouver, there is no horizontal (across-sectors) integration of decision-making for growth management and transportation. VRS and PSRC have the ability to coordinate both sectors based on state law.

In the land use sector, Metro Vancouver pursues an interactive planning process (based on state law) and VRS pursues the *Gegenstromprinzip* ensuring procedural coordination (based on federal and state law). Metro Vancouver can negotiate with communities on land use issues through the interactive planning process which makes coordination mandatory (vertically integrated). VRS has the ability to engage in implementation procedures with statewide sectoral agencies and local communities based on federal and state law. Coordination is mandatory across sectors and levels of government (*Gegenstromprinzip*; ROG §1(3)). Both systems are designed to ensure consistency of goals and efforts across different levels of government. In both instances, state laws are designed to help resolve conflicts between levels of governments and to balance different interests through a set of predefined collaboration procedures. Therefore, both systems have mandatory vertical (across levels of government) integration of decision making.

For PSRC in Seattle, decision making is voluntarily integrated for growth management and mandatory for transportation. As the MPO, the planning process has to be collaborative, comprehensive, and continuous (Also referred to as the 3C-Process) (USC 23 Sec 134(c)(3)). Based on state law, the regional certification process of local and countywide plans is mandatory for the transportation component but not for the land use components. However, PSRC has voluntarily set up a certification process that also covers growth management aspects. This makes vertical coordination on growth management voluntary. If the certification process is based on municipalities giving the MPO these rights, there may be a reverse incentive for the MPO to strongly enforce compliance.

Overall, in the Seattle region the regional level has been very inventive with implementation tools such as the Regional Compact, the Plan Review Process, and the tax levy for transit funding. In a way, the lack of state support, requires broader expertise and capacities at the regional and local level, including procedural (administrative), tax, and legal in addition to spatial planning and transportation needs. Therefore, a key difference for implementation is the additionally required capacities at the regional level. Furthermore, differences are the state support for spatial climate mitigation actions, as well as legislative coordination requirements across levels of government (vertical integration) and across sectors/ scales (horizontal integration).

7. Conclusion

This paper reviewed the commitment and capacities to implement climate friendly regional development and mobility patterns at the regional level in Seattle, Vancouver and Stuttgart. While Vancouver and Stuttgart have national and state support for climate action, the institutional structures in the United States leave metropolitan regions to take mostly voluntary actions. In an effort to reduce emissions, all three regions are committed to spatial development patterns that protect open space and focus growth in mixed-use centers along transit-corridors, however, the implementation of these patterns follow different pathways.

In Germany coordination on implementation is mandatory (legally defined procedures) across sectors and levels of government; in British Columbia coordination is mandatory across levels of government; in the US coordination is voluntary (regional policy defined procedures) across sectors and levels, except for the transportation sector. There is a need to further study the actual coordination and implementation of urban containment and transit-oriented development in each region to fully grasp the relevance of the state planning system. Furthermore, there needs to be more research to understand if the climate discourse has led to systematic changes in the planning system or if climate mitigation efforts benefited from existing systems. Furthermore, the underpinning cultural context of the planning system needs to be examined to understand the differences in outcomes. Understanding potentials and challenges at the regional level may help improve conditions for more collaborative climate actions across sectors and levels of government as part of a multi-level climate governance reforms.

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Endnotes

1 Canada, Germany, and the USA are organized as federations with strong state governments (Province, Landesebene) in contrast to central states such as France and the Netherlands (Heinz, 2000, p. 3)

2 Broad planning is the Canadian term, growth management the US-American term and spatial planning (Raumplanung) the German/ European-English term. PSRC is actually in a fairly unique position in the US to be responsible for growth management. In most US states, all planning responsibilities reside at the local level. Metro Vancouver is a special case in Canada, too, as the BC Local Government Act is not common in the other provinces. In Germany, having growth management (spatial planning) authorities is a core responsibility of regional planning. VRS is a special case having transportation planning responsibilities by state law.

3 Metro Vancouver is currently working on an Integrated Regional Climate Action Strategy (MV-Climate 2050-DP 2018). VRS has a climate adaptation strategy but no mitigation strategy.

4 To reduce emissions, Metro Vancouver's RGS plans to accommodate the anticipated population growth of 1 million residents by 2040, "in a network of transit-oriented urban centers and […] compact, complete communities that offer amenities close to home" (MV-Climate 2050-DP 2018, p. 45). PSRC's Vision 2040 plans to focus the forecasted population growth of 1.7 million people by 2040 in centers within existing cities in the urban area which is projected to reduce emissions by 6% (Vision 2040, p. 13). VRS aims to reduce VMT by defining primary transportation corridors (*Festlegung von Entwicklungsachsen*) and by concentrating retail and housing developments in centers (*Verortung von Wohnbau- und Gewerbeschwerpunkten*) in the regional plan (WIV 11617, p. 5).

5 A common critique on growth boundaries is the housing affordability problem. In all three regions this issue is addressed within the regional growth strategy and through separate plans or policies.

6 To create a compact urban area (Goal 1), the Metro Vancouver's RGS establishes an Urban Containment Boundary (Strategy 1.1), Urban Centers and Frequent Transit Development Areas (Strategy 1.2), and rural areas to be protected from urban development (Strategy 1.3) (MV-RGS 2011, pp. 13, 45). A core of PSRC's Vision 2040 is to develop mixed-use pedestrian-oriented centers along transit-lines (p. 14). By focusing growth in already built-up areas, farmland and resource lands are to be permanently protected (Vision 2040, p. 14). Infrastructure investments prioritize transit and nonmotorized transportation facilities for urban areas (Vision 2040, p. 14 and 82).

7 The federal government in Germany has little influence over implementation as zoning authority is a right of local municipalities, however, the Spatial Planning Law provides a framework of coordinated land use decision making across sectors and levels of government.

Indigenous knowledge a solution against drought in cities of Iran (the case study: Qazvin city)

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Iran has been located in hot and dry region and water scarcity is always a permanent problem in this country. In recent years by global warming of the earth the water resources of Iran have been decreases so much and there will be a serious crisis in Iran. In past years Iranian harvested water from underground water by a more sustainable technique which called "Qanat". This technique was more sustainable than deep wells in harvesting water to irrigate cities and farms. The morphology of cities obeyed from the track of water of Qanat as well.

Harvesting and supplement of water in historical cities in Iran (hot and dry regions of Iran) was according an indigenous knowledge which was so innovative and intelligently.

Iranian harvested and used water in the most effective and efficient ways which can have some good lessons for recent generation which uses water in an uneconomical and illogical way.

This paper will review the indigenous knowledge in harvesting and supplement water in historical cities of Iran to learn some sustainable solutions to challenge with the drought which is the result of global warming of the earth.

The case study of this paper is Qazvin city. This city has been located in semi hot and dry region in Iran which was irrigated by several Qanats and a traditional supplement of water in city which determined the morphology of the city.

Key words: global warming, traditional urban planning, Qanat, indigenous knowledge

Introduction

Water is a scarce element in most parts of Iran and there are few rivers and lakes in Iran specially in central parts of Iran.

Iran has been covered with vast desserts and Iranian earned water by an intelligent technique which called "Qanat".

This system is the most prevalent system to earn water for settlement and agriculture. Iran has been survived by “Qanat” or “Kariz”. Actually we can notice a “Karizian civilization” in Iran which is an ancient civilization in a hot and dry region. Cities and villages was formed according the recourses of water and path of Qanat. In the other word cities were formed based on the path of Qanat and water was an important factor in morphology of cities.

The location of many buildings of the cities especially hydraulic structures was determined according the path of Qanat.

Old Iranian has a rich knowledge in harvesting water and supplement of water in cities. By this indigenous knowledge water was earned and supply in a most efficient way which water was consumed in the optimum way. This paper is about indigenous knowledge in harvesting and supplying water which enabled Iranian to maintain and spread their cities for a long time.

Methodology

Methodology of research is descriptive – analysis and by an exploring and surveying method study the role of water in the morphology of the historic city of Naragh. In the other word traditional harvesting of water (Qanats and wells) and traditional water supplement have a very important effect in morphology of city which in this paper was described.

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1- Qanat and its elements:

This system contains a horizontal corridor to transfer water to a settlement or farms. Other elements of Qanat are a mother well and some shafts which enable pitmen to construct and maintain the Qanat.

Water appears in mouth of Qanat on the ground then transfers to everywhere which need water such as houses, hydraulic structures and farms.

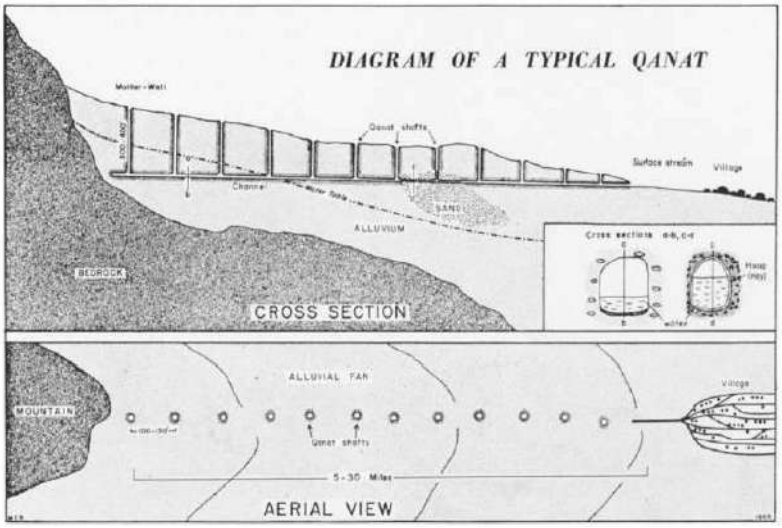

Fig 1- The section and plan of Qanat (source : English)

2- Hydraulic structures:

The most relevant historical hydraulic structures in Iran were Payab, traditional bath, water reservoirs, ice houses, water mills. The location of these structures were obeyed from the path of water which mostly was from the water of Qanats. Sometimes cities obtain their water from rivers or streams. However, these hydraulic structures were feed by water and were located next to the path of water. The water sometimes followed underground. Some houses of cities have this score which water passed through their courtyards. Usually these kind of houses were more expensive and belonged to elite and rich citizens.

2-1 Payab:

To reach the underground path of Qanat people construct a building which is called Payab contains some steps, which lead to underground water and there was a room which water pass through it and there was a hole on the roof to let the sunshine come in. There were public and private Payab both. The number of steps which lead to water depended on the depth of underground water of Qanat.

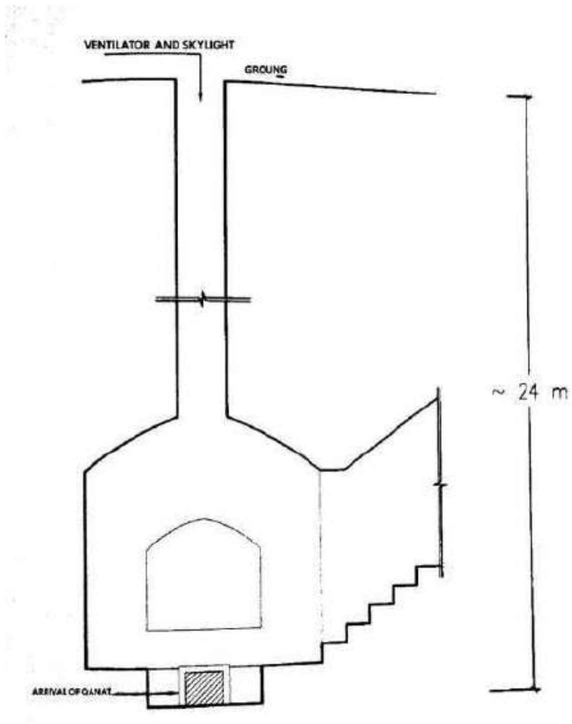

Fig 2. Section of a Payab (source:semsar Yazdy)

2-2 Water reservoir (Ab Anbar):

Water should be reserved in large structures which was called water reservoir (Ab Anbar).
The elements of this building consisted as large tank which was constructed inside the ground and a large doom covered this tank and the air of this building was ventilated by some wind tower (badger).

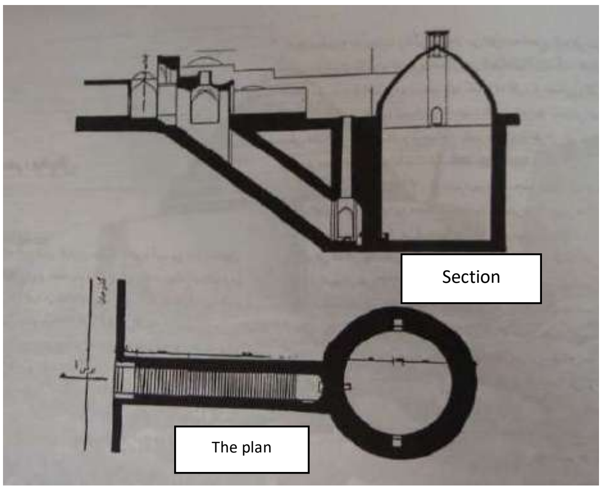

Figure3: section of a water reservoir in Kashan city (source: Ghobadian)

2-3 traditional bath:

Traditional bath is another building type in hydraulic structures. In Islam there is an important emphasis on washing and cleaning. According to Islam roles people should clean and wash themselves so in cities there were several bath to serve citizens. As usual the bath was fed by water of Qanats and traditional bathes had a plan but in this paper there isn’t enough space to describe them.

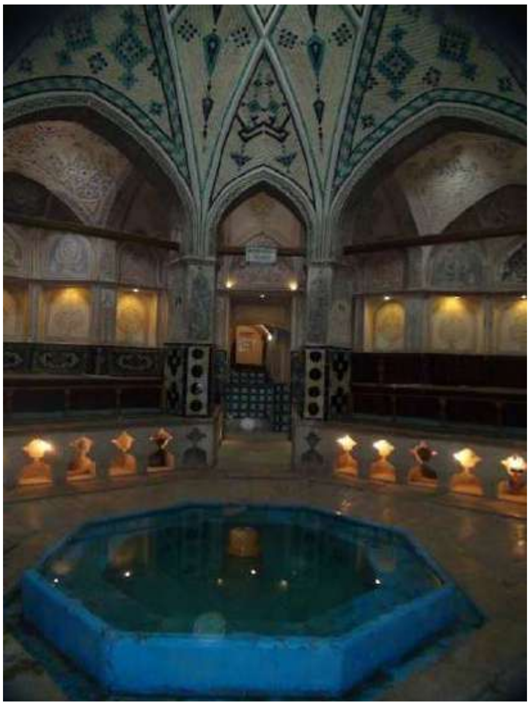

Fig 4. Amir Mhammad Bath in Kashan (source : author)

2-4 Ice houses:

Iran has hot and long summer. There is an intelligent system to produce ice for hot days. In ice houses there are two main elements: a tall wall and a storage. In winter water froze in shallow pools which was in shadow of a tall and long wall.

People cut the ice and stored it in a huge structure which was erected inside the ground and was covered by a large doom. In summer people brought out the ice and consumed it.

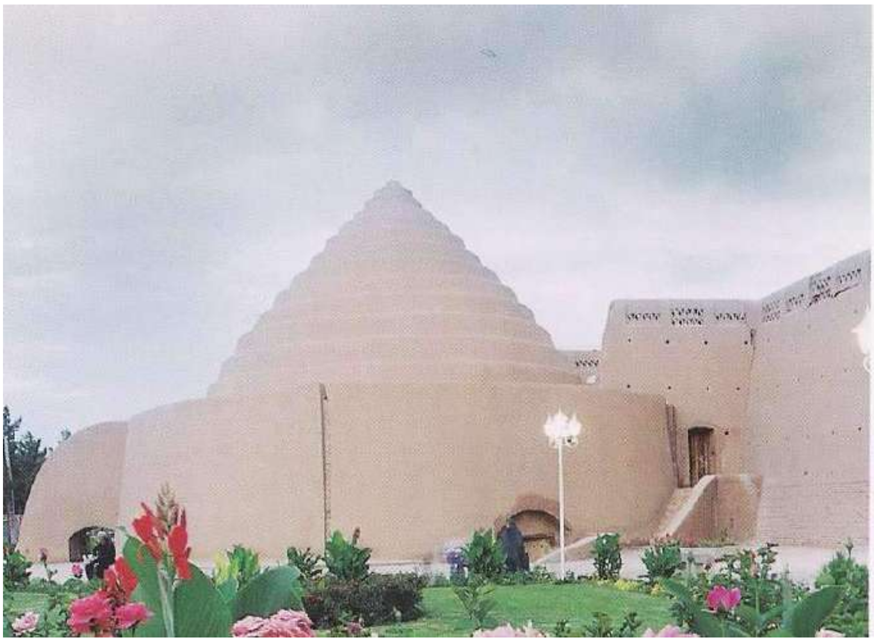

Fig 5: Ice house Kerman city (source: author)

2-5 water mill:

In past time most of water mills worked by hydraulic power. As there are few rivers in Iran people use the hydraulic power of water of Qanat. So there were several water mills in the path of water of Qanat and the wheel of water mill moved by the power of water and produced the flour of people.

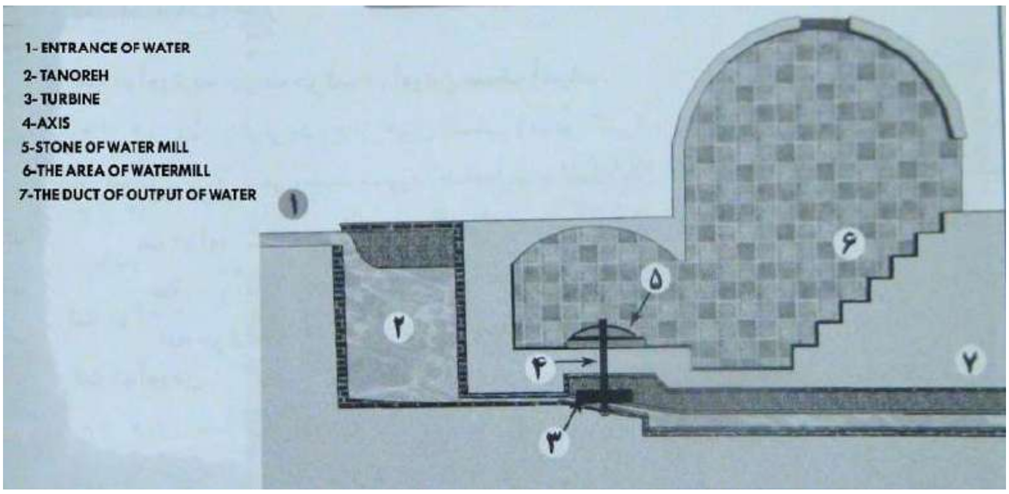

Figure 6: section of a watermill in rout of Qanat (source:Semsar Yazdy)

3- The location of hydraulic structure in cities:

As it was mentioned before, the location of hydraulic structure was determined by the path of water in cities either followed on the ground or underground.

However, usually first of all water mills were located on the path of the water and then water passed through some public and private Payabs, traditional bathes, ice houses and water reservoirs. Mosques usually reached to water by Payab to achieve a ritual of praying (vozu). Of course water was used in a hierarchy in hydraulic structures and finally was lead to farms and gardens.

In two below maps the path of two Qanats of Qazvin city in Iran and its hyrulic structures have deen shown.

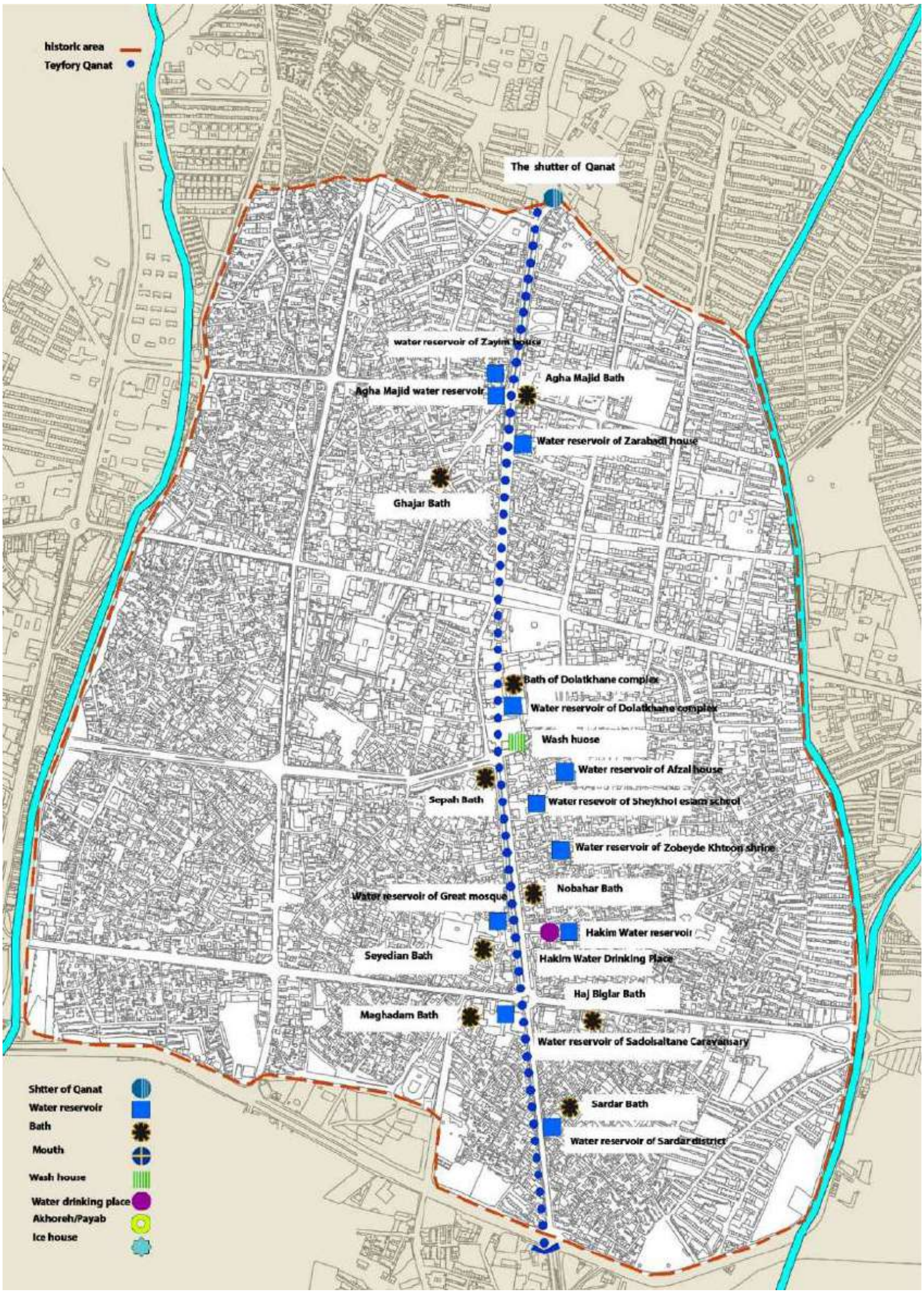

Figure 7. The rout of Teyfory Qanat in historic area of Qazvin and location of hydraulic structures on it (source : authors)

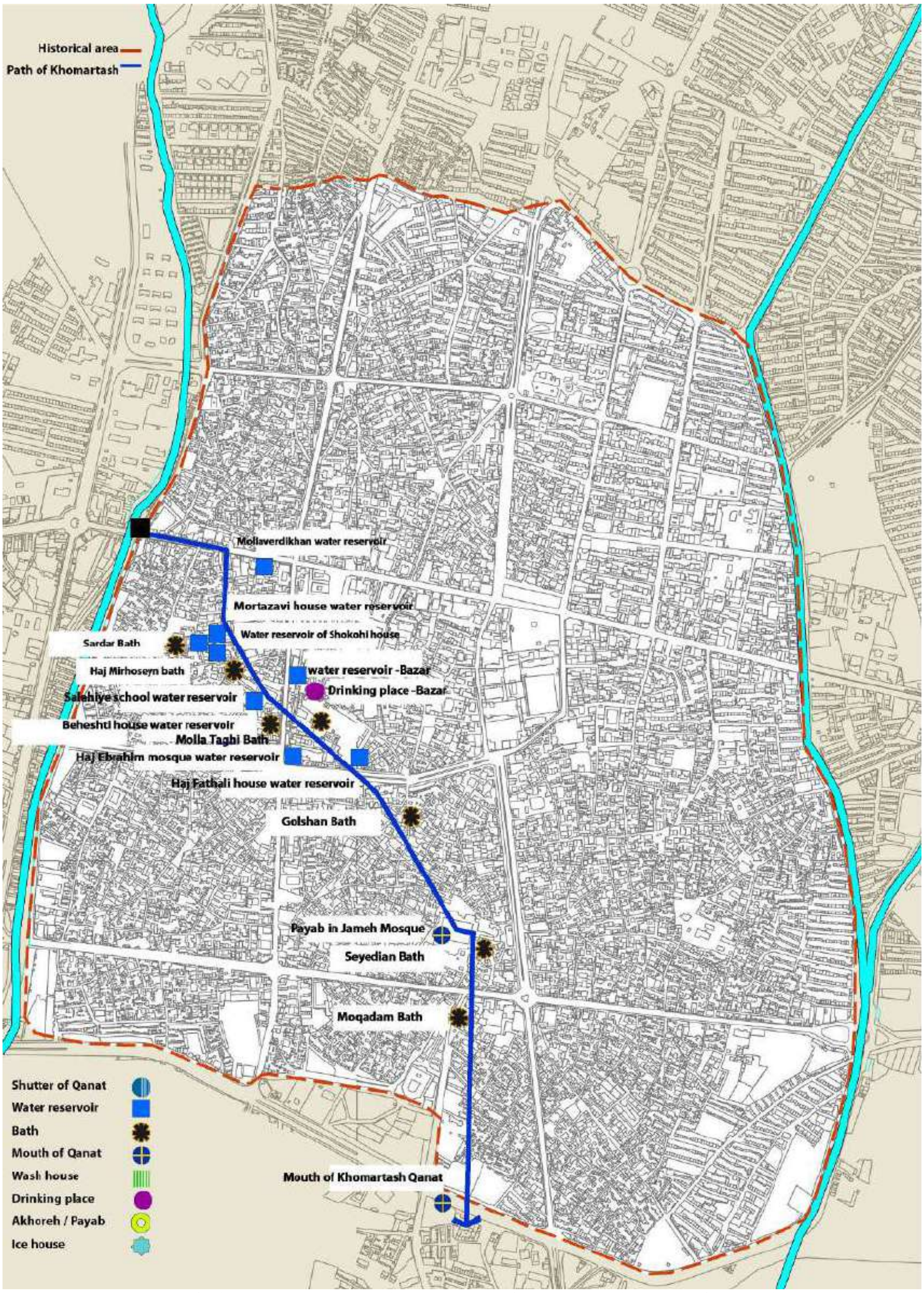

Figure 8 - The rout of Khomartash Qanat in historic area of Qazvin and location of hydraulic structures on it (source : authors)

4-Comparing Qanat with wells in harvesting underground water:

Water harvests mainly by two systems: Qanat or deep wells. In comparison harvesting water by Qanat is more sustainable than wells.

Qanat harvested water from alluvial fans and the amount of water directly depends on the water of alluvial fan.

But deep wells discharge the water of alluvial fans so fast so its water will finish and can’t be back anymore.

5-Conclusion:

Water is the main factor to survive a settlement. Iran in spite of scarcity of water has an old civilization which was based on the water of Qanat. Qanat and hydraulic structures invented by a rich indigenous knowledge.

Reviewing this knowledge will be very useful and can lead us to more sustainable ways to achieve more efficiency in harvesting and consuming water.

In the other word we need the best solutions to achieve two major problems: the water scarcity and drought and referring to indigenous knowledge will be a good solution.

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Main Title

The Impact of Climate Change on Spatial Planning, the case of Durban, eThekwini Municipality.

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1. Introduction

It is said that by 2050, 6.5 billion people, or two thirds of the world's population, are expected to live in sprawling metropolises. To safeguard this future urban way of life new forward-thinking strategies for mitigation and adaptation to the impacts of climate change need to be integrated into conventional concepts of urban development. To that end eThekwini Municipality has developed a Spatial Development Framework which outlines a development trajectory for short, medium, and long-term planning scenarios. The Spatial Development Framework presents a long-term (20+ years) vision and plan of the desired spatial form of our Municipality, and thus, is critical for infrastructure planning.

The Spatial Development Framework guides the desirable spatial distribution of land uses within a Municipality to give effect to the spatial vision, goals, and objectives of the Municipality. It prioritises areas for spatial interventions and is aligned with National and Provincial strategies to achieved both horizontal and vertical alignment. When completed, the Spatial Development Framework is adopted by the Municipal Council. Our Spatial Development Framework has been informed by key international, national, provincial, and local influences, as shown in the following diagram. Each of the strategies discussed later in this paper should not be seen in isolation, but as integrated components of an overall framework for sustainable development of the city.

Figure 1: Key Spatial Development Framework informants

The plans for the development of our Municipality and its built environment are underpinned by global, national, and regional policy. The objectives of these policies have influenced the strategic and spatial direction of our Municipality. The most recent and relevant international developmental policies that informed our Spatial Development Framework are listed and described below.

- The **New Urban Agenda** officially adopted in Quito, Ecuador in November 2016. This agenda provides a 20-year "roadmap" to guide global sustainable urban development. The 2030 agenda is built around a series of Sustainable Development Goals. Most relevant to the New Urban Agenda is Sustainable Development Goal 11, which aims to “make cities and human settlements inclusive, safe, resilient and sustainable”.

- The **Sustainable Development Goals**’ intention is to be a universally shared common and globally accepted vision to progress to a just, safe, and sustainable space for all inhabitants.

Figure 2: An image of the Sustainable Development Goals

- **Sendai Framework for Disaster Risk Reduction 2015-2030:** The Sendai Framework is a 15-year voluntary, non-binding agreement which recognizes that the State has the primary role to reduce disaster risk, but also finds that this responsibility should be shared with other stakeholders including local government, the private sector, and other stakeholders. It aims for the following outcome: “The substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries”.

- **The Addis Ababa Agreement -**The Addis Ababa Action Agenda provides a foundation for implementing the New Urban Agenda. The agreement was reached by the 193 United Nations Member States attending the United Nations Third International Conference on Financing for Development.

- **Paris Agreement -**The Paris Agreement is universally regarded as a seminal point in the development of the international climate change regime under the United Nations Framework Convention on Climate Change (UNFCCC). The Paris Agreement was adopted on 12 December 2015 at the 21st session of the Conference of the Parties to the United Nations Framework Convention on Climate Change Conference of the Parties 21. The Agreement was the result of four years of intense negotiations mandated by the United Nations Framework Convention on Climate Change Conference of the Parties, held in Durban in 2011.

  The Agreement is a comprehensive framework which guides international efforts to limit greenhouse gas emissions and to meet all the associated challenges posed by climate change. The main objective of the Agreement is to limit the global temperature increase to well below 2 degrees Celsius, while pursuing efforts to limit the increase to 1.5 degrees. South Africa is a signatory to the Paris Agreement and has an obligation to limit temperature increases to 1.5°C, above pre-industrial levels.

We have customised the above global documents to suit the prevailing conditions in Durban and their key outcomes informed the development of our Spatial Development Framework. For example, the Spatial Development Framework contains strategic responses to climate change, including the Durban Climate Change Strategy, which is part of the Municipal Climate Protection Programme. This programme defines a city-wide approach to adapting to climate change and mitigating Durban's contribution to climate change. It covers 10 themes: water; sea level rise; biodiversity; food security; transport; energy; waste and pollution; health; and economic development as well as recognizing knowledge generation and understanding as cross-cutting fields.

The vision of the Durban Climate Change Strategy is: "To transform Durban's governance, social, development and economic systems in order to effectively respond to climate change". It guides the implementation of climate related work done within the Municipality, its governance framework and the subsequent development of implementation plans, supported through the C40 2020 Climate Action Planning Programme. It enables better co-ordination between municipal sectors and structures helping to build a climate smart city.

2. Governance structure that responds to Climate Change within eThekwini Municipality

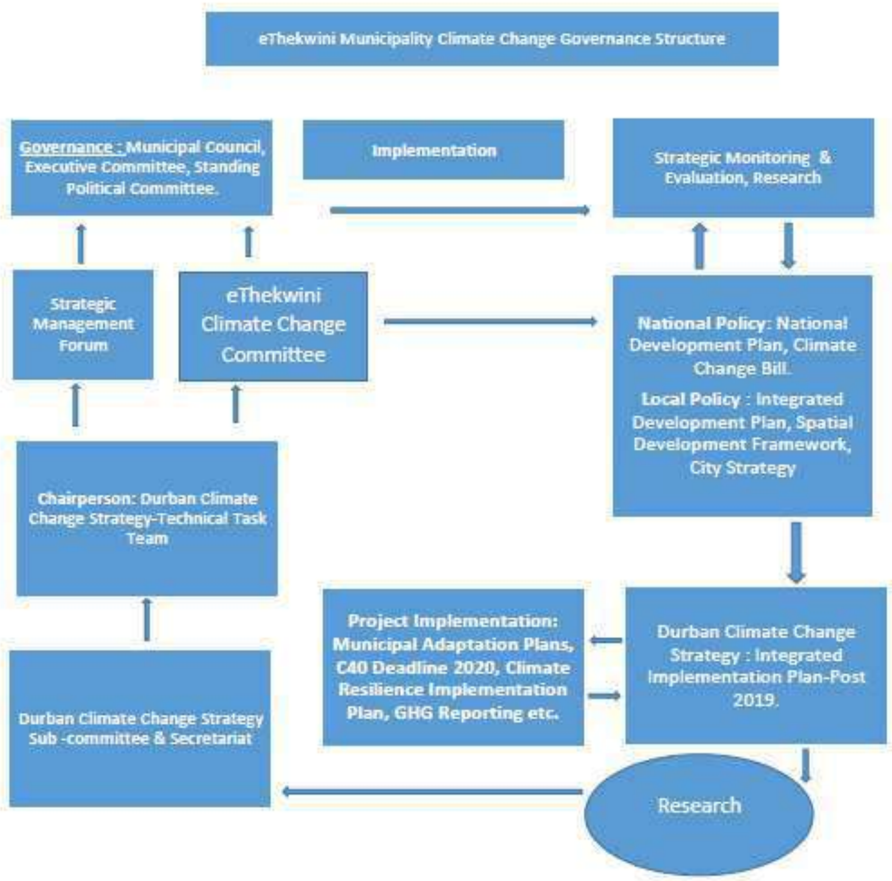

Figure 3: An image of the eThekwini Municipality Governance Structure that deals with Climate Change

Governance of local climate action

As outlined in figure 3 above, the eThekwini Municipality Climate Change Governance is led by Her Worship the Mayor of the City of Durban, and she is the C40 Vice Chairperson for Africa. The Mayor has delegated the responsibility of climate change political oversight role to the eThekwini Municipality Climate Change Committee. The Strategic Management Forum plays the administrative oversight role on the Durban Climate Change Strategy implementation. The Durban Climate Change Strategy Technical Task Team comprises of Heads of Departments and fulfils a coordination and implementation of the Durban Climate Change Strategy between line functions and reports to the eThekwini Municipality Climate Change Committee. The Task Team is supported by the Sub Committee which comprise largely of Senior Managers from different line functions, the Sub Committee also oversees the implementation of various climate change projects working with network partners such as C40 Climate Change Leadership Group, Cities Fit for Climate Change, as well as other projects with their respective steering committees.

There are intentions to review the Durban Climate Change Strategy in 2020 which will be informed by the Monitoring and Evaluation Framework to be completed by mid-2019. This governance structure is supported by officials who serve on a number of climate change networks or partnerships. The knowledge derived from all climate change work streams is fed into the Governance Structure with the intended outcome being integrated and effective climate change response by the eThekwini Municipality. The concept of Network Density becomes applicable if this structure is viewed as a Network Map. Density refers to the number of interconnections between members in the network map. Effectiveness is increased by density, because the more the interconnections there are, the better the communication of new ideas between network members. Everybody is talking to each other, and nobody with potentially useful information is isolated.

3. Cities as actors of sustainable development

Our plans have also been influenced by the participation of the Municipality in international partnerships and learning exchanges. These events have informed our spatial planning response to climate change and mitigation. The following section describes one such partnership we have entered to mainstream our climate change response work.

3.1 Global Project Cities Fit for Climate Change Project:

The global project 'Cities Fit for Climate Change' implemented by GIZ on behalf of the Federal Ministry for the Environment, Nature Conversation, Building and Nuclear Safety (BMUB) cooperates with various international partners, in Germany, and with its three partners cities. The partner cities, Santiago (Chile), Chennai (India), and Durban (South Africa) were selected in agreement with the relevant national ministries and authorities. The decisive selection factors were the commitment of the mayors and city councils, and the cities' level of climate change vulnerability. Each city determines their project priorities, which might be, for example, the climate-proofing instruments, strategies, regulations, the implementation of participatory city development strategies, or the development of financing options for realising available climate protection and adaptation concepts. Each partner cities exchanges knowledge with each other and with other cities within the framework of the exchange workshops.

Figure 4: A global map illustrating the location of Cities Fit for Climate Change Partner Cities

Cities Fit for Climate Change aims to strengthen cities as actors of sustainable development, and to assist cities in the development of integrated, resilient, and low carbon instruments for sustainable urban development. The development of these instruments will facilitate a Climate Proof Urban Development Model, which promotes a new urban design vision. With this model, the project supports innovative approaches for urban planning and makes cities "fit for climate change". A fundamental question is how can cities, as drivers and victims of climate change, cope with the risks and become custodians of a livable climate? This project is focused on finding answers to this question. Because there are no universally applicable solutions, existing concepts for resilient low carbon urban development are being analysed and compiled in a sourcebook. Selected cities develop case-specific, climate-friendly, locally adapted strategies which are derived from this knowledge base. This work was guided by the 'Leipzig Charter on Sustainable European Cities' and the BMUB Memorandum 'Urban Energies-Urban Challenges'.

It is the intent of the program to share the collected knowledge at international conferences, such as the International Society of City and Regional Planers (ISOCARP) Congress, and to support the United Nations Framework Convention on Climate Change process. The Program also contributes to the implementation of the 'New Urban Agenda', the international agreement of the Habitat III process.

3.2 International Learning Exchange Workshop of the Cities Fit for Climate Change project in partnership with Connective Cities. Durban, South Africa, February 2017.

Three 'inter-connected' workshops were planned in each of the participating partner cities. At each workshop new elements of climate-sensitive urban planning would be incrementally developed into a new urban development model that draw on real city-level case studies. The first was held in Durban in February 2017. It hosted urban practitioners from the partner cities together with representatives from the German cities of Hagen, Nuremberg and Stuttgart, the Swedish City of Malmö, the South African Local Government Association (SALGA) and members from GIZ SA (Climate Support Program).

Figure 5: An image of the City of Durban.
Source: Letebele, K.E. (2018) Photographic Image.

These exchange sessions were intended to enable and facilitate peer-to-peer knowledge sharing, support and collaboration, the joint generation of new knowledge, and the promotion of innovation with regards to the planning of low-carbon and resilient urban development. The workshop discussions were centred on analysis tools, city development strategies, planning approaches, implementation frameworks etc. revised to reflect climate change considerations with the resultant outcome - to make cities low-carbon and resilient to the impacts of climate change.

The workshop objectives were:

- To establish the status quo regarding the integration of climate change issues in urban development instruments and strategies of the partner cities;
- To learn from existing practices and innovations in climate sensitive urban development;
- To identify synergies between the existing urban development instruments and strategies;
- To develop a roadmap for the workshop series with the intermediate steps needed for conceptualizing a new climate-sensitive urban development model.

To generate workable solutions for the next workshop, the primary aim of the Durban workshop was to discuss lessons from successful efforts that can be replicated on the various projects and programmes presented by the participating cities. A key outcome of the Durban workshop was the realization that for climate change adaptation and mitigation strategies to gain traction in cities, they need to be main-streamed into urban planning development and not viewed as a separate discipline or add-on.

After the Durban workshop, the eThekwini Municipality developed a meaningful implementation plan for the Durban Climate Change Strategy, which mainstreams climate adaptation and climate resilience into the planning processes, such as the Spatial Development Framework and lower order spatial plans. The Climate Resilience Implementation Plan is an outcome of the Cities Fit for Climate Change (CFCC), a global programme implemented by GIZ on behalf of the Federal Ministry for the Environment, Nature Conversation, Building and Nuclear Safety (BMUB) of the Federal Republic of Germany.

In general, our implementation plan aims to assist in the development of integrated, resilient, and low carbon instruments for sustainable urban development. The development of these instruments will promote a new urban design vision, which supports innovative approaches for urban planning and makes cities "fit for climate change". Furthermore, our approach ensures that the implementation of the Climate Resilience Implementation Plan is undertaken through agreed municipal procedures and integrated into relevant municipal planning and decision-making processes.

The integration of the Climate Resilience Implementation Plan outcomes will feed into the Non-Motorized Transportation and active mobility strategy for eThekwini amongst others. Efforts are underway to lobby support from all municipal departments to prioritize and incorporate climate change responses into their mid -term budget review in line with their respective mandates. This stems from the fact that the Spatial Development Framework is a multi-sectoral plan, and therefore when each sector implements an action linked to climate change then the outcome of the Climate Resilience Implementation Plan will be seen through to implementation as part of that process.

We also recognized that we need to think globally, but act local, to take meaningful steps towards climate change mitigation and adaptation. Furthermore, we learned that cities should not work in isolation of each other, their nation-states, or the global community. We recognized that solutions for climate changes need to address a multiplicity of issues for a city and cannot merely be about climate change protection and or mitigation alone.

3.3 International Dialogue Forum on Climate-Proof Urban Development, Santiago De Chile, September 2017.

The International Dialogue on Climate Proof Urban Development was held to map trajectories for a climate-friendly future. This dialogue forum involved the participants from seven different cities, including the three partner cities and four German cities (Leipzig, Nuremburg, Frankfurt and Munich). The German cities were invited to share information regarding their work on climate-proof urban development and to learn from the Cities Fit for Climate Change partner cities.

The main objectives of the Santiago Cities Fit for Climate Change dialogue forum were to:

- Generate networking opportunities between Cities Fit for Climate Change partner cities; and,
- Learn about and exchange information regarding municipal practices and climate-proof urban development experiences from the participating cities.

Figure 6: An image of Santiago de Chile.
Source: https://www.gettyimages.com/photos/santiago---Chile.

The Santiago International Dialogue on Climate Proof Urban Development concentrated on how to change institutional patterns to achieve enhanced integrated urban development. A cross cutting theme of the workshop was "The Governance of Local Climate Action and How to Foster Multi-Stakeholder Collaboration". It was at this International Dialogue session that emphasis was placed on the definition of Climate-Proof Urban Development as follows:

> ´In connection with spatial planning and spatial development, climate proofing includes methods, instruments and procedures that ensure that plans, programmes and strategies, as well as the associated investments towards the current and future impacts of climate change will be more resilient and adaptable, and that they also aim for the corresponding plans, programmes and strategies to take into account the aim of climate change mitigation' (Birkmann and Fleischhauer, 2009).

The above definition points out that to achieve a climate proof urban development a collective action from all stakeholders responsible for urban development is required. Two site visits in the city of Santiago were undertaken to showcase urban development projects and the climate considerations that come with them. The real-life examples, Bajos de Mena, in the municipality of Puente Alto, and Ciudad Parque Bicentenario, in the municipality of Cerrillos, were discussed to illustrate the challenges and opportunities of climate-proofing urban development in district neighbourhoods or infrastructure projects. Both projects were selected to represent examples of national policy implementation in urban development, as well as to stimulate conversation regarding the challenge of integrating climate change related elements into such projects.

Bajos de Mena

Bajos de Mena is a historically neglected area, 20 kms away from Santiago with more than 120,000 inhabitants. It was built to provide social housing, but without territorial planning. Bajos de Mena is a social housing condominium area located in the southern periphery of the city of Santiago. It is a neighbourhood of high complexities with the following characteristics: "precarious condition of habitability with serious problems of violence and insecurity; lack of infrastructure and public - private services; and, above all, deteriorated relationships with authority and feeling of abandonment by the State".

One of the primary challenges was to incorporate climate change adaptation into the new plan by generating pilot development projects which include renewable energy and water efficiency among other actions. The plan was to evaluate the impacts of these interventions and to determine the feasibility of scaling up such approaches. The plan is led by the Regional Government of the Metropolitan Region of Santiago, in direct coordination with various public and private services.

Figure 7: An image illustrating the built form in Bajos De Mena
Source: Letebele, K.E. (2017) Photographic Image.

The Second Chance Plan for this area was incorporated into the Bajos de Mena Integral Plan, under the direction of the Integral Plans Unit of the Metropolitan Intendencia. It proposed housing and neighborhood improvements, more transport infrastructure, services, green areas, and new security prevention plans. It also seeks to provide the area with services (banks, supermarkets, police, public, services, etc.), improved housing quality (isolation, bigger spaces), connectivity, and public areas focused on sustainability in terms of living standards, both in social and environmental terms. The project highlights the co-benefits and synergies between the various social and climate related challenges, by incorporating adaptation initiatives that respond to both social and climate problems identified by the local community, such as flooding in certain areas of the various neighbourhoods. However, there is still work to be done in terms of transportation and connectivity, as well as energy efficiency and supply.

The experience generated by the project points towards a recommendation to clearly understand the pertinent climate change risks prior to any urban intervention, by performing a vulnerability and risk assessment. This allows for climate change related challenges to be integrated from the beginning of the project, instead of having to integrate such considerations after the development phase has begun.

Ciudad Parque Bicentenario

Ciudad Parque Bicentenario (CBT), also known as the Bicentennial Park of Cerrillos, is an urban-real estate project located in the commune of Cerrillos within the metropolitan area of the city of Santiago, Chile. The project was designed to commemorate the Bicentennial of the Country in 2010. CPB is an integral urban project led by the Ministry of Housing and Urban Development (MINVU). The project program consists of the reconversion of 250 hectares of the former Los Cerrillos Airport into: a 50 ha park; a proposed development of about 16,500 homes to be developed over the next 20 years; the development of Sports Village for the Pan-American Games to be held in Santiago on February 2023; the development of homes to be transferred to the Chilean Air Force; and, apartments for the institution's members. Due to its size and location, the CPB provides an opportunity for implementation of public policies that promote the improvement of the quality of life of its inhabitants and the environment.

Figure 8: Plan City Bicentenario Plan

This project attempts to consolidate a new form of city, which enhances the role of the state in guiding urban development with an emphasis on building socially integrated, environmentally sustainable neighbourhoods, fully equipped with quality public spaces and a very good standard of green open spaces. Emphasis was given to initiatives such as water collection in the lagoon, the integration of urban gardens and organic waste management into the courtyards, climate modelling of the structures and their orientation, and connections with surrounding neighbourhoods.

As a demonstration project for Santiago, this project seeks to set a benchmark for Chile and the Latin American countries in terms of three primary pillars: sustainability and a response to climate change; urban design; and, social integration. It is perceived as an urban laboratory where new urban policies are and will be tested. A mixed-use approach will be employed to assimilate changes that are happening in Santiago into this project. It will be developed by both public and private entities. It is interesting to note that the incorporation of climate change considerations into the project was an outcome of the practitioners from Santiago participating in the Cities Fit for Climate Change.

Figure 9: An image depicting the public open space within Ciudad Parque Bicentenario
Source: Letebele, K.E. (2017) Photographic Image.

A key finding that emerged from Santiago was that Climate change is not an environmental issue, it is about politics, planning and it is a transversal phenomenon. It was also emphasized that it is important to convince political leadership to address Climate Change issues beyond their political term of office to ensure that new leaders assume their predecessor's role and continue advocating for Climate sensitive spatial planning.

3.4 International Dialogue Forum -Chennai, India

The Dialogue Forum in India, Chennai will be held in August 2018. This the third in the series of comprehensive workshops and will build on the outcomes of the previous Dialogue Forums. The third Dialogue Forum will focus on the process that spans from Policy to Action. After having intensively looked at urban development approaches and concepts, urban stakeholders and actors; the idea is to jointly sketch out the path that leads from theory into practice. The focus of the Dialogue will be the Rehabilitation of the Buckingham Canal in Chennai. This process has been generating various social conflicts, related to high levels of pollution as well as periodic floods. The restoration is planned for 3 km of the canal in the southeast sector of the city, and consists of cleaning the river, fencing it off, constructing tracks for running and protecting dikes and other activities. Following the implementation of this project, the restored area could be used as a model for the rest of the canal.

Concluding remarks

The following important lessons were derived from our participation in the Cities Fit for Climate Change program: how to conceptualise and frame climate change responses; how national and city-level policies can support cities in dealing with the impacts of climate change; how valuable the contributions of civil society can be, working in partnership with government; the value of hard science and building scenarios; and, what institutional arrangement within cities and across government are helpful in promoting climate change resilience at the local level.

A strong coherent and coordinated future vision that is owned, not only by city officials and politicians, but by the residents, will assist in embedding climate change adaptation and mitigation measures into local level planning and hold leaders accountable. A common vision can pull together communities, departments within a city and the various government agencies that operate at the local level and galvanise these actors into action.

The climate-proof urban development approach represents an important framework for how to pursue climate change adaptation and mitigation in the context of urban planning. Based on the experiences of the participating German cities, many interesting ideas, urban development processes and lessons learned were identified as being of great use for the cities involved Climate Change projects, as well as for other cities experiencing similar difficulties regarding climate-proofing urban development.

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Letebele, K.E. (2017) Photographic Image

Letebele, K.E. (2018) Photographic Image.

From Green to Resiliency: A Review of Evolution, Experiences and Implementations of American Climate Change Action Plan

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1 Introduction

Among the inducements to global climate change, cities with its artificial environment play the most important roles. On the other hand, cities suffer a lot from threatens of global warming, followed sea level rise, and shortage of energy sources. Consequently, urban areas are pivotal to global adaption and mitigation efforts. In the past decades, there has been a lot of countries throughout the world signing agreements as well as launching climate change actions plans. But how do cities actually perform in terms of climate change response? What are the plan visions, how to implement, through what approaches and strategies? This research sheds light on city-level climate action plans in the United States. Since 2000s, there have been over 170 local authorities and municipalities participating into CCP movement (Cities for Climate Protection). Almost all cities in America enacted related climate action plans at least five years ago, and have released a series of reviews and reports in following years. While the review and investigation of plans is beneficial for cities in other countries that are willing to make efforts as response to climate change, there is a lack in current relative literatures that focus on systematically reviewing the planning implementation as well as the policy-making process.

Through reviewing hundreds of climate action plans, this research aims to answer the following questions: (1) how have the values and targets of climate action plan evolved during the past couple of years? (2) which authorities take charge of making the plans, and (3) how to guarantee the implementation and how do plans perform? This paper makes a comprehensive analysis of the plans quantitatively and qualitatively in terms of policy-making stakeholders, planning targets, constitutions, implementation mechanism, and socio-economic guarantee. It then makes a deep review on a series of sustainable plans of New York City from 2007 to 2016.

2 Climate Action Plans in American Cities

2.1 Development of Cities Climate Protection Program

At the federal level, the U.S. has been a slow starter on climate change policy but has shown progress during the Obama administration, with the Clean Power Plan, investments in renewable energy, fuel efficiency standards for cars and the recent refusal of the Keystone XL pipeline. Yet, despite a politically gridlocked congress, 74 percent of Americans favor federal regulation on greenhouse gas emissions, according to a 2015 poll. This reality makes city action all the more important as local governments are able to push for the climate action that Americans are hoping for.

With cities responsible for more than 70 percent of global greenhouse gas emissions, there is an acute need to capitalize on local solutions to climate change, particularly in the lead up to the COP21 climate conference in Paris. American cities are positioning themselves as the true leaders when it comes to tackling climate change, making it clear that action is wanted, needed and possible. Within recent years, U.S. cities have started reducing their greenhouse gas emissions, as their citizens are feeling the impacts of climate change, such as floods, storms and droughts. Local leaders are well-poised to address these problems with adaptation and mitigation measures due to the fact that city governments are smaller and more agile in their decision-making and more directly accountable to their constituents than their national counterparts, making them more able and willing to act. Action at local levels also has the benefit of yielding near-immediate results, while nationwide changes can take a number of years—and political terms—to materialize.

The Cities for Climate Protection program (CCP) is one of three major global transnational municipal networks aimed at reducing urban greenhouse gas emissions. Established in 1990 by the International Union of Local Authorities and the United Nations Environment Program, one of the largest global transnational networks, the International Council for Local Environment Initiatives (ICLEI), presented a framework to represent local government environmental concerns internationally. The ICLEI strives to ‘establish an active and committed municipal membership… that promotes environmental and sustainable development initiatives within…[a] framework of decentralized cooperation’. In 1993, subsequent to an ICLEI successful pilot scheme, the Urban CO2 Reduction Project, the CCP program was established during the post-Rio Earth Summit era. The CCP program illustrates itself within local climate policy, as a transnational governance network. So far, ICLEI USA has worked in hundreds of cities and towns around the country, in red states and blue states, in communities wealthy and underserved. At the local level nearly everywhere is inspiring in its connectivity, tolerance, and dedication to keep and maintain relationships.

100 Resilient Cities (100RC) is an innovative global network pioneered by the Rockefeller Foundation to help cities around the world become more resilient to the physical, social, and economic challenges that are a growing part of the 21st century. New York City was in the first wave to join the network in 2013, and through its participation, demonstrates leadership in resiliency and takes advantage of the resources and opportunities it presents.

2.2 Exemplars

Together with Los Angeles, Chicago, and New York City, the three largest American cities now boast the “80 by 50” target. This signifies the fact that in the U.S., cities are taking lead on developing and implementing the solutions needed to take action on climate change.

Figure 1. Some large cities in the US taking climate action plans

Washington, DC has entered into a 20-year power purchase agreement (PPA) that greens the district’s electricity supply while saving taxpayer money. Under the PPA, the nation’s capital does not pay for the wind farm itself, but rather, agrees to purchase wind electricity every year at a fixed rate 30 percent lower than fossil fuel power. Wind power procured under the PPA will supply roughly one-third of the District government's electricity from a 46 megawatt wind farm.

Portland, Oregon has been an American leader on climate change for many years and its 2015 Climate Action Program takes an innovative step further by analyzing how Portland residents' and businesses' purchasing habits influence greenhouse gas emissions elsewhere in the world. This consumption-based emissions inventory methodology enables the city to track the emissions it is responsible for regardless of where those emissions took place, and to better comprehend exactly how the city contributes to climate change in order to develop additional mitigation opportunities.

According to a recent study, New Orleans, Louisiana is the most at risk of all American cities from rising sea levels, since, by the most conservative estimates, more than 98 percent of its population will live below sea level in the future. Facing complex climate change-related challenges—including diminished protective wetlands, intense storm threats, land subsidence and regular flooding—the City of New Orleans has improved collaboration between agencies to close gaps in services, which has led to a reduction of 135,000 tons of CO2 in municipal energy use related to water management and reconstruction the city's streets, drainage and sewer systems.

In a hallmark challenge to make Philadelphia "The Greenest City in America," Mayor Michael Nutter has committed to reducing the City's exposure to rising energy prices, to limiting the City's environmental footprint, and repositioning the workforce and economic development strategies to leverage an enormous competitive advantage in the emerging green economy. He created the new cabinet-level Office of Sustainability and a Sustainability Advisory Board representing public, private, and nonprofit interests from across the metropolitan area. In April 2009, the City launched "Greenworks," an innovative action plan focusing on Energy, Environment, Equity, and Economy. PWD's Green City, Clean Waters plan integrates management of Philadelphia's watersheds into this larger context. It is designed to provide many benefits beyond the reduction of combined sewer overflows, so that every dollar spent provides a maximum return in benefits to the public and the environment. Philadelphia's Green City, Clean Waters plan is a unique and fresh approach that supports numerous EPA initiatives at a time when our nation's cities need 21st Century solutions to aging infrastructure problems.

3 Evolution of Green Plans in New York City

3.1 PlaNYC 2007-2013

A growing population, aging infrastructure, a changing climate, and an evolving economy posed challenges to the city's success and quality of life. New York City Municipality recognized that they will determine the city's own future by how the citizens as well as local authorities respond to and shape these changes with their own actions.

In 2007, Mayor Michael R. Bloomberg released the first PlaNYC, which focused on responsibly meeting the city's growing population and infrastructure needs. It is a bold agenda to meet these challenges and build a greener, greater New York. Titled 'A Greener, Greater New York', it included the City's initial sustainability strategy, and became the model for other large global cities. PlaNYC outlined measures to address the city's aging infrastructure, support parks, improve the quality of life and health for New Yorkers, and for the first time ever, commit to a goal for reducing greenhouse gas emissions. PlaNYC 2011 expanded on these initiatives by strengthening the City's commitment to environmental stability and livable neighborhoods, launching brownfield cleanups, and improving the quality of our air and water.

Since the first PlaNYC in 2007, the City has made considerable progress on reaching its goals. The city has reduced greenhouse gas emissions 19 percent since 2005, invested billions of dollars to protect our water supply, planted nearly a million trees, installed 300 miles of bike lanes, and passed regulations and developed programs to phase out polluting heating oils. The City also strengthened coastal defenses, fortified crucial infrastructure such as wastewater treatment facilities, and worked to make buildings and neighborhoods more resilient. In just four years the city has added more than 200 acres of parkland while improving existing parks. More than 64,000 units of affordable housing were created or preserved. The government has provided New Yorkers with more transportation choices, and has enacted ambitious laws to make existing buildings more energy-efficient.

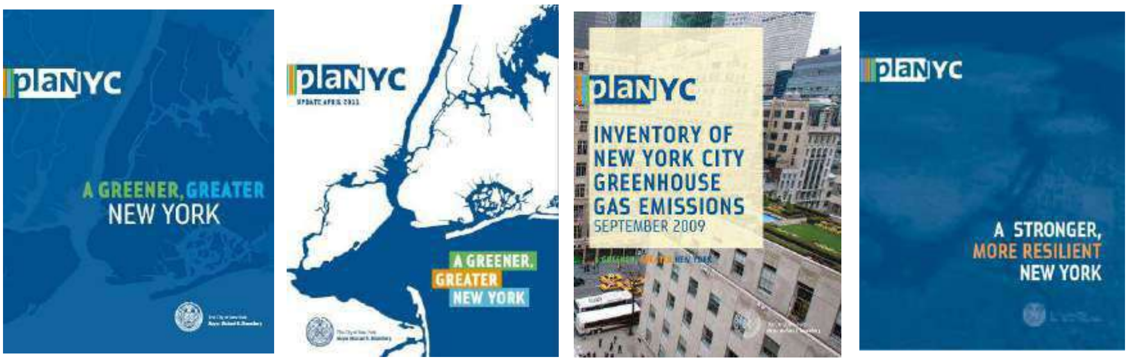

Figure 2. Plans about PlaNYC

In 2013, after Hurricane Sandy, the City released PlaNYC: A Stronger, More Resilient New York, which documented the lessons learned from Sandy, developed a strategy for the city to build back, and developed recommendations to adapt the city to the projected impacts of climate change, including rising sea levels and extreme weather events.

3.2 GIs in New York City

City climate action plans are steering cities in their implementation of policies and actions providing both tangible local benefits and contributing to global impact. Case in New York City shows that cities can leverage the benefits of green infrastructure in their climate action planning.

New York City's efforts to improve water quality are a critical part of PlaNYC, Mayor Bloomberg's blueprint for a greener, greater city. Already the Harbor is cleaner than it has been in over 100 years, and millions of people enjoy the City's waterfront and waterways every year, thanks in part to the New York City Department of Environmental Protection's (DEP's) investment of billions of dollars in sewer and wastewater treatment plant upgrades. But in those waterbodies that do not yet meet water quality standards for pathogens, the biggest remaining challenge is to further reduce combined sewer overflows (CSOs) that discharge a mixture of untreated sewage and stormwater runoff when it rains. Traditional approaches to reduce CSOs further would include the construction of additional, large infrastructure, but the remaining opportunities for such construction are very expensive, and do not provide the sustainability benefits that New Yorkers rightly expect from multi-billion dollar investments of public funds.

The Green Infrastructure Plan presents an alternative approach to improving water quality that integrates "green infrastructure," such as swales and green roofs, with investments to optimize the existing system and to build targeted, smaller-scale "grey" or traditional infrastructure. This is a multi-pronged, modular, and adaptive approach to a complicated problem that will provide widespread, immediate benefits at a lower cost. The green infrastructure component of this strategy builds upon and reinforces the strong public and government support that will be necessary to make additional water quality investments. A critical goal of the green infrastructure component is to manage runoff from 10% of the impervious surfaces in combined sewer watersheds through detention and infiltration source controls.

This Green Infrastructure Plan builds upon and extends the commitments made in PlaNYC and the Sustainable Stormwater Management Plan. This plan provides a detailed framework and implementation plan to meet the twin goals of better water quality in New York Harbor and a livable and sustainable New York City. The analysis in this Green Infrastructure Plan is based upon the predicted impacts of the strategy on CSO volumes in individual watersheds and upon the City's estimates of capital and operating costs. Further analysis, which is substantially under way, will refine the modeling and projections in this report by using more updated geospatial impervious data, incorporating detention technologies, and assessing the impact of CSO reductions on water quality. It will also present data about the operating costs, maintenance, and performance of the green infrastructure projects currently underway. This Green Infrastructure Plan forms a framework for CSO reduction strategies and investments over the next 20 years and will lead to both clean waterways and a greener, more sustainable city.

3.3 Evolution of a Solid Foundation

New Yorkers have a long and proud tradition of confronting tough issues head on, with determination and heart, and having the skills to get the job done. Through it all, the city has remained tolerance and diversity, one that has drawn people from around the world since the origins as a Dutch settlement. The government has a noble history of innovating urban policies that have been adopted across the country and around the world. The city created the first fire districts and a Board of Health committed to eradicating cholera and other epidemics, a system of reservoirs to bring water to the city and engaged creative designers to build great public parks, a citywide zoning ordinance that became a worldwide model. The government pioneered school meals programs, settlement houses for a booming immigrant population, and social programs that became a template for the New Deal and the Great Society. Today, it is leading the way in curbing greenhouse gas emissions and preparing for climate change.

From 2012 to 2014, the de Blasio administration of New York City presented a series of long-term goals and strategies, and launched comprehensive initiatives across City agencies. For instance, Pre-K to all is a plan to create a truly universal pre-kindergarten system, with a seat in a high-quality pre-kindergarten class for all four-year-olds in need of such services. Vision Zero commits the City to using every tool at its disposal to improve the safety of our streets and to reduce traffic fatalities to zero. One City: Built to Last commitment to cut its greenhouse gas emissions 80 percent by 2050 focusing on reductions in buildings, which are responsible for nearly three quarters of the city's contribution to climate change. Housing New York is an ambitious ten-year plan that addresses New York's housing crisis by building our next generation of affordable housing and supporting the quality of life in our neighborhoods. Career Pathways is a plan to create a more comprehensive, integrated workforce development system and policy framework focused on skills building and job quality. One City, Rebuilding Together aims to overhaul the Build It Back program to accelerate the Sandy recovery process for homeowners and establish targets for reimbursements and construction starts. It also established a first-ever Mayor's Office of Recovery and Resiliency to lead the City's climate adaptation and resiliency program.

The city released a series of plans in 2015. IDNYC provides a free identification card to every city resident, including the most vulnerable populations who may have difficulty obtaining other government-issued ID, and provides access to services and programs offered by the City and other businesses. New York City Community Schools Strategic Plan provides key system-building efforts that will be implemented over the next three years to achieve and surpass the City's initial goal of establishing 100 fully developed Community Schools to improve student achievement through strong partnerships among principals, parents, teachers and Community Based Organizations. The CEO Poverty Measure Report is an annual report by the Center for Economic Opportunity in the Office of the Mayor that measures poverty in New York City and is aligned with OneNYC's focus on anti-poverty goals. The CEO measure improves on the official methodology by considering the cost of living in New York City and the resources available to households after tax and social policy is taken into account. Ten-Year Capital Strategy provides a blueprint for capital spending over the next decade. OneNYC and the Ten-Year Capital Strategy are aligned to ensure funding for OneNYC goals.

These initiatives have already begun to show results, which become a solid foundation for city mission transforming from single green toward resilient development.

Figure 3. Evolution of several long term goals and strategies after PlaNYCs

4 From Green to Resiliency: One New York

As a pacesetter in sustainable American city development, New York City faces more opportunities and choices for urban development. It cannot fully predict its vulnerability because of the difficulty in foreseeing urban disasters, risk degree, and potential losses. Coupled with its high susceptibility and low adaptability, any serious disaster may be disastrous. Consequently, it is significantly important to ensure the safety of New York City. Resilient city aims to make citizens and property perform better than those relatively lack of flexibility and adaptability under extreme pressure while subjected to major disaster attacks (Bolin and Stanford, 1998).

From the perspective of etymology, the word of "resilience" first came from the Latin word "resilio," with the meaning of "returning to the original state" (Alexander, 2013). After going through the three stages of engineering resilience, ecological resilience, and evolution resilience, it has been formally applied to urban studies. At present, evolution resilience is more academically accepted. Shao Yewen et al. (2015) argue that resilient city emphasizes the continuous adaptation, learning ability, and innovation, and has the attribute of dynamic systems closely related to continuous adjustment. Xu Jiang et al. (2015) proposes the issue that resilient city has to solve is adaptability when social ecosystem faces "uncertain disturbances," laying more emphases on the systematic and long-term city security and showing more respects for the evolution law of urban systems. Jha et al. (2013) argue that resilient city should have four characteristics involving infrastructure resilience, institutional resilience, economic resilience, and social resilience, so as to mitigate urban crisis in a number of aspects. Although domestic and foreign scholars differ in their interpretations on resilient city, there is a general consensus on the idea that resilient city should have dynamic learning ability, multi-dimensional dispersion of external disturbance, and the ability to mobilize social forces (Davoudi, Shaw, and Haider, 2012; Allan and Bryant, 2011; Jabareen, 2013; Campanella, 2008; Ahern, 2011; Zheng, 2013).

With 45 percent of residents at or near the poverty line, New York City recently launched OneNYC—a comprehensive plan to for sustainable development in the Big Apple with a special focus on socioeconomic equity that aims to lift 800,000 New Yorkers out of poverty by 2025 as well as reducing CO2 emissions by 80 percent by 2050. The plan: One New York: The Plan for a Strong and Just City builds upon these initiatives as a launching point for the ambitious goals set forth in this plan. With the launch of OneNYC, the municipality builds on New York City's global leadership when it comes to growth, sustainability, and resiliency—and embrace equity as central to that work. The plan includes adaptation measures to protect vulnerable, low-income communities from flooding and long term displacement after shock events, like Superstorm Sandy. OneNYC will also ensure that, by 2040, 90 percent of New Yorkers can reach at least 200,000 jobs by transit within 45 minutes by 2040.

Figure 4. Cover of OneNYC

4.1 Concepts and Focuses

OneNYC is a citywide effort. Nearly all City agencies came together in cross-cutting working groups that examined underlying trends and data in order to develop new initiatives. The working groups were tasked with envisioning how the physical city should be shaped to address a range of social, economic, and environmental challenges on the municipal and regional scale.

Extensive pre-launch discussions with New Yorkers directly shaped the goals and initiatives detailed in this plan. When nearly 3,500 people submitted comments to the online survey about housing and affordability, the research group affirmed the affordable housing commitments in Housing New York, the City's ten-year housing plan. That plan lays out strategies to create and preserve 200,000 affordable housing units over the next ten years. OneNYC now sets a goal of creating 240,000 new housing units—both market rate and affordable—within the next decade. It also calls on governments across our region to support efforts to create new housing throughout the metro area. Other feedback focused on providing New Yorkers with transit access from their homes to good jobs. Through transit investments, job creation in diverse locations, and transit-accessible housing construction, this plan will ensure that by 2040, the average New Yorker will be able to reach 1.8 million jobs by transit within 45 minutes. Survey respondents requested that to reduce garbage in New York because it's good for the environment and our neighborhoods. Consequently the city has responded with a strategy to achieve Zero Waste by 2030.

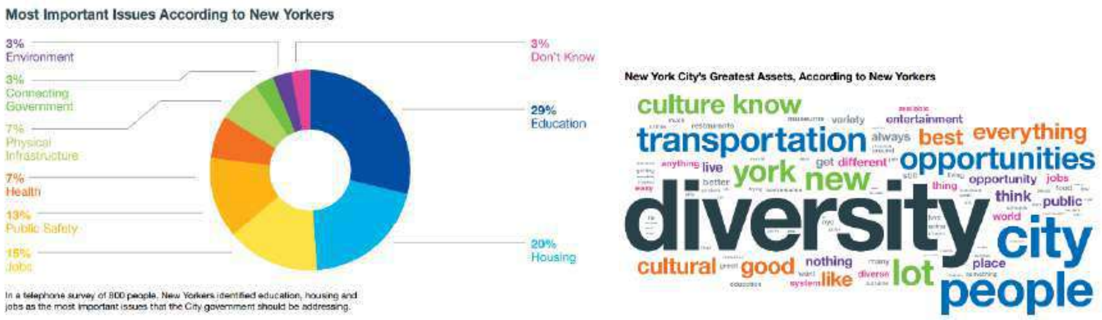

Figure 5. Survey of New Yorkers about most important issues and Keywords

Previous PlaNYC reports have focused on the pressing issues of growth, sustainability, and resiliency. All of these goals remain at the core of OneNYC, but there are three significant differences in the approach taken with this plan: focus on inequality, a regional perspective, and leading the change in need.

With the poverty rate remaining high and income inequality continuing to grow, equity has come to the forefront as a guiding principle. This plan envisions a city that is growing, sustainable, resilient, and equitable—a place where everyone has a fair shot at success. The explicit addition of equity is critical, because a widening opportunity gap threatens the city's future. These four pillars, growth, equity, sustainability, and resiliency together will spur the innovation we will need for the next century.

To make the changes we need, OneNYC recognizes that citizens need to reach out to the neighbors so that the whole region may thrive. The strength of the city is essential for the strength of the region, and strong communities around the city make it more competitive nationally and globally.

Figure 6. Development of New Visions for OneNYC

While New York City has a vast and complex government, even one of its scale cannot accomplish all that needs to be done on its own. While City government will take the lead in every single aspect of OneNYC, this plan also calls for action from other levels of the public and even private sector. That means calling for some actions that are not entirely within the control of the City government, but they are all steps that are credible and necessary.

4.2 Visions and Strategies

New York City's success has brought many benefits, but the city also faces significant challenges. Thus it is time to build on the strengths and address these challenges and opportunities. The city is at risk when so many New Yorkers struggle to find living-wage jobs, good schools for their children, affordable housing, and neighborhoods and communities they can proudly call their home for years to come. OneNYC builds upon the four core challenges addressed in past PlaNYC reports, and now includes growing inequality, the importance of the region, and New York City voices.

The plan runs the risk of becoming two New Yorks: one for the affluent and one for those who are left out of the city's success and lack access to good schools or good wages for hard work. Now the plan chooses to confront these challenges will define the future of New York City and what kind of city left to our children.

OneNYC conducts four principles which informed the plan's goals and initiatives: growth, equity, sustainability, and resiliency. "Growth" refers to population growth, real estate development, job creation, and the strength of industry sectors. "Equity" is about fairness and equal access to assets, services, resources, and opportunities so that all New Yorkers can reach their full potential. "Sustainability" contains strategies improving the lives of our residents and future generations by cutting greenhouse gas emissions, reducing waste, protecting air and water quality and conditions, cleaning brownfields, and enhancing public open spaces. Finally, "resiliency" is related to the capacity of the city to withstand disruptive events, whether physical, economic, or social.

Figure7. Four Pillars of OneNYC

In each vision, the OneNYC sets up a series of goals, followed by deep description on each goal. The descriptions includes indicators, target, and figure for most recent year in each goal. Furthermore, there are about 3-5 initiatives in each goal, accompanying with the departments and authorities which enact the initiatives as well as sources of budget. The table below shows the funding status and funding source for each OneNYC initiative and supporting initiative. Specific funding details for newly funded initiatives are available in a separate table featured in the FY'16 Message of the Mayor, and are marked with an asterisk.

Figure 8. Vision, goals and initiatives

Vision 1: Our Growing, Thriving City

VISION 1

INDUSTRY EXPANSION AND CULTIVATION

Initiative 1 Maintain New York as the global capital for innovation by supporting high-growth, high-value industries	A. Maintain and grow New York City's traditional economic sectors.	DCP and others	Budget neutral	N/A
	B. Ensure that businesses in emerging sectors are able to find and fit out the space they need to start, grow, and scale their companies.	EDC	In planning	N/A
Initiative 2 Make triple bottom line investments in infrastructure and City-owned assets to capture economic, environmental, and social returns	A. Support a state-of-the-art food production and distribution industry.	EDC	Funded*	City capital
	B. Activate the City's industrial assets to support the creation of quality jobs.	EDC	Funded*	City capital
Initiative 3 Foster an environment in which small businesses can succeed	A. Reduce the regulatory burden on small businesses through the Small Business First plan.	SBS	Funded*	City capital

WORKFORCE DEVELOPMENT

Initiative 1 Train New Yorkers in high-growth industries, creating an inclusive workforce across the city	A. Establish and expand Industry Partnerships.	SBS	Funded*	City operating
	B. Use Common Metrics for workforce programs.	Mayor's Office	Funded*	City capital and operating
	C. Create bridge programs to prepare low-skill job seekers.	DYCD, Mayor's Office	Funded*	City operating
	D. Ease path to employment for formerly incarcerated people.	Mayor's Office	Budget neutral	Regulatory/ legislative
Initiative 2 Leverage OneNYC investments to train and employ New Yorkers of all skill levels	A. Leverage City investments to create jobs and training opportunities for New Yorkers, and encourage targeted hiring.	SBS	Funded*	City capital and operating
	B. Capitalize on the Career Pathways Construction Industry Partnership to create and expand construction training and employment opportunities for traditionally underrepresented New Yorkers.	SBS	Funded*	City operating
	C. Support the creation of, and training for, green jobs	DEP, Mayor's Office	Funded	City operating
Initiative 3 Ensure that all New York City students have access to an education that enables them to build 21st century skills through real-world, work-based learning experiences	A. Significantly expand access to computer science/technology education across New York City public schools by 2020.	DOE	In planning	N/A
	B. Strengthen and expand Career and Technical Education programs.	DOE	In planning	N/A
	C. Expand Transition Coordination Centers to every borough by 2020 to improve postsecondary outcomes for students with disabilities.	DOE	In planning	N/A
	D. Explore the opportunity to create bilingual learning environments to promote multilingualism among New York City students.	DOE	Budget neutral	City operating
Initiative 4 Increase postsecondary attainment	Increase postsecondary attainment by promoting high-school graduation, college matriculation and degree completion.	CUNY, DOE	Funded	City operating

Figure 9. Initiatives, Implementation Authorities, and Budget

4.3 Progressive Evaluation

OneNYC emphasizes the initiatives and milestones for the pillar of "resiliency". At the end of this plan, it reported the progressive outcomes of each initiatives in the aspects of resiliency, following with description of initiative status, 2014 milestones, and status of milestones. It is worthy to mention that the plan divided each initiative into detailed approaches and strategies. For instance, in the initiative of “strengthen the quality of available climate analysis”, there are six steps, such as “Work with FEMA to improve the flood-mapping process” (in progress), “Call on the State and Federal governments to coordinate with the City on local climate change projections” (completed), and so on.

Chapter	Initiative No.	Initiative	Initiative Status	Initiative Status Description	2014 Milestone	Milestone Status
CLIMATE ANALYSIS	**STRENGTHEN THE QUALITY OF AVAILABLE CLIMATE ANALYSIS**					
	1	Work with FEMA to improve the flood-mapping process	In Progress	The City continues to work with FEMA to improve the flood mapping process and provided expert analysis in FEMA's most recent release of Preliminary FIRMs. The first Technical Mapping Advisory Council meeting, on which the City sits, was held in September 2014. The next one will be held in May 2015.	Implement technical and process improvements	Completed
	2	Work with FEMA to improve the communication of current flood risks	In Progress	The City has partnered with the Center For New York City Neighborhoods (CNYCN) on its interactive webtool (floodhelpny.org), which was launched in September 2014. Additionally, the City is conducting a consumer education campaign and developing tools for explaining flood risk and the changes that are coming to the maps and insurance programs. Finally, the City continues to advise FEMA on its local flood risk messaging and online tools.	Launch a new interactive tool	Completed
	3	Call on the State and Federal governments to coordinate with the City on local climate change projections	Completed	NOAA and the USACE have agreed to incorporate the most recent NPCC projections into their climate models.	Obtain Federal agreement to rely on NPCC	Completed
	4	Continue to refine local climate change projections to inform decision-making	Completed	The City released expanded NPCC projections to include humidity and new projections through 2100. NPCC3 will focus on the following: enhancing coordination across the entire New York metropolitan region, looking at a neighborhood scale, and studying the interactions of mitigation, adaptation, and equity.	Issue expanded NPCC projections; release evaluation metric for climate change	Completed
	5	Explore improved approaches for mapping future flood risks, incorporating sea level rise	In Progress	The City, with Stevens Institute of Technology, has completed its study of Sea Level Rise mapping, which was incorporated into the NPCC's most recent report. NPCC has also developed future flood maps to show the projected floodplains.	Develop revised future flood maps	Completed
	6	Launch a pilot program to identify and test strategies for protecting vulnerable neighborhoods from extreme heat health impacts	In Progress	The City, in partnership with the Nature Conservancy, has launched a new urban heat island working group to develop new monitoring methods and tools for mitigating heat risk.	Launch pilot program	Partially Completed

Figure 10. Detailed analysis of resiliency development

5 Conclusion

One trend we’ve identified is that American cities are positioning themselves as the true U.S. leaders in combating climate change, making it clear that action is wanted, needed and possible. American cities are positioning themselves as the true U.S. leaders in combating climate change, making it clear that action is wanted, needed and possible.

Based on a series of green plans, the climate action plans have moved their targets from simply reducing GHG toward creating a resilient city that not only mitigating hazards to environment but also improving social performance. The stakeholders involved in the plan vary a lot, depending on different local circumstance. But there is an increasing number of cities calling for collaboration among market, government and public citizens. With regard to the content of climate action plans, strategies have evolved from simply reducing energy consumption and gas relief toward multiple approaches in addressing social and economic vulnerability involving neighborhood, building, urban infrastructure, and specific geographic issues. The efforts for sustainable development require a transformation of policy from green development toward improvement on resiliency. Thus, further changes to planning implementation in terms of financial support, public participation, and post-evaluation mechanism will be still needed.

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Case Study: incorporating climate change resilience into spatial development tools in South Africa

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Abstract

The Biodiversity and Land Use Project, which is funded by the Global Environmental Facility through the United Nations Development Programme aims to support improved regulation and land use management that ensures that biodiversity continues to provide essential ecosystem services at the municipal scale. South Africa has a rich history in systematic biodiversity (conservation) planning and the output of that process is a Map of Critical Biodiversity Areas and Ecological Support Areas (CBA Map). When these maps are developed, they incorporate climate change adaption areas, ecological infrastructure, as well as a host of priority biodiversity features such as threatened ecosystems and species of special concern. The Biodiversity and Land Use Project is piloting several ways in which the CBA Map can be integrated into the tools which municipalities (local governments) need to develop in terms of the recently promulgated Spatial Planning and Land Use Management Act. The key tools which the Project is aiming to integrate the CBA Map into are the municipal Spatial Development Frameworks and Land Use (Zoning) Schemes.

1. Introduction

South Africa recently promulgated its Spatial Planning and Land Use Management Act (no 16 of 2013) (SPLUMA) which aims to bridge the gap between spatial planning and land use management within the country. This paper will first explore the changes that the new planning Act brings to the spatial planning and land use management arena within the country. Then an explanation of how the Map of Critical Biodiversity Areas and Ecological Support Areas (CBA Map) are developed, including how they have incorporated both climate change adaptation and ecological infrastructure will be provided. CBA Maps are defined as a map which represents spatial sustainability (SANBI, 2017). Lastly, a discussion on how the Biodiversity and Land Use Project will attempt to integrate the CBA Map into Spatial Development Frameworks and Land Use (Zoning) Schemes will be discussed.

The Biodiversity and Land Use Project is based within the South African National Biodiversity Institute (SANBI) which is a parastatal body which provides science based policy advice to the Department of Environmental Affairs. The Project is funded by the Global Environmental Facility through the United Nations Development Programme. This is a five year project which began in 2015 and aims to support improved regulation and land use management to ensure that biodiversity continues to provide essential ecosystem services at the municipal scale. The Project is operating in four District Municipalities in South Africa: Ehlanzeni in Mpumalanga, uMgungundlovu in Kwa-Zulu Natal, Amathole in the Eastern Cape and Cape Winelands in the Western Cape.

Figure one below provide the project sites in South Africa.

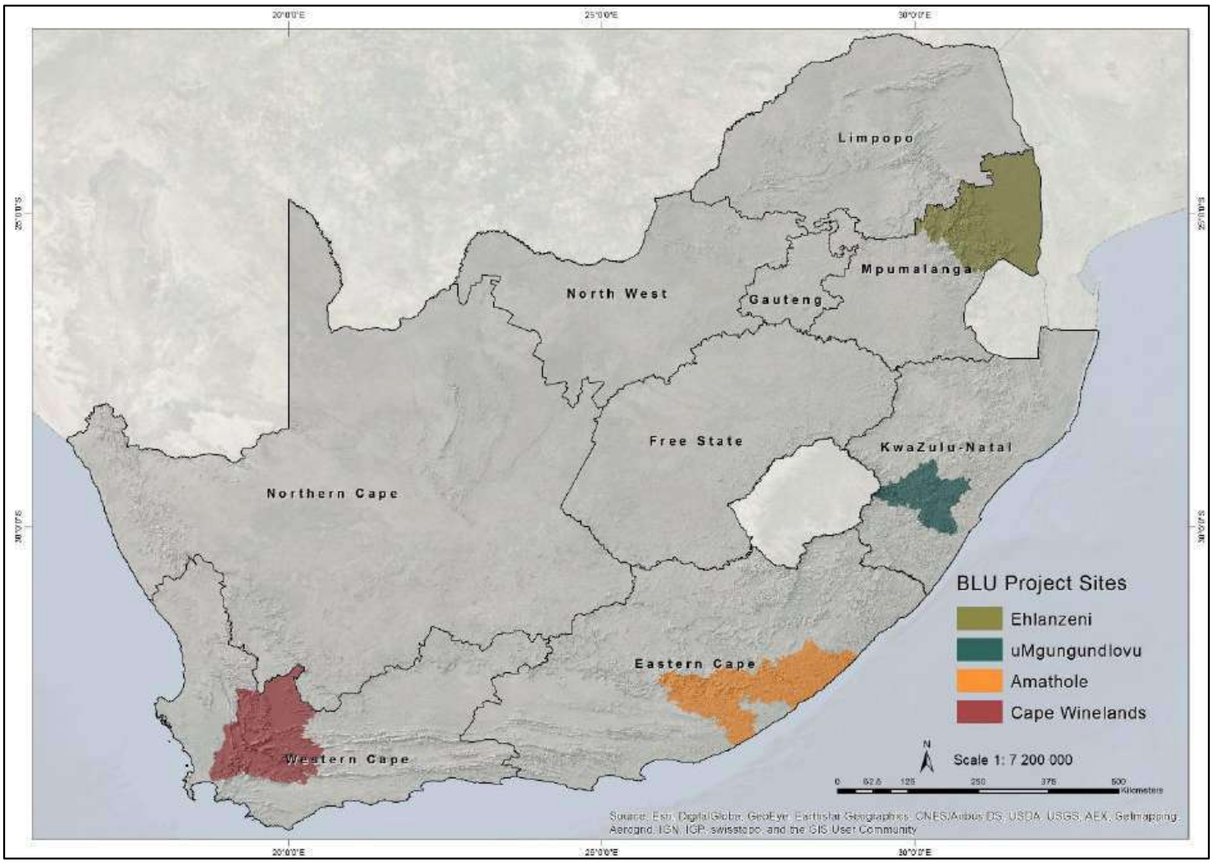

Figure 1: Biodiversity and Land Use Project sites (SANBI, 2018)

2. Spatial Planning and Land Use Management in South Africa

Before South Africa enacted the SPLUMA, provincial governments were responsible for both spatial planning and land use planning. In some areas, provinces delegated decision making powers over certain categories of land development applications to municipalities (Nel, 2016). However, most provincial governments maintained their ability to adjudicate appeals. Municipal Planning is listed under Part B of the South African Constitution as part of the local government competencies (Constitution of RSA, 1996). However, the Constitution does not provide a definition of municipal planning, resulting in provincial governments continuing to make municipal planning decisions. It was only in 2010 that municipalities began asserting their rights in making decisions with regard to municipal planning. As a result a number of Constitutional Court challenges were instituted among others are the Johannesburg Metro (a municipality) vs Gauteng (a Province) Development Tribunal, Shelplett 47 Pty Ltd vs Member of the Executive Council for Environmental Affairs & Development Planning (Western Cape) (Nel, 2016). The Constitutional Court in these instances ruled in favour of municipalities which are responsible for municipal planning. These judgements set out rules on what municipal planning should entail and these included land use decisions. The judgments further clarified that national decisions cannot override municipal ones. Through these judgements, provincial governments were also barred from deciding on the appeals that dealt with municipal planning. SPLUMA was therefore a response to all of these judgements and as South Africa had never had a national planning Act before, SPLUMA defined how spatial planning and land use management should operate within the country, while also taking the Constitutional Court judgements into account.

Although SPLUMA was signed into law in 2013, it only came into effect on the 1st of July 2015 after a Presidential Proclamation. SPLUMA seeks to create a uniform way of addressing land use management and spatial planning in the country. It further specify the relationship between spatial planning and land use management systems (SPLUMA, 2013). The current SPLUMA Regulations deal with Chapter 6 of SPLUMA, Land Development Applications.

Unlike the previous provincial planning legislation of South Africa, SPLUMA proposes 5 normative principles which are aimed at guiding spatial planning and land use planning in the country and these are:

- Spatial Justice-*past imbalances need to be addressed through improved access to and use of land*
- Spatial Sustainability-*promote land development that is within the fiscal, institutional and administrative means of the country while adhering to environmental management instruments*
- Efficiency-*decision making procedures are designed to minimise negative financial, social, economic or environmental impacts*
- Spatial Resilience-*whereby flexibility in spatial plans, policies and land use management systems are accommodated to ensure sustainable livelihoods in communities most likely to suffer the impacts of economic and environmental shocks*
- Good Administration-*all spheres of government ensure an integrated approach to land use and land development that is guided by the spatial planning and land use management systems as embodies in this Act.*

Some of the changes that SPLUMA brings are among others are as follows: a) it makes municipalities the authority of first instance in all land development applications; b) if a land development application requires approval from another government institution, such as environmental authorisation in terms of the National Environmental Management Act (no 107 of 1998), then both approvals need to be obtained before the commencement of such development; c)in addition, SPLUMA mandates that land development applications be approved by either an authorised official or a Municipal Planning Tribunal. This was a move away from previous practice wherein, the executive authority of the municipality was responsible for the authorisation. However, appeals are still decided by the executive authority of the municipality or the executive authority can delegate this responsibility to an institution/tribunal. SPLUMA also requires all municipalities to have wall to wall land use schemes (previously known as zoning or town planning schemes) within 5 years of the implementation of SPLUMA. This means that areas which were previously excluded from schemes now need to be included, such as rural areas and areas under traditional authority.

The changes that SPLUMA has brought has presented the ideal opportunity for the Biodiversity and Land Use Project to ensure that CBA Maps get incorporated when those wall to wall land use schemes are developed. Details around how the CBA Map is developed will be discussed in more detail below.

3. Climate Change and Biodiversity Planning in South Africa

South Africa has moved away from conservation planning towards biodiversity planning as conservation planning has a protected areas connotation and the CBAs which we develop are not protected areas. Also, protected areas have a long history of excluding certain racial groups during the former Apartheid government and as such, we have moved towards biodiversity planning which is more inclusive.

Although South Africa is a signatory to the Convention on Biological Diversity and is compelled to adopt the principles embedded in Local Agenda 21, the implementation of these within the country has had some challenges. According to Pierce, Cowling, Knight, Lombard, Rouget, and Wolf (2005) some of the challenges with local governments adopting environmental sustainability principles in Agenda 21 is that local government decision makers lack an awareness of the importance of planning to protect biodiversity priority areas as identified through conservation assessments. Pierce *et al* (2005) go on to argue that there is a disjunction in the structure and content of conservation plans and those required for land use planning; and that municipal land use planners lack the capacity to effectively integrate biodiversity into planning products.

Biodiversity planning in South Africa has since moved to incorporate some of the challenges which Pierce *et al* (2005) identified. As a result, as of 2017, all the provinces and some municipalities in South Africa have Provincial Biodiversity Sector Plans (SANBI, 2017). The Biodiversity Sector Plans are the CBA Map with land use guidelines, which indicates what land uses are compatible within the various CBA Map layers and these layers will be discussed in more detail below.

The concept of ecological infrastructure has recently gained traction within the country. Ecological infrastructure can be defined as naturally functioning ecosystems that deliver valuable services to people and ecosystems (SANBI, 2013). A single piece of ecological infrastructure often has several benefits such as a wetland providing both water purification and flood attenuation services. Although mapping ecological infrastructure is still in its infancy in South Africa, many CBA Maps already include elements of it as either part of their Critical Biodiversity Area or Ecological Support Areas layers (SANBI, 2017). According to SANBI (2017) South Africa has been able to map ecological infrastructure for water source areas, wetlands, riparian zones, coastal dunes, spawning grounds, and natural forage for pollinators. Given that many of the elements above are directly related to climate change adaptation and disaster risk reduction, these have been used as a proxy for climate change adaption mapping within this paper.

According to SANBI (2017), the CBA Map identifies a set of biodiversity priority areas, called Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs). Both of these as well as the protected areas (national parks, nature reserves, etc.), are important for the persistence of a viable representative sample of all ecosystem types and species as well as the long-term ecological functioning of the landscape as a whole. SANBI further indicates that the CBA Map is made up of 5 key features:

- Protected Areas (*areas that have been formally declared or recognised in terms of the National Environmental Management: Protected Areas Act (57 of 2003), including National Parks, Nature Reserves, etc.*)
- Critical Biodiversity Areas (*areas outside the Protected Areas network and must be maintained in a good ecological condition (natural or near-natural state) in order to meet biodiversity targets)*
- Ecological Support Areas (*areas that must be maintained in at least a fair ecological condition (semi-natural/moderately modified state) in order to support the ecological functioning of a CBA or Protected Area, or to generate or deliver ecosystem services, or to meet remaining biodiversity targets for ecosystem types or species when it is not possible or necessary to meet them in natural or near-natural areas*)

- Other Natural Areas (*areas in a fair or good ecological condition that fall outside the protected area network and fall outside of CBAs and ESAs. However, these areas can be demarcated as CBAs or ESAs if the existing CBA's and ESA's are destroyed)*
- No Natural Remaining (*areas with no natural habitat remaining and include areas that have been irreversibly modified (transformed) such as urban and industrial areas)*

Areas for climate change adaption which can act as climate change refugia at the local scape or areas which provide landscape scale gradients for the movement of species in response to climate change are all also important for ecological processes. (SANBI, 2017). Therefore, climate change is intricately integrated into the development of the CBA Map.

SANBI (2017) recommends that the input layers for developing a map of CBAs and ESAs should, at least, include the following:

- Biodiversity features
    - Ecosystem types (classified and mapped)
    - Species of special concern
    - Unique or special habitats or features
    - Areas important for ecological infrastructure
- Protected areas
- Ecological condition, including land cover
- Socio economic constraints and opportunities in the landscape

Below is an example of the CBA Map for the Western Cape Province (Pool-Stanvliet, Duffell-Canham, Pence and Smart: 2017)

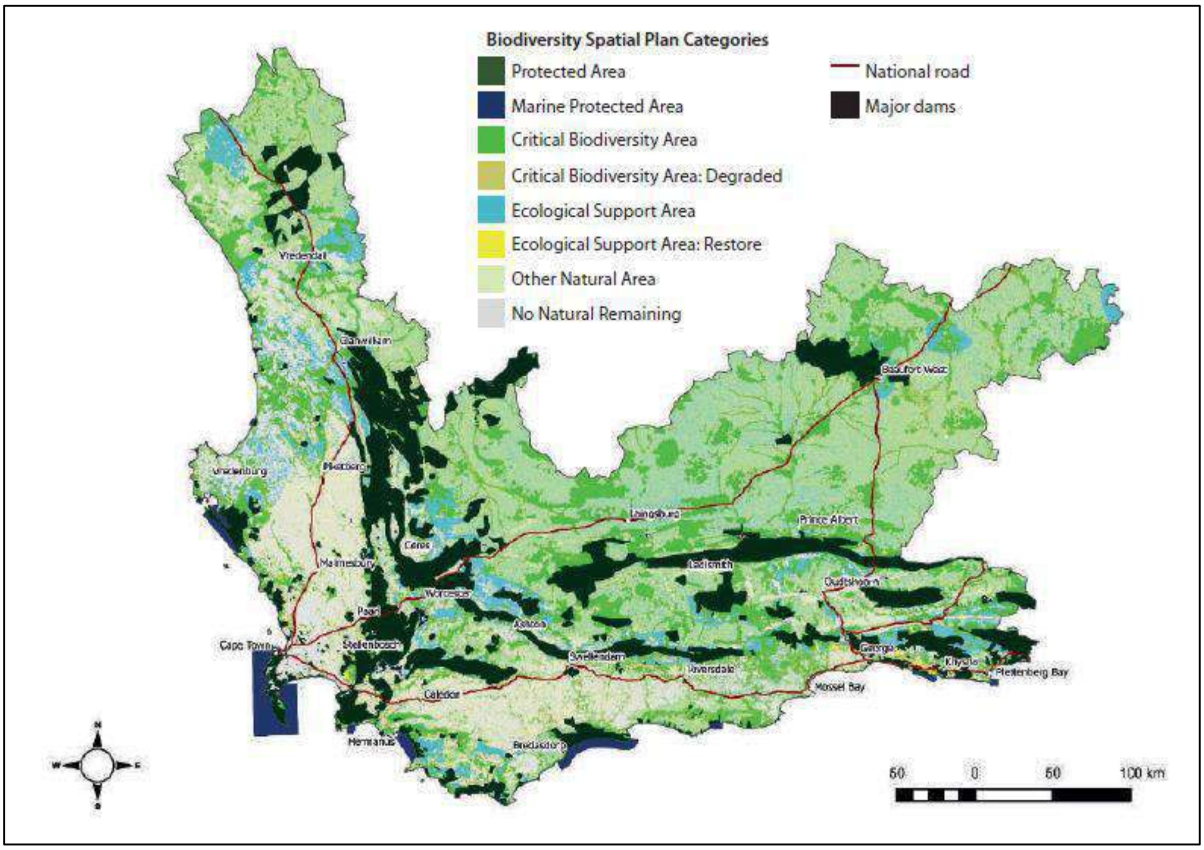

Figure 2: Biodiversity Sector Plan for the Western Cape, 2017 (CapeNature, 2017)

In this paper the Biodiversity and Land Use Project argues that within the South African context, the best tool to incorporate both climate change and biodiversity considerations into municipal spatial planning and land use process is through the integration of the CBA Map into spatial development processes. Therefore, the Biodiversity and Land Use Project has been integrating the CBA Map into both Spatial Development Frameworks and Land Use Schemes which are discussed in the section below.

4. Integrating the CBA Map into Spatial Development Frameworks

Although SPLUMA governs the development of Spatial Development Frameworks (SDFs), because the SDF's are still a core component of the municipal Integrated Development Plans (IDP), they are also governed by the Local Government: Municipal Systems Act (no 32 of 2000). According to Ruwanza and Shackleton (2015), the IDP is the primary tool to achieve integrated territorial development and guide the work of municipalities. This severely limits the effectiveness of SDF's in South Africa as IDP's are updated every 5 years, linked to general political elections cycle. However, attempts are currently underway to decouple the SDF from the IDP process as the SDF's are long term plans which should not be overly tied to the political term of a particular political party.

One of the key ways in which we have been integrating biodiversity and climate change into SDF's is by incorporating it as part of either the open space system or as part of the environmental management area of the municipality. Within some of the municipalities we have been working with, we found that they prefer to flatten out the various layers from their CBA Map and treat all of the layers the same way. Bushbuckridge Local Municipality, which falls within Ehlanzeni District in Mpumalanga is an example of such a municipality which has chosen to go this route. In Figure 3 below, the large protected area to the west of the municipality is the Kruger National Park which is one of the largest national parks in Africa. The municipality has decided to treat both the Protected Areas and the CBA's and ESA's as a single layer and they have called this new layer the Environmental Management Area. Although SANBI finds this to be an effective approach as it helps to protect CBA's, this approach has some disadvantages such as being externally land hungry and not allowing the town planners in that municipality to make full use of the compatible land uses within the CBA Map. However, as this is a predominantly rural municipality which suffers from a lack of capacity, this is seen as an ideal way to protect biodiversity and to allow the municipality to plan for climate change.

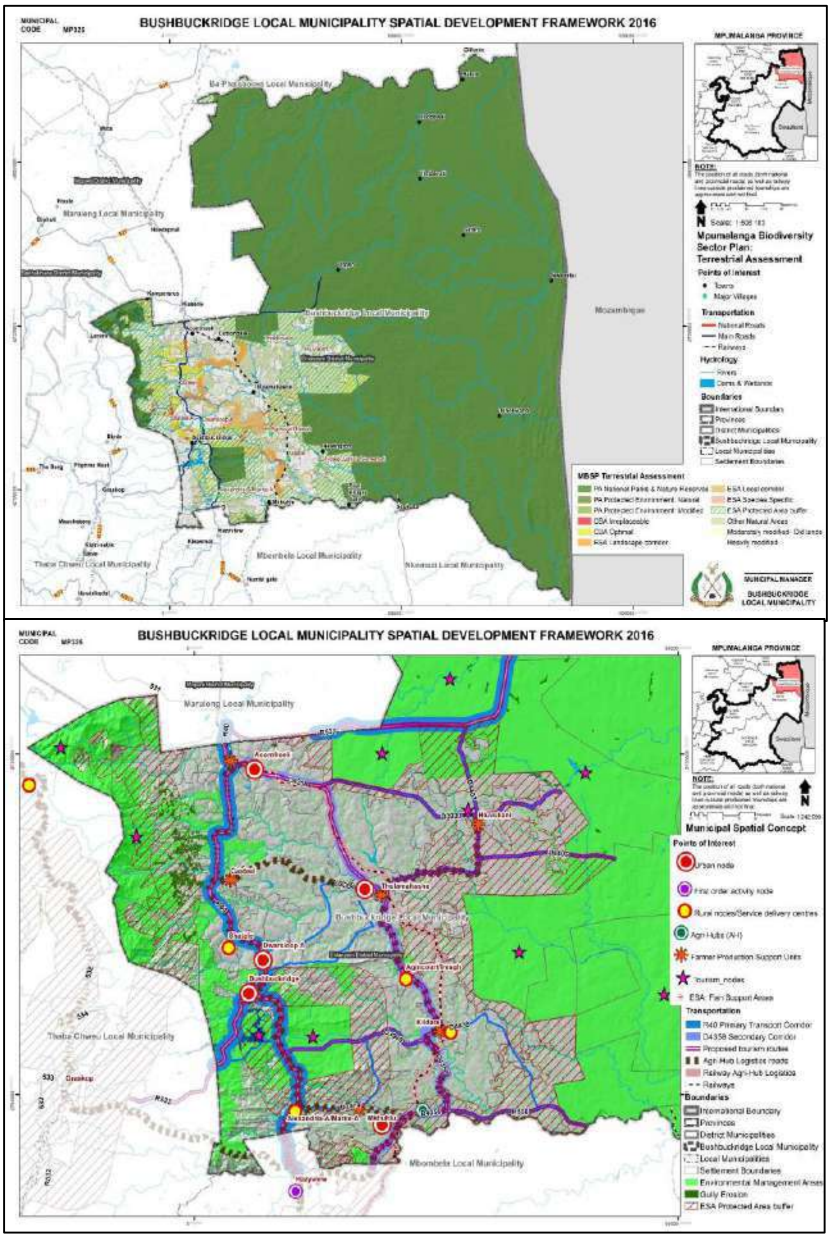

Figure 3: Bushbuckridge Local Municipality Conservation Plan and SDF, 2017 (Bushbuckridge Local Municipality, 2017)

Msunduzi Local Municipality in uMgungundlovu District in Kwa-Zulu Natal has chosen to refer to its environmental framework as ecological infrastructure. This is a more urban and a relatively well capacitated local municipality. Their ecological infrastructure framework is primarily based on their Metropolitan Open Space System (which includes the CBA Map), the findings of some of their Strategic Environmental Assessments and the various types of ecological infrastructure as discussed above. Within their final SDF, they have incorporated it into their Green Structure category. As the Biodiversity and Use Project, we have found that calling their environmental framework ecological infrastructure is a very useful as it ensures that climate change is integrated into their SDF.

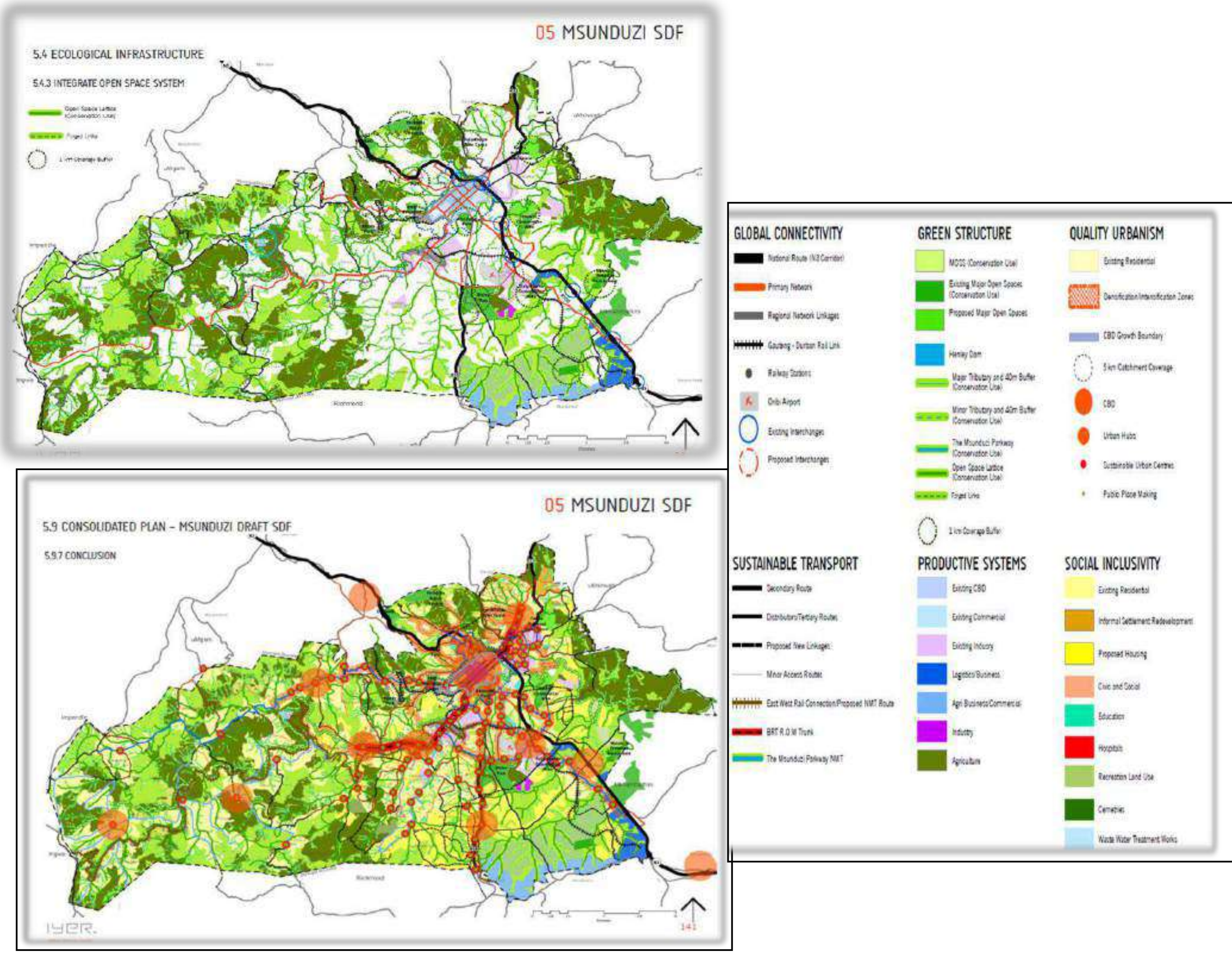

Figure 4: Msunduzi Local Municipal Spatial Development Framework, 2014 (Msunduzi Local Municipality, 2014)

5. Integrating the CBA Map into Land Use Schemes

Nel (2016) claims that, although SPLUMA allows for municipalities to develop land use schemes, these are in conflict with the normative principles which it proposes, mainly spatial justice which aims to promote integration and inclusion. However, these are challenges which we have chosen not attempt to address through the Biodiversity and Land Use Project as these are structural in nature and would take longer than the Project's lifespan to attempt to resolve.

Accordingly to Nel (2016) zoning drives land value as it determines properties development potential, along with its location. Therefore, municipalities in South Africa have traditionally looked at the properties which have been zoned for public open space under their ownership as the first pieces of land which they auction off to private developers. In an attempt to counteract some of this inherent bias of municipalities, particularly in the more rural ones, the Biodiversity and Land Use Project has been undertaking extensive capacity development interventions to inform municipal officials and politicians of the benefits of appropriately managing their biodiversity and planning for climate change. This is where we have found the term ecological infrastructure to be particularly beneficial as it speaks directly to the mandates of municipalities in providing services for their inhabitants.

The Biodiversity and Land Use Project has further been funding the development of land use schemes within some of the municipalities that we are working in. This has provided us with the opportunity to influence the process which we ordinarily would not have had as most conservation agencies are regulated to a commenting authority within the development of municipal schemes. The Biodiversity and Land Use Project has proposed that the CBA Map within our municipalities be used as an overlay zone within the schemes. Therefore when a land owner applies to have their rights upgraded, the overlay zone will come into effect. The requirement of this overlay allows the municipality to determine the location of buildings to be constructed within the property. This allows the municipality to ensure that structures avoid sensitive biodiversity areas and they can also request that the portions of the property which are not to be developed be rezoned to open space as part of the conditions of approval.

The overlay proposals discussed above are only applicable when a land owner applied to upgrade their existing land use rights as within the legislative framework of South Africa, there is no way for a municipality to deprive a land owner of their existing rights without financial compensation. Given the financial health of many of the country's municipalities, this is not an option that we believe the municipality would be willing to entertain.

Within the City of Mbombela local municipality, which is also in Ehlanzeni District in Mpumalanga Province, as part of the project, we have proposed onsite verification of the CBA Map. As part of the development of their land use scheme, the City needed to conduct a land use audit. We supported the process of the land use audit by requesting that they also conduct a basic verification of the CBA Map to see if those areas shown on the CBA Map are still undeveloped. The obtained information will be used to update the land cover layer and it will also be use during the revision of the CBA Map.

In terms of how CBA's are zoned within the land use schemes, we proposed that these either be zoned as part of the conservation/environmental zones or as open space. The advantage of using the term open space is that it is a well understood town planning term and is regarded as an area where urban development should not occur. Therefore, it would be an ideal space for CBA's to be included into the land use scheme. In terms of the categories that we have recommended for Open Space, we recommended to our municipalities that they subdivide open space into Passive Open Space (CBA Map) and Active Open Space (other green features such as sports fields and golf courses). In addition, we recommended that within urban areas, buildings should face these open to not only provide a hard boundary for those spaces, but to also provide passive surveillance.

The main reason that we have focused on Land Use Schemes is that they grant real rights to land owners. Therefore, unlike the SDF which neither grant nor removes rights, the schemes are a powerful tool for ensuring that municipalities are better prepared for climate change.

6. Conclusion

The above paper has looked at how the opportunities provided by South Africa's recently promulgated Spatial Planning and Land Use Management Act has enabled the Biodiversity and Land Use Project to achieve its goals. The paper first explored the changes that the new Act has brought and then discussed how the CBA Map is developed and how it incorporates both climate change adaptation and ecological infrastructure. The paper then explored the various ways that the Project has been integrating the CBA Map into Spatial Development Frameworks and Land Use Schemes.

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Travel modes for visits to non-primary dwellings: considerations and justifications

Paper for the ISOCARP 2018 congress in Bodø, October 1 – 5, 2018.

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Abstract

Travel in connection with visits to non-primary dwellings represents considerable carbon footprints. Based on qualitative interviews of Norwegian vacation home users, supported by a questionnaire survey including also other types of non-primary dwellings, this paper addresses travel modes when visiting non-primary dwellings and the reasons stated for choosing the relevant modes of transportation. Car is the dominant mode for travel to, from and within the areas of non-primary dwellings. Interviewees travel by car to vacation homes mainly because they bring much baggage and/or travel with kids, need the car for travel within the local area, and because of poor transit connections on the last part of the journey from the primary dwelling to the vacation home. Transit users emphasize environmental concerns and qualities of the journey itself and often combine train or express bus with taxi, or are driven by relatives on the last part of the journey. The reasons stated by interviewees for their choices of travel modes when visiting vacation homes are in line with rationales for travel mode choice found in studies of transport rationales for daily-life travel. Better shuttle bus and taxi provision in vacation home areas could enable less environmentally harmful travel to such areas.

Introduction

The purpose of this paper is to provide a nuanced picture of travel modes for visits to non-primary dwellings[1] and the reasons for using the respective modes of transportation for such trips, based mainly on qualitative interview data from a Norwegian study supplemented with some of its survey results. By doing this, we also aim to contribute to wider debates about the climate impacts of the multi-dwelling home lifestyle (Paris, 2006; Arnesen et al., 2012) and how it could possibly be made more environmentally sustainable.

More than one out of five Norwegian households own one or more dwellings in addition to their primary home. A nearly equally high number of households have regular access to non-primary dwellings that they do not own themselves. Most non-primary dwellings are located at some distance from the users' primary dwellings, and visits to non-primary dwellings may therefore involve considerable travel. According to Farstad et al. (2011), Norwegian users of vacation homes (which make up the dominant part of all non-primary dwellings) spent on average 36 days at such dwellings in 2007. Seventy percent of the vacation homes were located more than one hour driving distance from the user's primary home address, and 28 % more than three hours driving distance away. A more recent study of non-primary dwelling users whose primary dwelling is located in Greater Oslo shows a somewhat higher number of annual days stayed at non-primary dwellings (46), with an average of 14 separate stays per year (Xue et al., 2018).

Although the number of trips annually to and from non-primary dwellings is much lower than, for example, workforce participants' commuting trips during a year, the long distances covered when visiting non-primary dwellings imply that the CO_2 emissions from such trips can still be considerable (Aall, 2011, 2014; Adamiak et al., 2015). This is especially the case for non-primary dwellings located abroad, which are often accessed by long-distance flights, but also for non-primary dwellings located in Norway, domestic users' trips to and from such dwellings represent considerable carbon footprints. On average, each of the Greater Oslo respondents using non-primary dwellings emitted 585 kg of CO_2 for their trips between their primary and non-primary dwellings during the last 12 months. This corresponds to 7.5 % of the mean total CO_2 emissions per year among Norwegians (including domestic as well as international aviation but excluding the oil and gas production sector). If looking only at trips to non-primary dwellings located in Norway, Oslo respondents' trips to and from such dwellings produced about 360 kg of CO_2 emissions annually, or about 4.5% of the total per capita emission among Norwegians (Xue et al., ibid.). Travel within the non-primary dwelling areas when staying there comes in addition.

Travel to and from non-primary dwellings thus represents a non-trivial contribution to the climate impact of the users of such dwellings. For visits to vacation homes located in Norway visited by Norwegian residents, private car is the all-dominating travel mode (Aall, 2014). Still, many visitors to non-primary dwellings also use other means of transportation, and some trips to non-primary dwellings include a combination of different travel modes.

In this paper, we will discuss why the car has such a prevalence for trips in connection with visits to vacation homes. Apart from some very rough national-scale or regional studies, travel modes in connection with visits to vacation homes is a rather under-researched topic. In particular, this applies to visitors' travel within the vacation home area when staying there. Moreover, no study has so far, to our knowledge, investigated the visitors' motivations, justifications and reasons for using their chosen travel modes for trips to, from and within vacation home areas[2].

In the next section (2), we present the data and methods of the study. Section 3 offers an overview as well as a more detailed picture of travel modes among Greater Oslo survey respondents and interviewees for their trips between primary and non-primary dwellings. Considerations and motivations stated by the interviewees as reasons for their choices of travel modes are also presented. Based mainly on qualitative interview data, section 4 shows examples of the various travel modes that interviewees use when staying in their vacation home areas, and their reasons and motivations for choices of travel modes for these trips. In section 5, the interviewees' reasons for travel mode choices are discussed in comparison with rationales for travel mode choices found in studies of daily-life travel in urban areas. A few concluding remarks finalize the paper, including a discussion of possible policy measures that could change travel modes in connection with visits to vacation homes in a more environmentally friendly direction (section 6).

Data and methods

The empirical material on which this paper is based stems from a questionnaire survey among inhabitants of Greater Oslo, and eighteen qualitative interviews with persons with access to vacation homes. The survey and the qualitative interviews were both conducted in 2016. The survey respondents were recruited among inhabitants living within 45 postal zones in Greater Oslo. These zones were chosen in order to ensure variation in terms of housing types, neighborhood densities, centrality (distance from the city center of Oslo) and district-scale income levels. In total, we sent 10,000 invitation letters to the web-based questionnaire survey to addressees randomly selected among the residential addresses within the selected postal zones. We received 707 completed responses, yielding a response rate of 7.1 %. While rather low, such a response rate is not uncommon in social science studies nowadays, especially for extensive and complex questionnaires such as the one used in the present study. Since the questions focused on the use of non-primary dwellings, persons who did not use or have access to any such dwellings were less prone to answer. This is reflected in the high share of persons with access to non-primary dwellings among the respondents (68%), which is considerably above the national average of about 40%. However, since the present paper focuses only on the owner/user group, we still consider this group as fairly representative of the population of second home owners/users among Greater Oslo residents.

Apart from questions about ownership and access to non-primary dwellings, the questionnaire included questions about, among others, motivations for going there, duration and frequency of stays, the address, type, size and standard of primary as well as non-primary dwellings, modes of traveling between primary and non-primary dwellings, and how far from the primary dwelling each non-primary dwelling was located. Thirteen percent of the non-primary dwellings available for the respondents are located abroad and the remaining 87% in Norway.

We also asked if the respondents were willing to participate in a follow-up qualitative interview. After a preliminary analysis of the survey data, we decided to focus on non-primary dwellings that are mainly for recreational use, since this is the dominant type in the survey. Among the 244 respondents that stated their willingness, nine who had access to vacation homes located at various places in Southern Norway were selected as interviewees. Subsequently, nine additional interviewees were selected among owners/users of vacation homes located in the municipalities of Oppdal, Trysil and Kragerø. The interviewees of Oppdal (a mountain municipality) all lived in Trondheim, whereas the additional interviewees with vacation homes in Kragerø (a coastal municipality) and Trysil (a mountain municipality) all lived in Greater Oslo, like the interviewees who were recruited through the questionnaire did. All interviewees had a Norwegian ethnic background. Persons with an immigrant background, who often have access to non-primary dwellings in their own or their parents' country of origin (Duval, 2004), were thus not represented among the interviewees.

Several interviewees had access to more than one vacation home. Figure 1 shows the locations of the vacation homes owned by or accessible for the interviewees[3]. Although we attempted to include interviewees with different socioeconomic characteristics, persons with high income and particularly long academic education are, similar to the survey respondents, overrepresented among the interviewees, compared to the populations in the city regions in which they live.

The interviews lasted for 60 to 90 minutes and were semi-structured, addressing several pre-identified topics. Each interview was conducted in an open manner, where the interviewees were first given the opportunity to speak freely for some minutes about their visits to vacation homes. Six interviews were conducted in Norwegian and the remaining twelve in English language. The interviews were all audio-recorded and subsequently transcribed word by word. An important tool in the subsequent analysis of interview data was an interpretation scheme developed in studies on residential location and travel conducted earlier by some of the project team members (Næss, 2013; Næss et al., 2018; Næss, 2018) and adapted to the present study. The interpretation scheme requested the interpreters to state what each interview could tell about each of 37 detailed research sub-questions Each interview was interpreted by one member of the research team while another research team member who had read the same transcript acted as a quality-checker. Synthesizing across the 18 interviews was conducted separately for seventeen different question groups formed from the original 37 research questions of the interpretation scheme. The present paper is based on the information elicited from two of the question groups, “Travel modes between primary dwellings and vacation homes” and “Travel mode within vacation home areas”, which together included five separate research questions.

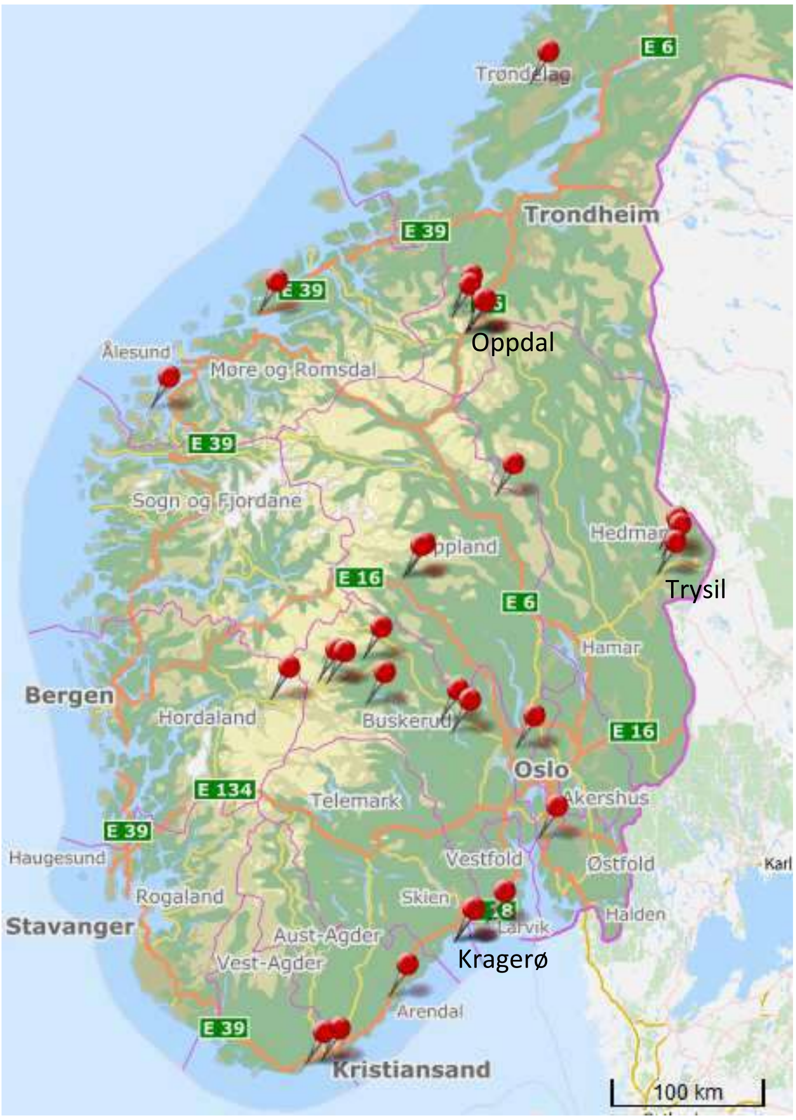

Figure 1: Locations of the vacation homes owned by or accessible for the interviewees

Travel modes for trips between primary and non-primary dwellings

Results from the survey

Figure 2 shows the main travel modes[4] used for respondents’ trips between their primary and non-primary dwellings. Car is by far the main travel mode used by most respondents, accounting for 79% when trips to the first (i.e. most frequently used) as well as any second and third non-primary dwelling are taken into consideration. Airplane is the main travel mode for 11% of the respondents[5], whereas train and bus account for 4% each. The dominance of the car is especially strong (81%) for respondents’ trips to the first non-primary dwelling, with somewhat lower shares for trips to the second and third non-primary dwelling (75%). For respondents who travel to their second or third non-primary dwelling, flights play a more important role, reflecting that a higher share of the second and third than the first non-primary dwellings are located abroad. This also implies that the role of the airplane becomes more important if we compare the travel *distances* accounted for by different modes instead of just comparing the *number* of trips.

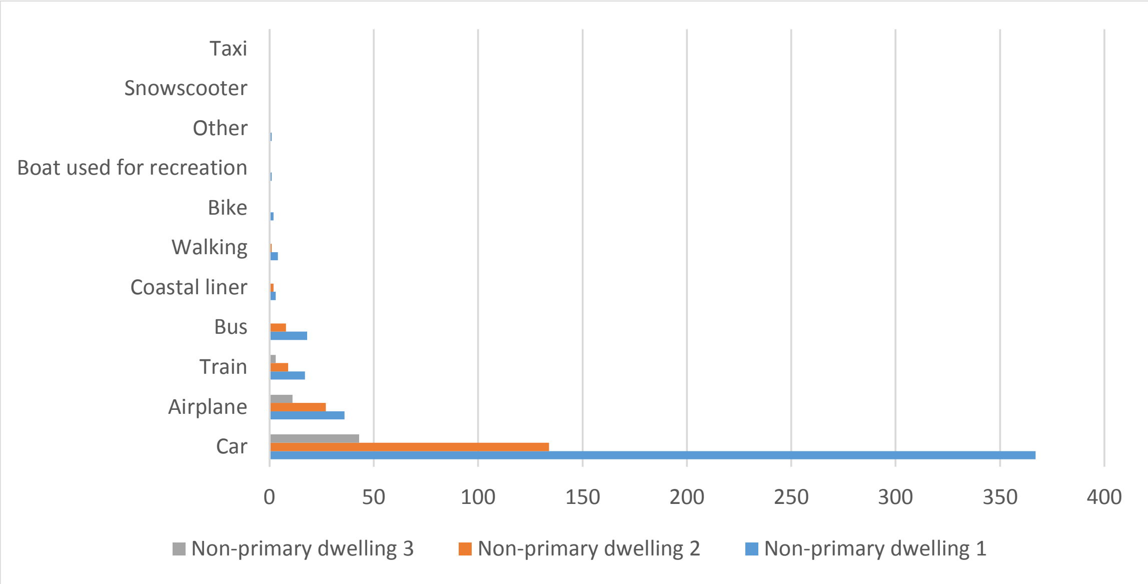

Figure 2: Main travel modes normally used for trips from primary to non-primary dwellings. N = 417 respondents.

A closer look at the material shows that travel modes such as bus, taxi and train play a somewhat larger role than indicated in Figure 2, since respondents sometimes combine the main travel mode with these modes for a shorter part of the journey. For example, respondents who go by airplane for the longest part of the journey may combine this with trips by bus or train to their final destination, or they may rent a car. Similarly, some respondents travel by bus or train for the longest part of the journey and supplement this with taxi, coastal liner/ferry or leisure boat for the last part before they reach the non-primary dwelling.

Whereas Figure 2 was based only on the number of respondents stating a particular mode as the most important one for trips to non-primary dwellings, Figure 3 shows the number of kilometers that the respondents traveled per capita by the four main travel modes (car, airplane, bus and train) when visiting non-primary dwellings over the last 12 months[6]. The car is still the dominant mode, but airplane plays a greater role now than in Figure 2, especially for trips to respondents' second and third non-primary dwellings. In total for all non-primary dwellings, trips by car as the main travel mode account for 71% of the kilometers traveled, airplane 24% and the remaining amount of travel equally distributed between bus and train. For trips to the first non-primary dwelling, car accounts for 77% and airplane for 18%, whereas the shares of air travel are as high as 41% and 40% for trips to respondents' second and third non-primary dwellings.

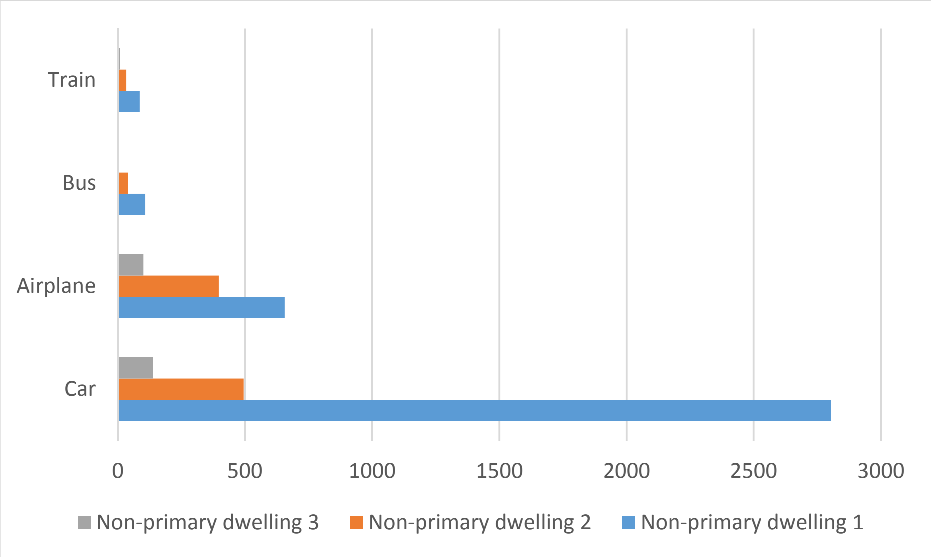

Figure 3: Person kilometers per capita traveled by car, airplane, bus and train to respondents' non-primary dwellings. N = 426 respondents.

As shown in the qualitative interviews (see below), one reason for the dominant role of the car as travel mode for trips to non-primary dwellings is that many such dwellings are difficult to access by public transportation. In order to assess the transit accessibility of the respondents' non-primary dwellings, we asked how close they could come to their non-primary dwellings by public transportation (not including taxis). The results (Table 1) show that the non-primary dwellings are on average located far away from the closest transit stop, with mean distances of 12 km, 13 km and 27 km for the first, second and third non-primary dwellings of the respondents. Some non-primary dwellings located very far (300 km or more) from the closest transit stop pull these mean values upward. But the median distances are also long, with 5 km for first and second non-primary dwellings and 12 km for third non-primary dwellings. Some non-primary dwellings are still located close to transit stops. Among the respondents' first, second as well as third non-primary dwellings, 10% can be accessed within a distance of 500 m or less from the closest transit stop, and for first and second non-primary dwellings, 25% can be reached within 1 km from a transit stop. Moderate distance from the non-primary dwelling to the closest transit stop does seem to contribute to somewhat higher share of travel by transit. Leaving out air-traveling respondents, 15% of those whose non-primary dwellings are located less than 1 km from the closest transit stop travel by bus or train, compared to 8% among those with more than 1 km distance to the closest transit stop.

	First non-primary dwelling	Second non-primary dwelling	Third non-primary dwelling
Mean	12.0	13.2	27.1
10% percentile	0.50	0.43	0.47
25% percentile	1.0	1.0	2.6
50% percentile (median)	5.0	5.0	12.0
75% percentile	15.0	15.0	24.0
N	386	142	48

Table 1: Distance (in km) from non-primary dwelling to the closest opportunity for public transportation (taxi not included).

Poor transit accessibility is especially the case for mountain cabins. Non-primary dwellings in coastal areas are often easier accessible by transit, since some of them are located in villages and towns (but many are still located on small islands or other places not served by transit). For respondents' first non-primary dwellings in Norwegian mountain areas, only 10% are located within 1 km from a transit stop. For respondents' first non-primary dwellings located elsewhere in Norway, 25% are located 1 km or less from a transit stop, and 10% have a distance to such a stop of 300 m or less. Respondents' first non-primary dwellings located abroad have similar accessibility by transit as those located in non-mountainous parts of Norway. Similar differences in transit accessibility between locations in Norwegian mountainous areas and elsewhere in Norway or abroad exist for also respondents' second and third non-primary dwellings.

Results from the qualitative interviews

The qualitative interviews can shed light on the more detailed practices when traveling to and from vacation homes, as well as the motives, considerations and justifications underlying such practices.

Among the eighteen interviewees, fifteen use private cars as their main mode of travel between primary dwellings and vacation homes, while three normally go by transit, two of which by train and one by bus. These interviewees combine transit with taxi, rented car or travel as passengers with friends or relatives for a smaller part of the journey (closest to the vacation home). One interviewee has one of his vacation homes in Turkey and travels by airplane to an airport near the vacation home.

Some of the car travelers have occasionally used transit but do not normally do so. One interviewee who now uses the car intends to shift to transit in the future.

Reasons for going by car

The main considerations that interviewees refer to as reasons for traveling to their vacation homes by car are: A need to bring heavy/voluminous things with them (mentioned by eight interviewees), poor transit connections (seven interviewees), need for car travel within the vacation home area (four interviewees), time-saving (four interviewees), flexibility (three interviewees), convenience, money-saving and pro-car habitus (two interviewees each), and feeling of freedom (one interviewee).[7]

The reason that the interviewees most frequently refer to for traveling between primary dwellings and vacation homes by car is the need to bring with them baggage and/or other items that it would be cumbersome or impossible to transport if traveling by other modes. The following quote by the latter interviewee is illustrating:

> "I didn't use it [the bus from Oslo to Trysil], but my wife has used it a few times, and it's have been working fine for her. It's just that when we go there, or at least nowadays, we have a three-year old, we tend to have a lot more thing with us." (Male interviewee, 34, with access to cabin in Trysil and two other vacation homes)

The items that the interviewees bring with them include foodstuff, equipment for sports and outdoor life, clothes and laundry. One interviewee also says that they need to bring garbage from the vacation home to a container at some distance. A couple of interviewees mention that they were refurbishing or extending their vacation homes and needed to bring materials with them.

For many of the interviewees, the transit connections to the vacation home are poor, but some of those interviewees would have traveled by car also if the transit connections had been better. Some interviewees who can travel to their vacation homes relatively easily by transit also prefer to travel by car anyway. For example, one interviewee can travel by bus from Oslo to a bus stop only 150 m from the vacation home but always travels by car. However, for about half of those interviewees who normally travel to their vacation home by car, poor transit connections are mentioned as one of the reasons for their choice of travel mode. For many interviewees, going to the vacation home by other modes than car would require transfers between several transit lines (with related waiting times) and the use of taxi (if available) for the last part of the journey. For example, the bus stop closest to one of the vacation homes of one interviewee is 10 km from the cabin and there are no taxis. Another interviewee tells that the bus stop is located far away from and at an altitude 500 m lower than one of their the cabins and that it would not be tempting to take a bus for a short stay.

Four interviewees say that they travel to the vacation home by car (also) because they need to drive from the vacation home to various activities within the vacation home area. This will be discussed in Section 4.

For most interviewees, traveling to the vacation home by modes other than car would be more time-consuming. This is mentioned explicitly by only four interviewees but is probably an underlying concern also for those who refer to poor transit accessibility to the vacation home as a reason for traveling by car.

Only three interviewees explicitly mention flexibility as a reason for traveling to vacation homes by car, but a wish for flexibility is plausibly also an underlying reason when interviewees state that they travel to their vacation home by car because they want to drive to facilities within the vacation home area (see section 4). The illustrations given by interviewees about their wish for flexibility are all related to travel within the non-primary area and not to the journey between primary dwelling and vacation home *per se*.

Convenience as a reason for traveling between primary dwellings and vacation homes by car is related to the concern about bringing items to/from the vacation homes as well as to perceiving transit connections as poor, and is probably one of the underlying rationales for both these concerns. Two interviewees explicitly mention convenience as a reason for traveling by car, and it is implicitly indicated by another interviewee. The wife of one of these interviewees used to take the bus sometimes before, but now the bus does no longer stop just outside the neighborhood where their cabin is located.

A few interviewees say that it is economically more favorable to travel by car to their vacation homes than going by transit. This is especially the case when many people go together to the vacation home, as one of them stated.

A couple of interviewees also indicate that they have a long-standing habit of car driving and a predilection for using this travel mode. Both these interviewees belong to households that have for long periods had two or more motor vehicles (cars and motorcycle), and for one interviewee, driving seems to be so self-evident that the reasons for choosing this travel mode go without saying.

Finally, one interviewee likes the freedom provided by the car and mentions this feeling of freedom as one of the reasons for traveling by car to the vacation home.

Reasons for going by transit

Among the three interviewees traveling to their vacation homes by transit, the main reasons given for this choice are: Environmental concerns, easiness/convenience, non-ownership of private car, no driver's license, good transit connection and money-saving.

All the three interviewees who use transit as their main travel mode for trips between primary dwellings and vacation homes mention environmental considerations as one of the reasons for this choice of travel mode. In addition, another interviewee, who now travels by car but intends to shift to transit, mentions environmental concerns as one of the reasons for making this shift. Interestingly, all the four interviewees who mention environmental concerns as important to their travel mode choice when going to vacation homes are female.

The interviewees who talk about transit as a convenient and easy travel mode all refer to train travel. One of them says that life is much easier on a train than when driving, since in the latter case you cannot rest. She mentions their experiences of being stuck in traffic jam as an example of what she can avoid taking the train. On the other hand, she thinks bus travel is not very convenient, especially on winding roads, which makes them car sick. Another interviewee emphasizes the convenience of train travel and mentions that her kids like to take the train whereas they feel restless in a car. One important condition for her judgment of train travel as convenient is that they do not need to bring all stuff with them (bed linen, towels, skis, clothes, etc.), so the baggage is small, which makes it easier to go by train.

None of the three interviewees who travel to vacation homes by transit owns a private car, which is an important contributory reason for their travel modes for these trips. They all live at quite central locations in Oslo, inside Ring 3, and two of them explicitly say that their non-ownership of cars is because they do not need to travel by car at their primary dwellings, as illustrated by this quote:

> "It's important for us to live here [at the primary dwelling] without a car, and of course we could have borrowed a car going there, but life is much easier on a train, yeah. It's three and a half hours with rest, and when you drive a car there is no rest. … we take the bus here, from Sagene down to Oslo S, that's the first part, 10 minutes. And then it's 3.5 hours on the train, and then we walk just to the store, buy all the stuff, put it in a taxi and then we are up there." (Female interviewee, 41, one self-owned cabin (Ål) and one family-owned cabin (Åfjord)

All three non-car-owning interviewees mention environmental awareness as important reasons for not having a car, and one of them, who does not even have a driver's license, says that her non-possession of driver's license is an environmental choice. Non-ownership of car as a reason for traveling by transit is thus closely related to the above-mentioned environmental reason for choosing transit as travel mode when traveling between primary dwellings and vacation homes.

Only one of the transit-traveling interviewees explicitly mentions good transit connections as a reason for their travel mode choice. Another interviewee says that the transit connection to one of her vacation homes has worsened and is more of a challenge, since the travel time has increased from one hour to two hours. This interviewee, who does not possess a driver's license or a car (cf. above), is a car passenger with her mother when she visits her other, more distant vacation home, apart from when she travels alone. Then she travels by bus despite the long travel time of 12-13 hours.

For those interviewees who do not own a car and do not have the opportunity to travel as car passenger with other visitors to the vacation home, the alternative to transit travel is to rent or borrow a car. Compared to renting a car, travel by transit will then be cheaper, as stated by one interviewee.

One of the interviewees who often travels by transit between the primary dwelling and vacation homes sometimes does borrow a car (from her parents or parents-in-law) when traveling to their two least transit-accessible cabins. The reason for this is the relatively poor transit access to these cabins, where the train journeys must be combined with relatively long taxi trips at the end or they must make an agreement with local people to drive them.

Taxi, car, boat and ferry as supplementary travel modes
As already mentioned, three interviewees who travel by transit for most of the journey between their primary dwellings and vacation homes normally combine the transit trip with other travel modes (taxi or car passenger) for the part of the journey between the closest transit stop and the vacation home. Although not stated explicitly, the reason for the use of these means of transport is obviously that the distance between the transit stop and the vacation home is longer than acceptable non-motorized travel distance. This can in its turn be related to poor transit connections on the last part of the trip from primary dwelling to vacation home.

Three interviewees have their vacation homes on an island and take a taxi boat or ferry from the closest pier on the mainland after having traveled most of the distance from the primary dwelling by car. The following quote illustrates this:

> "I drive to Valle, it's a bit before Kragerø, ….. And I have parking place there. And from there I take a taxi boat. The only way to get there is either by a taxi boat or ferry, but then you have to go all the way to Kragerø." (Female interviewee, 50, one self-owned cabin (Jomfruland) and one family-owned cabin (Haugastøl))

Their reason for combining car travel with another travel mode is thus topographical. Another interviewee uses a car ferry as a shortcut across the Oslo fjord on his car trips between primary dwelling and vacation home, which can partly be attributed to topographical reasons. In addition, he likes the relaxation during the ferry trip.

Air travel
Only one interviewee has a vacation home outside Scandinavia. This interviewee, who besides his Norwegian mountain cabin owns a dwelling in Turkey, travels by airplane to an airport 20 km from the latter vacation home. Avoiding too much time spent on traveling is the obvious reason for this travel mode choice.

Travel modes within vacation home areas
The questionnaire survey did not include questions about the respondents' travel during their stay at the non-primary dwelling. This section is therefore based solely on the qualitative interview material.

Among the eighteen interviewees, fifteen use private cars when traveling within vacation home areas, i.e. all interviewees except three whose cabins are on an island. A slight majority of the car users combine driving with other travel modes within their vacation home areas, depending on trip destinations, purposes and other circumstances. However, nearly half of the car-using interviewees travel only by this mode when traveling to activities within their vacation home areas (recreational walking, skiing and biking starting directly from the vacation home not included).

Apart from driving, the interviewees make use of the following travel modes to reach activity locations within their vacation home areas: Walking (six interviewees), taxi boat or ferry (three interviewees), private boat (two interviewees), skiing (two interviewees), ski lift (two interviewees), and snow scooter, bike, bus, and rented or borrowed car (one interviewee each).

Reasons for going by car

The main considerations that interviewees refer to as reasons for traveling within their vacation home areas by car are: Long trip distance (eleven interviewees), bringing kids (three interviewees), flexibility (three interviewees), unsafe biking conditions along the roads (two interviewees), and social contact and altitude differences (one interviewee each).

To some extent, the use of cars for travel within the local areas of vacation homes seems to be the default option. Rather than giving explicit reasons for using this travel mode, the interviewees' explanations of their travel mode choices tend to focus on their reasons for using any modes other than the car. For example, none of the interviewees explicitly mentions poor transit connections as a reason for traveling within vacation home areas by car, although poor possibilities for using transit to local destinations is a widespread feature in many vacation home areas, particularly in the mountains. In addition to being the travel mode accounting for the largest number of trips, the dominance of car travel is even stronger in terms of travel distances, since each car trip is on average longer than those by other modes.

As mentioned above, the reason mentioned by most interviewees for driving to destinations within the non-primary area is that the trip distance is long. This includes trips to get supplies during the stay as well as trips to facilities for sports, outdoor recreation and other leisure activities. The length of the trip of course depends on what activity opportunities exist near the vacation home (such as grocery stores, alpine skiing facilities, etc.). However, some interviewees who can reach opportunities for a given kind of activity without needing to travel by car still sometimes drive to carry out this activity type at farther locations for the sake of variety. Similarly, some interviewees state that weather conditions determine the distances to activity locations. For example, one interviewee says that weather and snow conditions influence whether they go directly from the cabin to skiing trips or hiking tours. They prefer to go directly. If the weather is bad around the cabin, they go to other places and then use the car.

Another relatively frequent reason for driving to destinations within the vacation home area is that the interviewees bring children with them to the activities in question. One of these interviewees puts it this way:

> "… last winter we started to ski all together when he was 4 years old then, my son, and then we need to take a car because it's too much like flat skiing, and it's too long to take him here, so then we take the car and we drive up here, and then we do all the skiing all around the mountain."
> (Male interviewee, 42, with self-owned cabin in Trysil)

This reason is related to the above-mentioned trip distance reason, since the need to drive kids reflects that the distance to the activity is considered too long for the children to go on foot, ski or by bike even if the destination would be within acceptable non-motorized travel distance for a grown-up person.

This interviewee also mentions altitude difference between the vacation home and the trip destination as a reason for traveling by car. Both this criterion and the trip distance criterion reflects an underlying rationale of avoiding too much physical efforts. The distance criterion plausibly in most cases also reflects concerns about time consumption.

Three interviewees point at flexibility as a reason for choosing to travel by car. One of them says that he prefers driving because he likes to be flexible and to be able to visit the local shop and acquaintances. Another interviewee states that traveling by transit would require that they would have to plan their shopping very carefully. A third interviewee points to the possibility of visiting various places for outdoor recreation activities when staying at his vacation home in the mountains:

> "… during the stay .. I drive a little bit to go fishing or maybe go, to go alpine skiing I have to drive 10 minutes so, it's the freedom when I'm up there to have a car to get around to different places, because if I didn't then I had to use very much the same path in and out of the cabin all the time just going skiing and all." (Male interviewee, 55, with self-owned cabin at Heggenes and access to another vacation home in Søgne)

When staying at his second vacation home (at the coastline), this interviewee says that it is more flexible to visit his family by car. Otherwise, his family would have to visit him at the cabin.

Two interviewees say that they use the car for trips where they could otherwise have cycled because of unsafe biking conditions. One of them tells that they need to travel some distance to visit relatives, and that it is not safe to bike with children on narrow roads where everybody drives really fast. Therefore, they go by car for these trips:

> "… around my parents' house … we just use the bikes, and we can visit a lot of people, but the farm and my grandfather they are 20 kilometers up in the valley. And sometimes we can take a bike, but with children, it's a really narrow road, and everybody is driving really really fast … it's a lot less safer than biking in town, so then you just, everybody needs a car there." (Female interviewee, 41, one self-owned cabin (Ål) and one family-owned cabin (Åfjord))

The same interviewee also points at social contact as a reason for choosing to travel by car. Since she is at the vacation home with her family, they use her relatives' car to get around for some trips. Social contact is still probably not the only reason here, since this interviewee does not have a car or driver's license and therefore depends on someone else to drive her and her kids to destinations that cannot be reached by non-motorized modes or transit.

Reasons for going by transit
Five interviewees travel within their vacation home areas by different types of public transportation (bus, ordinary taxi, taxi boat and ferry). The main reasons given for traveling by these modes are: Topographic situation, with the cabin located on a small island, weather conditions and number of co-travelers, non-ownership of private boat, and long and steep distance back from shop and lower price for taxi than renting car. It should be noted that the latter interviewee travels from the primary to the vacation home by train and therefore depends on other modes than private car for motorized travel within the vacation home area.

Except for the interviewees who stay at vacation homes on a small island without any bridge or tunnel to the mainland, transit plays a very modest role for the interviewees' travel within their vacation home areas. For those with island vacation homes, the situation is very different, since there is no grocery store on the island where their vacation homes are located (Jomfruland). Boat transport is therefore the only opportunity to reach stores and other facilities not present on the island.

Two of the interviewees whose vacation home is located on an island own private boats and alternate between using these boats and public boat services. One of them states that strong wind/bad weather at sea can make him take the public boat rather than his own. The private boat is quite small, and he uses the public boat when traveling together with friends/relatives, probably because of the limited size of the private boat.

Reasons for going by non-motorized modes
Six interviewees state that they more or less often use non-motorized modes of travel (walking, skiing or biking) to reach activity locations within the vacation home areas. Here, non-motorized movement as the activity itself is not included.

Short distances to destinations is the most common reason given for choosing non-motorized modes. Two interviewees mention this as a main reason for reaching activities on foot as well as on ski. In addition, another interviewee states short distance as a reason for walking to shops and yet another one for skiing to activity locations.

Three interviewees mention the legislation against driving under the influence of alcohol as a reason for walking to and from destinations in the vacation home area instead of traveling by car. When visiting friends living in cabins in the surrounding areas, one interviewee and his wife sometimes walk so that they can have a glass of wine there. Indirectly, this concern also influences the travel modes of another interviewee as one of the reasons for choosing a location of the vacation home as close as possible to the alpine skiing facility. This interviewee says that they wanted to be able to have some wine on Friday nights without having to wait until the next afternoon to drive to the lifts. Similarly, yet another interviewee says that the location of their cabin not far from the alpine skiing hill is nice also because if you don't need a car you can take a beer when you go alpine skiing.

Two interviewees whose mountain cabins are located at some distance from the closest road, have to walk or go skiing one or two kilometers each direction between the car parking and the cabin. (One of them sometimes uses snow scooter instead of walking during winter time, see below.) Walking can also in some cases be shorter and more convenient than driving since the latter may include long detours along the road network. This is the case for one interviewee's visits to some of their friends who live in cabins just up the hill from their own, easier accessible on foot than if they were to walk to the parking place and then drive.

Finally, one interviewee states that he walks to local destination on the island where his vacation home is located because there is a ban against driving on island (except when arriving at and leaving the vacation home, which is allowed against a high fee). None of the two other interviewees with vacation homes on the same island mentions walking as a local travel mode, but they obviously have to walk at least the distances between their cabins and the piers for public and/or private boats.

Reasons for traveling by other modes
Some interviewees also use other travel modes than those mentioned above for transportation within their vacation home areas. These modes include ski lift (two interviewees, use of ski lift for alpine skiing not included), private boat (two interviewees), rented car (one interviewee) and snow scooter (one interviewee).

For some of their hiking/skiing trips, two interviewees take the ski lift from the valley bottom to the top of the mountain where they start the skiing or hiking activity. The obvious reason for this is to overcome altitude difference. This concern can in its turn be traced back to a wish to avoid too much physical efforts and probably also time-saving, which enables the interviewees to visit more distant and varied hiking and skiing areas than possible if they were to start the trips directly from the cabin. A rationale of variety-seeking may therefore also be an underlying reason for using the ski lift in connection with hiking and cross-country skiing.

As mentioned above, one interviewee sometimes uses snow scooter between the parking lot and the cabin, which is located 1 km away. She does this particularly when she brings food to the cabin after having visited the grocery store. The reason for using the snow scooter for these trips instead of skiing thus seems to be to avoid having to carry heavy shopping commodities.

Two interviewees sometimes use private boats for travel within the vacation home areas. These boats are largely used for trips where being on the sea is the recreational activity pursued (including doings such as water skiing, fishing and bathing during the trip), but they are also used for instrumental travel purposes. A main reason for using the private boat is that it is fast.

The only interviewee who uses a vacation home in a foreign country rents a car for his travel within his vacation home area at the Turkish south coast. They use the car for all destinations except those very close to the vacation home. Trip distance beyond acceptable walking distance is thus a reason for using the rented car. In addition, driving appears as more or less the default option of this interviewee for motorized travel – the possibility of using local transit does not seem to be considered.

Discussion

The most common reasons stated by the interviewees for their choices of travel modes when visiting vacation homes are in line with rationales for travel mode choice found in studies of daily-life travel (Næss & Jensen, 2005; Næss, 2005, 2013 and 2015b; Næss et al., 2018). By transport rationales, we refer to the backgrounds, motivations, and justifications that agents draw on when they make transport-relevant decisions about their participation in activities, location of these activities, modes of transportation, and the routes followed.

Six of the interviewees of the present study explicitly mention *convenience* as a reason for their travel mode choice. Moreover, reasons stated by the interviewees concerning flexibility, bringing baggage, quality of transit connections, bringing children, weather conditions and altitude difference are all related to this overall rationale. Both the need to bring baggage on the trip and altitude difference make certain modes of travel physically exhaustive, these concerns are thus related to a sub-rationale of avoiding too much physical effort.

Interestingly, we find some quite distinct differences between travel to/from and within vacation home areas in the occurrence of the different reasons. For travel between primary dwellings and vacation homes, the reasons indicated in most interviews are about baggage, quality of transit connections, convenience in general, and time-saving. Some interviewees also emphasize environmental concerns, expenses and habits. The importance attached to time-saving is very understandable from a time-geographical perspective (Hägerstrand, 1970). If traveling to the vacation home by modes other than car takes long time, the journeys between the primary dwelling and the vacation home will consume a high proportion of the time budget, for example the available days off from work during a weekend. The time allocated to travel may then replace other, desired activities at the vacation home. By traveling by car, some of the ‘capacity constraints’ (Hägerstrand, ibid.) are relieved and higher travel speed is obtained.

For travel within the vacation home areas, concerns about bringing children, flexibility and altitude differences come to the fore, and some also mention safety and weather conditions. However, what is really striking is the large number of interviewees referring to trip distance as a circumstance influencing their travel mode choice. This reason is mentioned particularly for situations where the options are whether to use non-motorized or motorized transportation (where the latter in most cases means car, since transit is usually poorly aligned with interviewees' travel needs within the vacation home areas). This corresponds to the findings in studies of residential location and travel where trip distance has been identified as an important intermediate criterion triggering the activation of (sub) rationales such as time-saving and avoidance of too much physical effort. Bringing children also involves a need to reduce non-motorized trip length and physical effort, compared to what would be acceptable for a grown-up person.

Social contact as a reason for travel mode choice (car) is mentioned by only one interviewee but is in line with a rationale encountered for daily-life travel and is also pointed at in an earlier study of second home mobility (Ellingsen & Hidle, 2012).

Some interviewees have their travel mode options constrained because of non-ownership of mobility resources possessed by most other interviewees (private car) or by most users of vacation homes in a particular area (private boat). At least for the three interviewees without a car, this appears to be a self-imposed constraint motivated by environmental concerns and could thus be regarded, in these cases, as a derivative of an environmental rationale.

In addition, the interviewees give some very context-dependent reasons for travel mode choice, such as missing road connection and local ban against driving. Such conditions are very unlikely to appear in an urban context and have thus not been encountered as reasons for travel mode choice in studies of residential location and travel in urban areas. For travel to non-primary areas, missing road connection on the last stretch before the destination can require that a car trip is combined with another travel mode for the final part. If car is the preferred travel mode, this can in its turn make up a pressure for road building to vacation homes presently unconnected with the road network.

Concluding remarks

Travel to, from and within non-primary dwelling areas represents considerable carbon footprints by those involved. Distances between primary dwellings and vacation homes are often long, since a main motivation for having vacation homes is to stay in a geographical environment different from that at the primary dwelling and to be able to access places and activity opportunities that are too far away for an ordinary day-trip from the primary dwelling. Most Norwegian vacation homes are also located in areas poorly accessible by ordinary public transportation. Private cars play a more dominant role for visits to vacation homes than for most other travel purposes (Hjorthol et al., 2014). Our interviews with users of vacation homes illustrate why this is so. Interviewees travel by car to vacation homes mainly because they bring much baggage and/or travel with kids, need the car for travel within the local area, and because of poor transit connections the last part of the journey from primary dwelling to vacation home. For these reasons, the car is often considered the default mode of travel when going to vacation homes.

Some interviewees stated that they considered it impossible to use their vacation homes without having a car at their disposal. Although none of the interviewees said explicitly that their use of vacation home had made them acquire cars they would otherwise not have needed, it seems plausible that at least some inner-city residents would have preferred not to own a car if they did not need to drive to their vacation homes. In these cases, being a vacation home user has ramifications on car driving practice far beyond the visits to vacation homes, since a car, once acquired, tends be used for trips for a number of purposes and to destinations that would otherwise be reached by other modes.

One could thus question whether the Norwegian vacation home phenomenon is at all compatible with environmental sustainability (Steffansen, 2017). It has not been the purpose of the present paper to answer this question, but the CO_2-intensive travel that the use of vacation homes often involves at least represents a serious sustainability challenge.

Our material still shows that some interviewees and survey respondents do travel in environmentally less harmful ways when visiting their non-primary dwellings. Transit users emphasize environmental concerns and qualities of the journey itself and often combine train or express bus with taxi, or are driven by relatives on the last part of the journey. These interviewees are often motivated for their travel choices by high environmental awareness and are willing to make some efforts to reach their vacation homes by other modes than the car.

A larger number of vacation home users might be able to travel in a more environmentally friendly way if three main difficulties could be alleviated: long distance from the closest transit stop to the vacation home, the need to bring baggage, and the need for transportation within the vacation home area. For spatial planning, this points toward more densely developed vacation home areas to facilitate more frequent and easily accessible transit service. For existing vacation home areas, one way to relieve the above-mentioned difficulties could be to establish more extensive, 'on demand' shuttle bus services between the closest train station or main bus stop and relevant vacation home areas. "On demand" here means that the driving route of the shuttle bus would pass the vacation homes of the actual passengers of each particular trip. Regular food deliveries organized by the local grocery stores is another idea. Such shuttle and delivery services would probably only be possible in areas with a relatively high number of vacation homes. In areas with less concentrated vacation homes, better taxi provision could be helpful. A possible way to finance such shuttle bus and taxi services could be to establish (increased) toll fees on the local roads leading to the vacation homes and earmark some of the revenues to run the conveyance systems at subsidized fares.

For trips to and from vacation homes, such shuttle services would be particularly useful on Friday and Sunday afternoons. However, since several interviewees mention that they need to use cars for trips within the non-primary areas, 'on-demand' shuttle bus services between vacation home areas and the nearest village should also be available during the most common vacation periods when people often stay for a longer period at their vacation homes and want to go to grocery stores, alpine skiing facilities or other activities located beyond acceptable non-motorized travel distance from the vacation home.

While the above-mentioned improvements might facilitate a shift from car to transit among those vacation home users who are motivated for changing their travel mode, many users would probably still prefer to drive. In order to induce a stronger shift to more climate-friendly travel when visiting vacation homes, "carrot" instruments should be combined with "stick", for example new or higher tolls on the main highways between the largest cities and the most important vacation home areas.

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Notes

[1] By non-primary dwellings, we refer to stationary dwellings other than the dwelling registered in the national census as a person's official home address, to which the person or household in question has regular access (Farstad et al., 2008), and regardless of whether the dwelling is located in Norway or abroad. The vast majority of the non-primary dwellings used by the survey respondents are vacation homes, but some are also dwellings used for other purposes such as work, studying or by couples living apart. All the non-primary dwellings used by the interviewees are vacation homes. In this paper we therefore use the term 'non-primary dwellings' when referring to the survey material and 'vacation homes' when referring to the qualitative interviews.
[2] A study on second home mobility in Norway (Ellingsen & Hidle, 2013) represents a possible exception, but his study focuses mainly on how different practices are linked to different home locations and to a lesser extent on the travel between or within these locations.
[3] One of the non-primary dwellings owned by one of the interviewees was located at the southern coast of Turkey and is not shown on the map. At three locations (Oppdal, Kragerø and Trysil), the number of interviewee non-primary dwellings within a concentrated area was too high to enable each such dwelling to be represented by a separate pin on the map.
[4] If the trip involves more than one travel mode, the main mode refers to the travel mode used for the longest part of the journey.
[5] Most of the non-primary dwellings to which respondents travel by airplane (63%) are located abroad.
[6] Travel distances by the different modes are calculated as if the main travel mode mentioned by the respondents accounted for the whole distance between the primary and non-primary dwellings. We consider this inaccuracy to be small, since a travel mode underestimated for one trip where it is the second or third most important mode may be overestimated for another trip where it is the main travel mode. Still, the length of flights may be somewhat overestimated since this travel mode is usually the main mode if chosen at all. We also ignore that some trips go directly between non-primary dwellings and workplaces/places of education. We consider this inaccuracy too to be modest, since the workplaces of most respondents are in the same urban area as their residences (Greater Oslo), and there is therefore usually little difference in travel distance to the non-primary dwelling from the primary dwelling compared to from the workplace.
[7] The number of interviewees who explicitly mention a concern does not mean that these interviewees are the only ones for whom the concern mentioned is of some importance. Therefore, the occurrence of the various concerns may be more widespread than indicated by the number of interviewees who explicitly talk about each concern.

Towards Evaluating The Management Of Climate Change Impact On Rural Communities Of Edo State, Nigeria

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ABSTRACT

In the last few years, rising temperatures and rainfall has characterized the climate pattern of Nigeria and no doubt it is a clear evidence of climate change. The attendant effects among others have been the increased heat and rainfall regimes which have resulted in the increased infection of heat related diseases and rainfall related problems such as the loss of crops and farmlands. While these effects are on the increase, studies have shown that urban centres are given more attention than the rural areas by way of mitigation. The rural areas are the largest in terms of land size, resources and population and they suffer as much environmental problems as the urban centres. But because they are administered by the local government councils which in themselves are characterized poor financing, the rural areas are therefore besieged with inadequate or lack of administrative mechanism and framework for climate change effects. The aim of this research is to evaluate the management of climate change effects in rural areas in Edo State, Nigeria. To accomplish this, the study examined the change pattern of the elements of temperature and rainfall, the effects of the change, the management of the effects by the local council authority, the impact problems. The study utilized primary and secondary sources of data. For the primary data, questionnaire and direct interviews were conducted. A total of 363 questionnaires were made and administered on the population of the study area

while interviews were conducted on the heads of environmental units of the local government councils. Secondary data were sourced from documentary sources such as text books and articles in journals. Data on temperature and rainfall for 15 years were got from weather station in the Cocoa Research Institute, Uhonmora, Edo State which is about 15 kilometres from the study area. The data collected were analyzed descriptively and statistically using tables. The findings were that rainfall and temperature pattern were changing and this change was having impact on farming, the physical environment, infrastructure and health in the study area. The **study** also identified the management techniques employed to ameliorate these impacts and the problems. Useful recommendations that will help reduce and ameliorate the effects of climate change and problems were therefore made.

INTRODUCTION

Awareness of climate change in Nigeria is very low and this is because over 70% of the population do not know about this phenomenon and are not also aware that it is the cause of excessive heat and rainfall in the last few years. The problem of awareness according to Nzeadibe, Egbule, Chukwuone and Agu (2011), include poor sensitization by government agencies and inadequate information from media sources like radio and television. Climate change according to Wu, X. and Xu, B. (2016), is the long term statistical shifts of the weather, including changes in the average weather condition or in the distribution of weather condition around the average.

According to the European Environment Agency (2008) the global average surface temperature has risen by 0.74^0c in the 20^{th} century. The global sea level has been rising 1.8mm per year since 1961 and the arctic sea ice berg been shifting by 2.7% per decade. Also different observational records of global average annual near-surface (land and ocean) temperature; the last decade (2008-2017) was 0.89^0c to 0.93^0c warmer than the pre-industrial average, which makes it the warmest decade on record (European Environment Agency 2008). The intergovernmental panel on climate change in 2001 predicted an average temperature rise of 1.5^0c -5.8^0c across the globe during the 21^{st} century accompanied by increase and anomalous weather events including heat waves, floods and droughts. The effects of climate change are quite noticeable and according to Beyioku (2016), these include disastrous erosion and flooding, rising heat waves, drought, rising sea levels, melting ice caps, wind storms, land and mud slides, rising sea temperatures among others.

Climate change is principally a major problem caused by human activities such as gas flaring, carbon emissions, bush burning, deforestation, burning of carbons and urban growth and development and other activities. The consequences of these in heat mortality, dehydration, spread of infectious diseases, malnutrition, migration and damage to public infrastructure Beyioku (2016).

The enormity of this problem has challenged the governments around the world to take certain actions with the view of curbing global warming and reduce its effects. On September 3rd, 2016 the CNN Television News had reported a signing of the Paris Climate Change agreement by both the United States and China. This agreement sought to cut carbon emissions by half within the next fifteen years. This signing was declared significant because the two countries are said to account for about 40% of global carbon emissions. In the same vain other developed countries have taking measures to reduce burning of gases and other chemicals with changes in technology that is environment friendly. Solar heat material, batteries and solar driven cars and machines and the replacement of carbon coolants in air conditioner and fridges are now been manufactured. In most developing countries, not much effort has been made technologically much effort is however been made to ameliorate the effects.

In Nigeria the evidence of climate change is massive. Few decades ago Lake Chad which covered an area of 40,000 square kilometres now encompasses about 1,300 square kilometers. Also rising temperatures has led to the rapid southward expansion of the Sahara Desert. Farmlands and surrounding villages have become barren and there is now the emergence of derived forest or grasslands. Excessive Logging and over dependence on firewood is rapidly devouring the guinea Savannah of Nigeria. Excessive rainfall leading to gully erosions has completely devastated the lands in most parts of the east of Nigeria while rising sea levels are threatening the coastal regions with floods. These occurrences are having negative impacts where farmlands have become uncultivable, increasing disease infections, migration, violent clashes between herdsmen and farmers, flooding, heat related diseases, destruction of infrastructure such as roads among others. Due to low level of technology, Nigeria's effort has been on ways and means to ameliorate the impacts of these occurrences. The management of these occurrences and their impact has been through the Federal Ministry of Environment and the National Emergency Management Agency.

While these bodies are doing their responsibilities, not much can however be said to have been achieved due to problems such as lack of funds due to low budget allocation, lack of continuity in programmes by successive governments and poor infrastructure. At the local government level, these problems are worse. It must be noted the local government council in Nigeria administer the rural areas of Nigeria. The rural areas are as affected by climate change as the urban centres. But because of poor funding of the local government councils and poor infrastructural development, these local councils through the departments of environment have achieved very little in managing climate change impact.

The study area is essentially a rural environment and it is administered by five local government councils. The impact of climate change is also very evident. The local government councils are saddled with the responsibility of managing the effects of climate change. What they are doing, which programmes are in place and how much they have achieved and the challenges they have is not known. It is upon this that this study wants to evaluate the management of climate change impact in this study area.

STUDY AREA

The study area is the five local government areas of Edo Central Senatorial District of Edo State Nigeria. The Senatorial District is located within Latitude 6^{0}17’ and 6^{0}45’ north of the Equator and Longitude 5^{0}45 and 6^{0}17’ east of the Greenwich Meridian. It is bounded in the north by Etsako west and central local government areas, in the north-west and west by Owan west and Uhunmwode local government areas, in the south by Delta State and in the east by the River Niger.

The five local government areas are made up of several settlements. Apart from the headquarters which are the only urban settlements, all other settlements are rural. For the purpose of this study, the headquarters and three rural settlements from each local government area are used for this study. The rural settlements were selected by stratified sampling method where the highly populated, medium and the least populated were selected. Table 1 shows the local government areas and their headquarters, selected rural settlements and their population.

Table 1. Local Government Areas, selected settlements and Population

Local Government Area	*Headquarters and Selected Rural Settlements*	*2006 Population Census*	*2018 projected Population at 3.0% growth rate*	*0.001% of population*
Esan West	***Ekpoma***	*36,432*	*65,578*	*66*
	Iruekpen	*14,226*	*25,607*	*26*
	Emuhi	*4,494*	*8,089*	*8*
	Egoro	*1,817*	*3,271*	*3*

Esan Central	***Irrua***	*24,650*	*44,370*	*44*
	Opoji	*4,365*	*7,857*	*8*
	Eidenu	*2,012*	*3,622*	*4*
	Ibholulu	*1,239*	*2,230*	*2*
Esan South East	***Ubiaja***	*23,371*	*42,068*	*42*
	Ewohimi	*6,542*	*11,776*	*12*
	Ugboha	*3,112*	*5,602*	*6*
	Oria	*816*	*1,469*	*1*
Esan North East	***Uromi***	*32,197,*	*57,955*	*58*
	Egbele	*8, 323*	*14,981*	*15*
	Uwalor	*3,114*	*5,605*	*6*
	Ukoni	*1,961*	*3,530*	*4*
Igueben	***Igueben***	*21,451*	*38,612*	*39*
	Ekpon	*6,842*	*12,316*	*12*
	Ewossa	*2,672*	*4,810*	*5*
	Amahor	*1,358*	*2,444*	*2*
Total		*200,994*	*361,792*	*363*

Source: Local Government Councils and the National Population Commission, Benin City (2018)

METHODS OF STUDY

Primary and secondary data are used in this study. Primary data were sourced from the Department of Environments in the secretariat of the local government areas and the field of study, that is, the residents of the selected settlements of study. To get primary data from the secretariat, five Interview schedule were distributed and administered on the Heads of Department of Environment in the five local government secretariats. Among others they were used to ascertain the level of climate change awareness created and the impact, the resources used, the measures adopted, the impacts and the common problems. On the other hand, questionnaires were used to obtain data from the residents of the study area. To this end, 363 questionnaires were made and distributed among the settlements. As shown in Table 1, 114 questionnaire were distributed in the local government headquarters (the urban settlements) while 249 questionnaires were distributed among the rural communities. In all 283 were farmers while 80 are into secondary and tertiary occupations. The systematic random sampling technique was used to distribute questionnaires among the sampled residents of these settlements. Among others, the questionnaires were used to get data on residents' awareness, the common problems of the change and the impact. 0.001% of the population of each selected settlement was used for questionnaire distribution as shown in Table 1.

Secondary data on the other hand were collected from relevant documentary materials, published and unpublished books, journals and internet sources. Data collected were analyzed descriptively and using tables.

Temperature and Rainfall Pattern of the Study Area

Characteristically the study area experiences the humid tropical climate which has two distinct seasons, the wet and the dry seasons. The dry season lasts between November and March and this period usually coincide with the period of low sun while the wet season lasts between April and October of each year and it is the period of high. This wet season is brought about by the South-West monsoonal winds which blows across the Atlantic Ocean into the hinterland while the dry season is brought about by the North-East trade winds which blows across the Sahara as at the time of winter in the northern hemisphere.

The mean annual rainfall is about 1915mm while the mean monthly temperature is 27^{0}c (Adejuwon 2011). The months of July and September have the highest rainfall while the months of December and January experiences the lowest rainfall of the year. The highest temperature in this area is recorded between January and March while the lowest temperature occurs in June and July. This shows that temperatures are relatively high all year round while rainfall is also heavy in the period especially May to October of every year. Table 3 and 4 shows annual rainfall and temperature records of the study area between 2003 and 2017. The data shows general but fluctuated high rainfall.

Table 2: Annual and Mean Rainfall of Study Area 2003-2017

Year	***Annual Rainfall (mm)***	***Mean Annual Rainfall (mm)***
2003	*1703.00*	*141.90*
2004	*1925.00*	*160.70*
2005	*1595.00*	*132.92*
2006	*1972.90*	*164.40*
2007	*2036.50*	*169.71*
2008	*1819.70*	*151.63*
2009	*1882.00*	*156.85*
2010	*2094.40*	*174.50*
2011	*2127.20*	*177.31*
2012	*2824.40*	*235.40*
2013	*2606.70*	*217.22*

2014	*2433.60*	*203.61*
2015	*1327.60*	*110.69*
1016	*1559.30*	*129.96*
2017	*2652.20*	*221.09*

Source: Cocoa Research Institute of Nigeria, Uhonmora, (2018).

Table 3: Annual and Mean Temperature of Study Area 2003 - 2017

Year	***Annual Temperature (^{0}c.)***	***Mean Annual Temperature (^{0}c.)***
2003	*326.53*	*27.20*
2004	*329.11*	*27.40*
2005	*318.72*	*26.50*
2006	*319.84*	*26.60*
2007	*310.45*	*25.70*
2008	*333.42*	*27.80*
2009	*343.47*	*28.60*
2010	*326.70*	*27.20*
2011	*318.82*	*26.60*
2012	*335.02*	*27.91*
2013	*337.52*	*28.10*
2014	*341.58*	*28.40*
2015	*320.56*	*26.74*
1016	*308.72*	*25.70*
2017	*316.94*	*26.43*

Source: Cocoa Research Institute of Nigeria Uhonmora, (2018)

Effect of Rainfall and Temperature Pattern in the Study Area

This study shows that high temperature and heavy rainfall causes flooding, erosion and heavy storms in the study area. Its associated impacts in the area include traffic congestion, poor infrastructural services, environmental degradation, poor yield on farmlands, and diseases infection.

Farming: The people of the study area are predominantly farmers. Farming is practiced more in the rural areas due to availability of land. Crops cultivated and produced include food crops such as yam, cassava, tomatoes and maize and tree crops such as cocoa, kola nuts and oranges. Temperature and rainfall change pattern in last few years is affecting farming. Responses from farmers show that high temperature and rainfall has caused disease infection on crops, poor soil fertility, farm and crop loss due to erosion and flooding which ultimately has led to low farm output.

Of the 363 questionnaires distributed 283 or 78% respondents are farmers who practice mainly crop farming on full time and part time basis. Of the 283 farmers 249 or 88% are rural farmers while 34 or 12% are in the urban centres. Using the impact of rainfall pattern on rural farming, the 249 farmers agreed that the impact was high. They identified erosion and flooding as the commonest which in the last few years have not only made farm roads impassable due to gullies created, but has consistently washed away farm lands and crops. Among the farmers, 102 or 41% remarked that they have witnessed continuous flooding and the washing away of their farmlands and crops in the last 7 years. Farmers in Esan South East made particular reference to the devastating floods of 2014 and 2015 caused by heavy rains that saw the increase in the waters of the River Niger which overflowed its banks and washed away several communities and their farmlands. Also, 27 or 10.8% of the farmers remarked that they have witnessed crop failure and poor harvest as excessive rainfall make tuber crops like yam and cassava rot in the ground.

***Physical Environment**:* Land and farming are the most valued in most rural areas. In the study area, rural lands have been devastated by erosion and flooding. Rural areas at proximity to urban centres are worst as they are places receiving waste water from urban centres. Emuhi community lands have become heavily fragmented due to excessive erosion from Ekpoma town. As a result of the fragmentation, the earth roads are difficult to use while houses and farmlands are severely affected. Most of the roads in the rural areas are earth roads which served mostly the purpose of transporting farm produce to the urban markets. Because the roads are not tarred, heavy rain often washed them and create gullies in them that make them almost impassable for most time of the year. In the urban centres, about 87% of the roads are also untarred and because of this, urban movement is often a serious task. Poor accessibility has grievous socio economic consequences. The rural farmers are all affected by the condition of rural roads. Apart from longer time spent on the roads, the cost of transporting goods is increasing while vehicle accidents are also very common. Of the 149 rural farmers, 36 or 24.% have been involve in vehicle accident in the process of moving from the rural to urban centres. Average cost of transportation between rural areas and their local government headquarters is on motor vehicles is ₦200 or 0.68 Dollars. It is of note to mention here that because of the nature of rural roads, motorcycle and tricycles are the most preferred means of transportation in the rural areas as accounted by 231 or 92.8% of respondents. This means is popular because it is faster on the roads and also has the ability to meander through bad spots on the roads. Average cost of movement per person to the urban centres is ₦400 or 1.2 Dollars. This means is also popular in the urban centres and is the most used within the urban centres as accounted for by 96 or 84.2% of the urban respondents.

***Infrastructure**:* According to Onokerhoraye (1982) over 65% of infrastructure in the Nigeria is located in the urban areas. This is also true of the study area where 62% of amenities are located in the local government headquarters of Edo Central Senatorial District (Omofonmwan, 2004 and Emily, 2011). Amenities in the study area and particularly the urban centres include hospitals, housing, tarred roads, electricity, schools, telephone, police stations, prisons, courts, post offices and banks. Using roads as an amenity of climate influence, it can be seen that roads and particular the urban roads are in deplorable conditions. The roads are characterized with pot holes and failed portions. A major cause is the constant flooding as can be seen in Ihumudumu road in Ekpoma and the Uromi-Ubiaja road. When it rains these and other roads are flooded and become almost impassable. Worse still the poor drainage system that are inadequate and lack good depth and network are always unable to drain the volume of heavy rain water. Apart from roads, many houses have also been affected. From the questionnaire survey, 9 houses in the rural areas and 5 houses in the urban areas have collapsed since the year 2008. The removal of soil around the foundation of such buildings for long year has partly been attributed. Some areas are erosion and flood prone. Examples are Ukpenu in Esan West, Ubiaja in Esan South East and Uwalor and Ukomi in Esan North East.

Health**:** The impact of climate change on health cannot be overemphasized. Temperatures affect virtually every aspect of the environment. The effect on man is mostly health related and according to Doerr, (2018), temperatures between 28-35^{0}C can cause problems such as heat rashes, heat stroke, exhaustion, cramps and syncope in man. From the questionnaires distributed, 86% of respondents agreed that heat rash was the commonest problem that people suffer as a result of excessive heat from high temperatures. On the diseases which are influenced by high temperature and rainfall pattern in the area, 82% of the respondents identified malaria, 14% identified typhoid fever while 4% identified other diseases like cholera and diarrhea. These diseases come about when accumulated floods from heavy rainfall become breeding places for malaria causing pathogens or when water consumed is contaminated by fecal microorganisms that have been spread during heavy rainfall (Oredola, 2016 and NCDC, 2017). It should be noted that temperature impact on the life cycle of pathogens. For example temperature of 21^{0}c to 23^{0}c is very suitable for the development of mosquitoes that causes malaria fever (Harvell et al 2002). To ascertain the claim of the respondents on these diseases, 5 year record of the diseases from the Primary Healthcare Centres in the study area were obtained as shown in Table 4.

Table 4. Reported Cases of Malaria, Typhoid and Heat Rash between 2013 and 2017 in the Study Area

Year	*Malaria*	*Typhoid*	*Heat Rash*	*Total*
2013	*43,783*	*18,436*	*53*	*62,272*
2014	*48,417*	*17,338*	*49*	*65,804*
2015	*37,615*	*21,855*	*118*	*59,588*
2016	*54.952*	*24,675*	*34*	*79,661*
2017	*54,413*	*28,016*	*72*	*82,501*
Total	*239,180*	*110,320*	*326*	*349,826*

Source: Primary Healthcare Centres in the Study Area (2018).

From the Table 4, malaria fever is obviously the most suffered disease in the study area and this accounted for 68% of the diseases listed. Typhoid fever accounted for 31.5% while Heat Rash accounted for 0.09% making it the least reported case. Let it be stated that 72% of the cases are from the rural communities in the study area while only 28% are from the urban centres. From the Table 4 also, one can see a general progression in the infection of these diseases which portend that more persons will be infected except adequate measures are taking.

Urban Environment. One of the commonest problems in the urban centres of the study area is indiscriminate waste disposal. The study of Ojeifo and Uwadiae (2005) shows that waste ranging from papers, plastics, metals, food remnants and wood material are usually disposed indiscriminately in the market places, open spaces, along roads, in drains and in other public places. Because of poor waste management practices by the people and the local government authorities, most parts of the towns are usually littered with wastes whenever there is heavy rainfall. Apart from creating poor aesthetics, the littered wastes create opportunity for bad smell and the breeding of pathogens that cause diseases. In a study of the problem of refuse disposal in Ekpoma and Irrua towns in Edo State, Ojeifo and Uwadiae (2005) observed among others, that lack distance to dumpsites, attitude of inhabitants and the local government council's inadequacies as responsible for the poor waste management in the area.

Management of Climate Change Effects and Problems in the study Area.

The management of climate change effects involves weather data gathering, dissemination of information based on data, awareness creation, response to effects of weather condition and the provision of facilities and equipment to ameliorate the effects. In the study area, the departments of environment in the local government councils are responsible for the management of climate change conditions. The techniques for administration include creating awareness for climate change and effects, responding appropriately to severe weather conditions and effects, facility provision and rehabilitation and the provision of equipment and personnel. From the field survey carried out however, it was discovered that very little of these goals are being pursued and achieved in the study area.

Field investigation shows that there is no form of climatic data gathering and information dissemination by the local government councils in the study area. The reason for this is that none of the councils have weather facilities from which data is gathered. Without weather data and information, it is practically impossible to disseminate information about weather conditions and possible effects.

For lack of data and information, awareness on climate change and effects was discovered to be low in the study area. The interview schedule administered on the local council authorities shows that they have little knowledge about the changing pattern of these climatic elements. Although they indicated that they are aware that temperatures are high all year and rainfalls are heavy in their periods and also know that effects occur from their occurrences but that they have never carried out any campaign to sensitize or create awareness about this.

For lack of information on weather data in the area, some residents now rely on mobile phones, print and electronic media for weather information. From the questionnaires administered, 44 or 12% of respondents have access to climatic data and information. Among this number, 36 or 82% get their data and information from their mobile phones while the remaining 8 or 18% gets theirs from other media sources such as radio, newspapers and television. The residents also remarked that the local authorities have never engaged the people in any awareness campaign to sensitize them on this change pattern and effects.

Management also involves quick response and inspection of places affected by climate change effect especially the action of heat waves, erosion, flooding and rainstorms. At the local government level, there exists Local Emergency Management Agency (LEMA). The department of environment is responsible for coordinating the objectives of this agency. The principal assignment is to provide quick response to emergency situations and take action that will prevent a reoccurrence. In the study area, this assignment is seldom made by the local government when there is emergency situation. Even when steps are made, they are often of non effect. For example, the local council authorities were not able to manage the floods that occurred in the study area in 2014 when the river Niger over flooded its banks as a result of excessive rainfall. As at today, no concrete measure has been taking either in terms of feasibility studies, attending to the river banks, construction of adequate drainages system for the area, provision of relief materials or empowering local farmers who were worst affected by the floods.

Effective management involves the provision, replacement or repair of facilities to ameliorate the effects of climate change. For example, facilities negatively affected by the action of erosion and flooding such as roads and drainages which result in damages and make them channels for flooding are expected to be fixed. In the study area, most tarred roads of which 65% are in the urban centres have potholes and failed parts. The rural untarred roads which are over 10,800 kilometers are constantly been washed. The interviews on the local council shows that only 13 kilometres of roads have been constructed and tarred by the local government council since 2012 while only 52 repairs were carried out on potholes and failed portions of existing tarred roads. On the rural roads, no new construction has been carried out since 2012, only re-grading of existing roads has been carried out in few communities. On the whole very little is been done by the local government to respond to road situation affected by climate change.

Availability of equipment and personnel are basic for effective management of climate change effects. For example, waste disposal trucks are essential for environmental sanitation. In the study area, weekly sanitation by the local government is done every Mondays but restricted to market places for the purpose of revenue generation. General sanitation is also done in the area once every month. The success of the monthly sanitation especially in the urban centres has been adjudged to be fairly higher than of the rural areas (Okhai 2017). The success has largely been attributed to residents' participation rather than the local government councils. This is because apart from the general sanitation announcement which the council makes to the public prior to the exercise and the physical presence of men of the department of environment to coordinate and do surveillance, all collection and disposal are done by the residents'. Therefore most of the refuse disposed indiscriminately and spread by erosion and floods are often disposed by residents" Table 5 shows types and number of some sanitation equipment owned by the local councils in the area.

Table5: Types and number of some Waste Management Equipment and Personnel in the Local Councils

Local Government Council	***Disposal Trucks***	***Pail Loaders***	***Personnel Carriers***	***Diggers***	***Shovels***	***Trained Personnel***	***Untrained Personnel***
Esan West	*2*	*1*	*1*	*7*	*5*	*4*	*8*
Esan Central	-	-	-	*3*	*2*	*4*	*4*
Esan North East	*1*	-	*2*	*7*	*6*	*3*	*5*
Esan South East	*1*	-	-	*5*	*3*	*4*	*6*
Igueben	-	-	*1*	*4*	*6*	*6*	*3*
Total	*4*	*1*	*4*	*26*	*24*	*21*	*26*

Source Field Survey (2018)

Column 7 of Table 5 here shows the inadequate qualified personnel in the department of environment in the local council authorities. This is one of the reasons why the study area and particularly the rural areas are not always covered for inspection and sanitation. The consequence is that these rural communities are dirty and filled with refuse of all kinds.

Finally, the management of climate change effects also involves managing victims of floods, erosion and heat related diseases. The study area has 54 Primary Healthcare Centres that are owned and operated by the local government councils. Although there are doctors and other medical personnel and equipment, they are however inadequate, Also the Primary Healthcare Centres cannot handle severe cases. As shown in Table 4, malaria, typhoid and heat rash are the frequently reported cases associated with climatic influence. Victims of weather related cases often handle their cases by themselves as the local government does not take any responsibility in this regard

Problems of Climate Change Management in the Study Area

The problems of the management of climate change effects in the study area are many. They are inadequate facilities, inadequate manpower, lack of action plan for climate change effects and the problem of funding the environmental department. The department of environment is responsible for environmental data gathering, plan formulation, enforcement and execution of plans and monitoring. This study has revealed that the departments in the local council areas have not been able to effectively handle most environmental challenges due to inadequate funding. For example budgetary allocation to this department has not exceeded 3 Million Naira or 855 Thousand Dollars in the last 15 years. This is rather too small for meaningful response to environmental problems. The highest budget ever presented by any council in the study area is 2 Billion Naira or 54 Million Dollars and this was in 2014. Every year, recurrent expenditure takes about 80% of budgets and what is usually left for capital and other developments is usually too meager to meet the aspirations of the people. Table 6 shows budgetary allocation to the departments of environment in the council authorities between 2013 and 2017.

Table 6: Percentage of Budgetary Allocation **(in Million Naira)** to the Departments of Environment of the five Local Government Council Areas

Year	*Esan West*	*Esan Central*	*Esan North East*	*Esan South East*	*Igueben*
2013	*1.6*	*0.6*	*0.8*	*0.6*	*1.2*
2014	*1.6*	*1.2*	*1.1*	*18*	*1.4*
2015	*1.8*	*1.9*	*118*	*1.6*	*1.8*
2016	*1.6*	*2.4*	*34*	*2,2*	*0.9*
2017	*3.1*	*2.1*	*72*	*1.9*	*2.1*

Source: Local Council Areas of the Study Area (2018)

CONCLUSION AND RECOMMENDATION

This study is an evaluation of the management of climate change impact on rural communities of Edo State Central Senatorial District. A process approach was followed in which rainfall and temperature conditions and their effects were examined while the role of the local authorities in mitigating and ameliorating these effects was ascertained. Primary and secondary data were used in the study and these data were analyzed descriptively with results presented in tables. The findings were that temperature and rainfall patterns are high or intense which is an evidence of climate change in the study area. On the impact of temperature and rainfall pattern, the study observed that these elements have great impact on farming, the physical environment, infrastructure development, the health of the people and the urban environment.

The study observed that the department of environment in the local council authorities was responsible for the administration and management of climate change effects. In managing these effects therefore, this unit adopted the techniques of awareness creation, response to occurrence, facility provision and the provision of adequate equipment and personnel. However, the study discovered that the department of environment in the local council authorities was not able to effectively manage these effects due to inadequacies in all the areas of management. For example the departments of environment do not have facilities for climate data collection, awareness creation and dissemination of weather information, waste disposal facilities, enough personnel to respond to effect occurrence and funding. It is against these operational problems that the following recommendations believed to be capable of ameliorating the effects of climate change in the study area are made

First it is recommended that the five local government areas jointly build an automated digital weather station where daily reading and recording of rainfall, temperature and other climate elements data could be carried out. This station can be located in any of the local government areas provided it is build by experts in the field with clear adherence to installation provisions. Climatologist or meteorologist can therefore be employed to do the recording of data.

Secondly, upon the location of a weather station, information from the station on daily data recorded and weather outlook should be disseminated to the general public through the television or the internet so those with mobile phones can easily access them. This innovation can easily prepare people ahead in the case of any severe weather occurrence and effects.

It is also recommended that the local government councils should wake up to their responsibility in the areas of the provision and rehabilitation of facilities. As observed, many roads particularly rural roads are not tarred and the few urban roads that are tarred are dilapidating very fast with potholes and failed portions. Drainages are broken and wearing away and creating opportunities for flooding and erosion in the study area. The local government must therefore engage in the construction and rehabilitation of roads and drainages so as eliminate the problem of flooding and its effect on traffic and the health of the people.

The environmental department is grossly underfunded. For this reason it is unable to function effectively and efficiently in the study area. For lack of or inadequate funds vital materials and equipments needed for regular operations such as personnel carriers, waste disposal trucks, fire service trucks, pail loaders, graders and even simple shovel and diggers are not adequate Also the number of trained personnel are inadequate to handle . The occurrence of severe weather condition or any other environmental problem must be attended to by qualified persons who have the requisite training. As it is presently the number of trained personnel is inadequate therefore it is recommended that more personnel be employed, that is a minimum of 10 qualified personnel in each department of environment in the local government areas who should be sent on regular training.

Finally, the effects of rainfall and temperature in the area are enormous. As rural areas, their major occupation is farming. The threat of high temperatures and rainfall on farming in the last few years has been very great. In the process, crops and lands have been lost. If famine and hunger must be avoided in the area, the local government must give support to the rural farmers. The support should be in the form of financial assistance, provision of improved seedlings, land reclamation and other extension services to boost food production in the study area.

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Application of Low-Rank Sparse Decomposition Method to Study Surface Urban Heat Island of Kolkata

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Abstract

In image data analysis Principal Component Analysis (PCA) performs well when the noise is small and Gaussian in nature. However, when the data is non-Gaussian in nature and may contain outliers and spikes, PCA fails. The intrinsic low ranked structure of the datasets can be used to reduce the dimensionality, remove noise and complete missing values by solving a convex Principal Component Analysis (PCA). Surface Urban Heat Island derived from Landsat 8 ETM+ data of Kolkata has been separated into a set of low-rank and sparse components. The Low-rank components depict the linearly correlated data the sparse component represents the perturbation with respect to the mean in the data set. This property is thus useful to assess trends or patterns in the data. Low-rank Sparse Decomposition Method has been used in the field of image processing, bioinformatics, data ranking problems. This study is an attempt to establish RPCA method for studying the trends in Surface Urban Heat Island (SUHI) phenomenon in the metropolitan city of Kolkata.

Key Words: UHI, Low-rank Sparse Decomposition Method, RPCA

1. Introduction

Low rank and sparse decomposition method have been used in data compression and dimension reduction. This study uses the RPCA to assess the evolving pattern of Surface Urban Heat Island for the city of Kolkata. Urban Heat Island (UHI) is a climatic phenomenon which results in an increase of air temperatures in cities compared to the immediate rural areas (Sobstyl et al. 2018; Dos Santos et al. 2017). Surface Urban Heat Island (SUHI) is used to measure the temperature difference between the land surface in rural and urban areas. UHI and SUHI significantly alters the comfort conditions in the urban area thereby increasing the energy requirements for cooling. The land use composition, emissivity and albedo of the surfaces, the storage heat, the energy balance between latent and sensible fractions, and the anthropogenic heat contribute to this phenomenon. This condition is exacerbated by pollution and global climatic perturbations in the form of Climate Change and the ensuing Global Warming. Changes in land surface characteristics of urban areas has also led to increase in the storage heat component in the net energy balance and the temperature within urban areas show hysteresis which is associated with time lag and decrement factor. Energy consumption in different urban processes has led to intensification of SUHI. Peng et al. 2012, studied that vegetation cover assumes a key role in attenuating SUHI in cities thereby mitigating the UHI effect. Several authors have contributed to the research on urban heat Island which has been summarized in table 1.

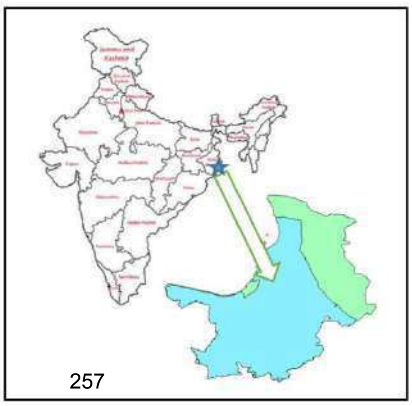

Figure 1: Location map of the study area (Kolkata Metropolitan Area)

Table 1 Factors affecting UHI

S.No.	***Authors***	***Factors affecting UHI in Cities***
1	Peng et al. 2012	Difference in albedo of urban in comparison to rural areas and attenuation effects of vegetation in rural areas
2	Sobstyl et al. 2018	City texture measured by building distribution function and the sky view factor is correlated to UHI
3	Dos Santos et al. 2017	Amplifying effects of developed areas for UHI
4	Menberg et al. 2013	Anthropogenic heat flux contributing to Ground Surface Temperature (GST)
5	Wu et al. 2017	Higher concentration of atmospheric aerosol particles PM2.5 over urban areas reduced UHI intensities by 1°K attributed to the radiative exchanges by the particles
6	Kumar et al. 2017	Urban rural temperature modulations mainly attributable to moisture availability from irrigation in rural areas and atmospheric aerosols
7	Battaglia et al. 2017	Temperature and RH increase as a result of UHI in urban areas affect semivolatile atmospheric species as nitric acid, ammonia and water affecting the aerosol pH (urban rural aerosol pH differences during intense summer ranging from 0.8 for Baltimore and 0.65 for Chicago)
8	Zhou et al. 2017	Studied the effects of city size and urban form on UHI phenomenon and observed that UHI intensity increased with the logarithm of city size and fractal dimension
9	Ward et al. 2016	Studied Europe wide heat wave and the effects of size of heat island, regional climate and central urban green spaces were found to be significant on Surface Urban Heat Island Magnitude (SUHIM)
10	Martin et al. 2015	Identified the hysteresis effect of global solar radiation (GSR) on surface intra-urban heat islands (SIUHI)
11	Yue and Liu 2016	Green ratio, Plot area, Building density and building height affected the land surface temperature significantly and the urban thermal environment
12	Heaviside et al. 2017	Studied health related risks in urban population compared to rural population due to heat exposure attributable to the UHI effect
13	Zhan et al. 2014	The subsurface urban heat island (SubUHI) intensity reaching first and second extremes in a diurnal temperature cycle lags by about 3.25 and 1.97 hrs per 0.1m

This research explores the daytime variations of Surface Urban Heat Island Intensity (SUHI) in the Kolkata Metropolitan area (figure 1). The correlation of normalised difference vegetation (NDVI) and fractional vegetation cover vis-a-vis the SUHI establish the relationship between the land cover types with the SUHI.

1.1 Low Rank Sparse Decomposition Method

Decomposition of low-rank and sparse components (LRSD) from partial or corrupted measurements is possible for separation of background and dynamic components. LRSD can be used in both static (Hou et al. 2014; Yang et al. 2018; Wen et al. 2016) and dynamic applications (Otazo et al. 2015; Hu et al. 2016; Chen et al. 2015). LRSD method have been used in several application areas including interpreting of MRI scans (Baete et al. 2018; Otazo et al. 2015), to detect voxelwise group differences, CT image sequence restoration (Gou et al. 2013), moving object detection (Hu et al. 2016), face recognition (Hou et al. 2014), discriminating between various sound classes in auditory signals (Lyon et al. 2010) etc.

The LRSD separates the sparse individual variability in the sparse matrix (S) and the essential features in the low rank matrix (L). This method can be applied for studying Surface Urban Heat Island phenomena where input data is temporal in nature and can be separated into background component and sparse component create scenario of deviation from the mean.

2. Methodology

Moderate resolution Landsat 8 ETM+ satellite data has been used for this study. Cloud free satellite data of Kolkata Metropolitan Area was downloaded from the Earthexplorer website for 6th April 2014, 11th April 2016 and 14th April 2017 which corresponds to the summer month having pronounced elevated temperature and clear sky conditions in comparison to other months.

The Landsat data has been corrected for atmospheric attenuations using a dark object subtraction (DOS) method (Nguyen et al. 2015). Dark objects can be assumed to reflect no light, and values greater than zero must result from atmospheric scattering and this is the basis of the DOS method.

The Landsat 8 image Digital Numbers (DNs) were then converted to spectral radiance using appropriate gain and bias values in the image header of the data file, based on equation 1.

$$L = L_{Max} - L_{Min} * 255 * DN + L_{Min} \quad (1)$$

Where,
DN is the degree of greyness of the pixels
$L(\lambda)$ is radiance in ($W/m^2/sr/mm$)
L_{Max} and L_{Min} are the calibration constants of the sensor, equal to the maximum and minimum values of the spectral radiance (in $W/m^2/sr/mm$) detectable for each band, by the sensor Landsat TM.

The noise equivalent delta temperature (NEΔT) of TM/ETM sensors is around 0.2-0.3K. Land Surface Temperature (LST) was calculated from brightness temperature using a single channel method using the band 10 based on the following equations (Jiménez-Muñoz et al. 2014).

$$LST = \gamma[\varepsilon^{-1}(\varphi_1 L_S + \varphi_2) + \varphi_3] + \delta \quad (2)$$

$$\gamma = \left\{\frac{C_2 L_s}{T_b^2}\left[\frac{\lambda^4}{C_1} L_S + \lambda^{-1}\right]\right\}^{-1} \quad (3)$$

$$\delta = -\gamma L_S + T_S \quad (4)$$

where,
L_S = at pixel radiance
T_s = brightness surface temperature
λ = effective wavelength, which was regarded to be 11.5 μm in this research,
ε = surface emissivity,
C1 and C2 = constant values of 1.19104 × 108 μm 4 m^{-2} sr^{-1} and 14387.7 μm K, respectively, and
ϕ_1, ϕ_2, ϕ_3 = atmospheric functions that are calculated using Eqs. (5)–(7) and the amount of water vapor in the atmosphere at the time of imaging.

$$\varphi_1 = 0.14714W^2 - 0.15583W + 1.1234 \quad (5)$$

$$\varphi_2 = -1.1836W^2 - 0.15583W + 1.1234 \quad (6)$$

$$\varphi_3 = -0.04554W^2 - 1.18719W + 0.39071 \quad (7)$$

The SUHI has been derived by differencing the LST with reference to average LST values of rural areas for each dataset.
The satellite images were classified using a maximum likelihood approach in Erdas Imagine Software and classification accuracy was determined by applying Kappa coefficient (Sharma et al. 2015; Li et al. 2011; Shishir & Tsuyuzaki 2018) using the following equation:

$$K = \frac{N\sum_{i=1}^{r} x_{ii} - \sum_{i=1}^{r}(x_{i+} * x_{i+})}{N^2 - \sum_{i=1}^{r}(x_{i+} * x_{i+})} \quad (8)$$

where,
r = number of rows in the error matrix,
xii = number of observations in the ith row and column,
x+i = total number of observations in the ith column, and
N = total number of observations

The fractional vegetation index has been estimated from NDVI using the following linear relationship (Gutman & Ignatov 1998):

$$FVI = \frac{NDVI - NDVI_S}{NDVI_V - NDVI_S} \quad (9)$$

where, $NDVI_S$ and $NDVI_V$ correspond to representative values of NDVI for bare soil (FVC=0) and a vegetation (FVC=1)

$$NDVI = \frac{\rho_{nir} - \rho_{red}}{\rho_{nir} + \rho_{red}} \quad (10)$$

where ρ_{nir} and ρ_{red} are the at-surface reflectivities obtained from sensor bands located in the near infrared (NIR) and red spectral regions of Landsat 8 ETM+.

The mixed pixel emissivity has been determined using an empirical relationship based on an exponential function which is NDVI dependent as proposed by Sobrino et al. 1996.

$$\epsilon_\lambda = \epsilon_{V_\lambda} - \left(\epsilon_{V_\lambda} - \epsilon_{S_\lambda}\right)\left(\frac{NDVI - NDVI_V}{NDVI_S - NDVI_V}\right)^k \quad (11)$$

where, λ represents the spectral band, ϵ_{V_λ} is the vegetation emissivity (0.99) and ϵ_{S_λ} is the soil emissivity (0.96 Ref. JPL Library Database). $NDVI_V$ is the maximum NDVI for fully vegetated pixel (0.99) and $NDVI_S$ is the minimum NDVI for bare soil (0.15).

Low Rank and Sparse Decomposition (LRSD) is a robust method for separating a rectangular (i,j) matrix $\mathbf{I}$ into a Low Rank Component (**L**) and a Sparse Component (**S**) :

$$\mathbf{I} = \mathbf{L} + \mathbf{S} \qquad (12)$$

This has been applied on SUHI Images using an inexact augmented Lagrange multiplier method (IALM) (Lin et al. 2011; Erichson et al. 2016) using RRPCA model of RSVD module in R.

3. Results and Discussions

Temporal changes in the extent of vegetation cover has been studied using NDVI for the 3 datasets. Significant changes (improvement in the vegetation content) can be observed in 2016 compared to the 2014 and 2017 when the NDVI values were significantly lower (having lesser vegetation content) due to more intense summer. The implication of this is reflected in the Surface temperature where the increased latent heat fraction results in lowering of the LST on 6th April 2016. The corresponding Fractional Vegetation Index is also high for the 2016 dataset (figure 2).

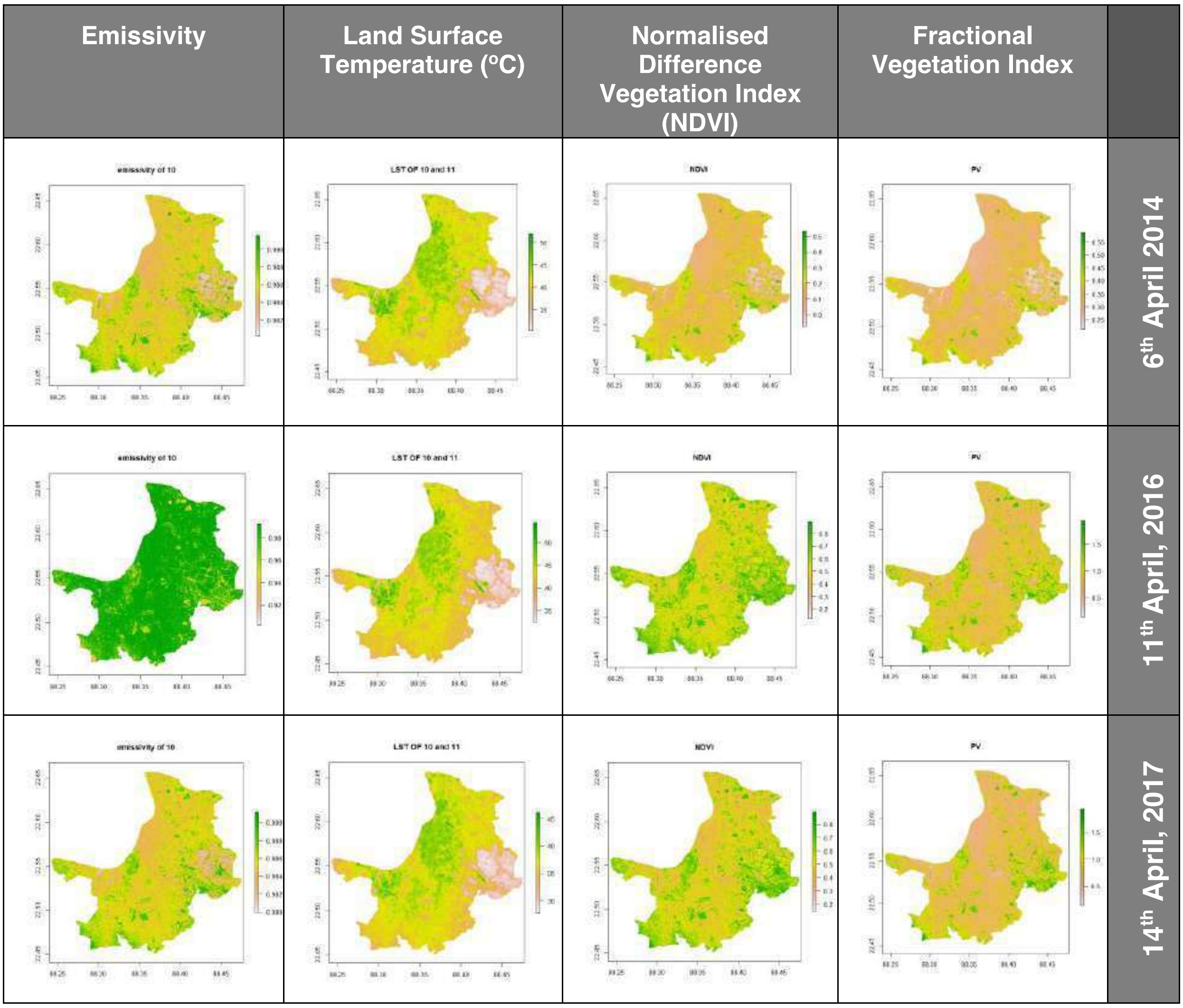

Figure 2: Emissivity, LST, NDVI and Fractional Vegetation Index Maps of Kolkata Metropolitan Area

Temporal changes in the extent of vegetation cover has been studied using NDVI for the 3 datasets. Significant changes (improvement in the vegetation content) can be observed in 2016 compared to the 2014 and 2017 when the NDVI values were significantly lower (having lesser vegetation content) due to more intense summer. The implication of this is reflected in the Surface temperature where the increased latent heat fraction results in lowering of the LST on 6th April 2016. The corresponding Fractional Vegetation Index is also high for the 2016 dataset (figure 2).

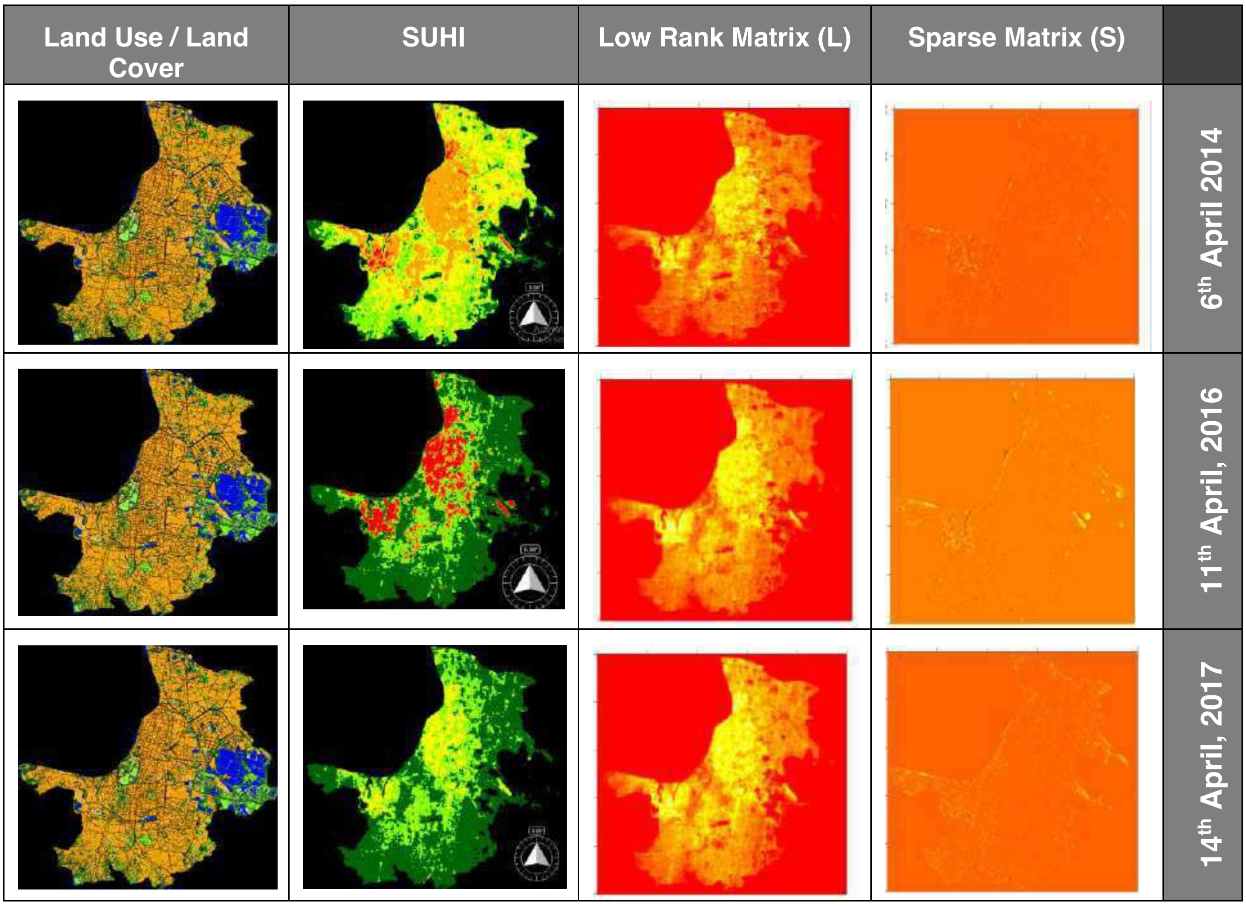

Figure 3: Land Cover, SUHI, Low Rank Matrix and Sparse Matrix of Kolkata Metropolitan Area

4. Conclusion

Low Rank Matrix and Sparse decomposition method can be applied for studying Surface Urban Heat Island (SUHI) phenomena. The temporal data and can be segregated into Low Rank or background component, which depicts commonalities between the time steps and Sparse component, which depicts the dynamic changes in terms of SUHI. The Sparse Component corresponds to changes in SUHI manifested due to changes in either or all parameters of emissivity & albedo which are characteristic of building materials and paved or natural surfaces and built form geometry which signifies re-densification and sprawl or intensification of energy use such as industrial activities or heat emissions due to adoption of cooling or cooling systems.

Thus low rank and sparse decomposition method is a very effective tool to study urban growth and its impact on the s u h i phenomena. this method can be implemented for Big Data Analytics of large volume of satellite derived surface temperature information at a global scale and detect anomalies and device strategies to control and mitigate the effects of these changes.

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Climate Change and the Impacts on Urban Planning and Design in Iranian Cities

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Abstract

Climate change is a key challenge 21th century that many countries are facing with and everywhere has different consequences based on local characteristics. Referring back to the substance of the century as century of cities, it's time to do a paradigm shift in urban planning and design. Such transformation in urban planning and design thoughts is critically needed in those countries which has a background of climate change geographically and historically. Iran is one of these countries that is touching the effects of climate change. Having different microclimate in the country, the challenge has been emerged in different face.
This article, first, is trying to elaborate the challenges resulting from climate change in Iranian cities and second assess the consequences and effects on everyday life of cities. Then, the text is directing to the introducing new solutions which is relating more to the process of urban planning and design.
As a methodology of the research two cities Tehran (the capital) and Ahvaz (the main reference city of dust storm) will be analyzed based on content analysis of official documents, environmentalist ideas and public opinions in social networks media. Also, some evidence of historical urban innovations adapting climate challenge will be analyzed based through case studies of Isfahan and Bushehr.
Some results demonstrate that complexity of climate challenge is more in metropolitan areas of Iran because combining the challenge with social challenges. Also, it is needed to change educational dimension of urban planning and design at universities, institutes and urban government section relating to climate change. To accelerate urban change according climate change, Iranian cities needs more engagement of people and urban-based NGOs.

Keywords: climate change, Iran, urban planning, urban design

1. Introduction

Starting period of 21th first century is an inspiring and disappointing ear for cities. It's a paradoxical situation because of the role of cities as main places of living, economy, and creativity and innovation one hand and crucial places for living, health and happiness because of complex, continuous and increasing challenges. Climate change is one these challenges which is encompassing and surrounding all of other challenges. Somehow it's more critical and essential than others. Such challenge is effecting on cities because of changes out of cities in regional, national and global level and also it has creating because of changes resulting of human actions in urban spaces and architectural level. Cities of this century tend to be extremely resource intensive and contribute hugely to increases in greenhouse gas emissions and consequently, climate change.
The impact of urban systems on climate change is illustrated by the fact that 75% of all greenhouse gas emissions are generated in the world's urban areas (UN, 2007); while only approximately half of the planet's population live in closer settlements. In other words, urban systems are a principal source of emerging climate threats (ESPACE, 2008 and Shalaby & Aboelnaga, 2017). The Third Assessment Report of the 'Intergovernmental Panel on Climate

Change' (IPCC) brought world attention to the likely impacts of climate change (Metz 2001). Climate change is now at the forefront of debate with dire warnings that worldwide temperatures may rise from 5 to 11 degrees C. over the next 50-100 years (Blakely, Edward, 2017) The extent of future climate change depends on a number of variables including the pace of greenhouse gas emissions, deforestation rates, and the response of ecosystems to the changing climate (Jeremy G. Carter. et al 2015) The specific effects of climate change on urban systems will vary depending on location, but may include reductions in potable water, more regular and severe weather events such as heavy rain-falls and cyclones, increased incidences of flooding, inland storm surges and an increase in extreme heat events.(Shalaby & Aboelnaga, 2017)

Referring back to the nature of climate change, the challenge is connecting local and global level of thinking on cities coherently which is opportunity and threat in the same time. Despite this role of climate change, knowledge of urban planning and design as a main discipline related to everyday life of cities is not well equipped. While urban planners are mostly seen as responsible and capable of adapting to disasters and climate risk (IPCC, 2007) their role, the actions to be accepted, and the responsibilities of city agencies are often unclear (Greiving & Fleischhauer, 2012). From urban design point view despite the discipline is the most effective discipline on urban form, climate change is not a key issue in urban design practices. This weakness can be seen also in urban planning and design pedagogy, so that's why we need a massive change in urban planning and design thoughts in the era of climate change.

Such need is more emergency and critical in the cities which have a prior context of climate change geographically and historically. Middle-east countries like Iran has this background from ancient times that's why we can see urban and architectural innovations adaptive to climate in Iranian cities during the history. We have different climate in Iran and the effects of climate change on cities in each climate are different. Mostly water tension or aridity is a key challenge for most cities of Iran especially those are in the deserts.

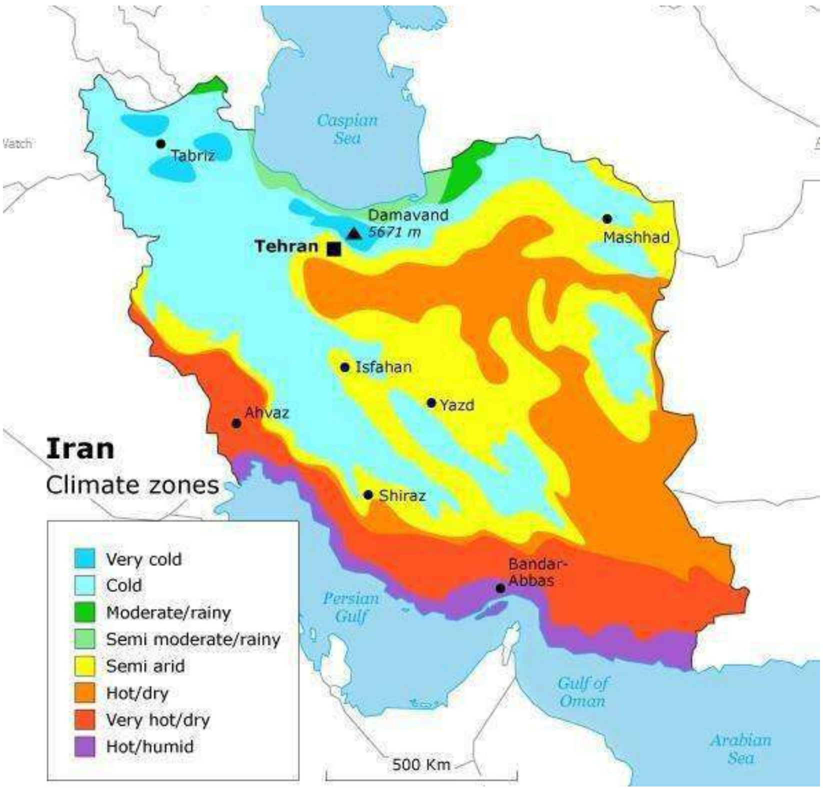

Figure 1: Climate zones of Iran (Alizade Govarchin Ghale, 2014)

But it's not all, there is another face of the challenge when we look at the water conflicts in the Middle East and the results are emerging in Iranian cities in the form of dust storm. For example environmental changes in Iraq including disappearing ponds effects on south-west part of Iran in the form dust in Iranian cities. Moreover, inappropriate national and regional policymaking in water management in Iran has created new challenges locally for instance the salt storm in north-west of Iran because of water tension of Uremia Lake. Adding everyday challenges related to pollution, traffic, quality of life, etc. especially in metropolitan cities of Iran, it's time for Iranian cities to make new decisions. Looking to Iranian cities situation according to face climate challenges in modern era especially in recent four decades reveals that they are directing in a way versus their history. With the enrich background of Iranian cities, they can recognize, recreate and regenerate facing climate change challenge.

This article is trying to highlight the climate change challenges in Iranian cities from urban planning and design point of view. After analyzing the impacts on urban spaces and everyday life, beyond formal and physical solutions like increasing green areas of the city, the article introducing approaches to change the way of thinking urban planning and design of contemporary Iranian cities.

2. Methodology

As a first step two case studies have been chosen to show the historical background of climate adaption knowledge in Iranian cities. Isfahan is one of these cases which is notable because of intelligent distribution of water in the city. The other one is Bushehr which is significant because smart design of city according to wind in sever hot humid climate. The goal of this analysis is demonstrating Iranian people awareness of mutual interaction of climate situation and form of city. The content analysis of selected previous studies is main method in this step. The second step of the research is concentrating on two contemporary cities in which the effect of clime change is crystal clear in different faces. Tehran (the capital) is first case in which we can see the effects of urban planning actions on intensification of climate change impacts. Ahvaz, the center of Khuzestan province, is the second case in which we can consider impacts of climate change happening out of the city in regional level but affecting on everyday life people. Content analysis of official documents, environmentalist ideas and public opinions in social networks media are methods in this step. These combination of case studies provide a basis to think about future of Iranian cities in climate change era.

3. Discussion

3.1. Urban innovations adaptive to climate in the history of Iranian cities

- **Isfahan; "Madi" an innovation of flowing water in a desert city**

Isfahan is a city in the central desert of Iran. Nowadays, Isfahan is one metropolitan cities of Iran in which water tension and aridity have caused a lot of changes. The river as the main element of city during the history has no water because of establishing a dam on the river. Water transferring projects from the source of Isfahan river (Zayanda-rud) to other cities in desert like Yaz has been effected on current situation Isfahan. In other word human intervention in ecosystem intensified climate change effects which in Isfahan mostly reflected in lack of precipitation. The climate situation of the city has not been changed a lot but human thinking about urban and regional planning of the city has been changed enormously in comparison to Safavid period (17^{th}-18^{th} century) when a scientist implemented a plan for flowing the river water in the city. He introduced new water ways with the name of "Madi" which was part of a greater plan of irrigation. Madi-s had a role of channeling water from the river into the city and its main elements like mosques, public baths and private houses. They were also used in cultivating fields and orchards (Falahat, 2014). Different studies have been analyzed the effect of Madi-s on urban structure of Isfahan in different periods where most of main elements of city like mosques, gardens and square have been shaped according to Madi-s direction. (Falahat,2014and Namdarian, 2016) From perspective of thermal comfort we can understand the unique impacts of Madi-s in urban spaces of Isfahan coherent with the impacts on aesthetical qualities of urban spaces. Nowadays, most of Madi-s are empty of water and we need to refer back on the thoughts behind Madi-s such as urban- evironmtal planning and design and multi-knowledge urban planner and designers.

Figure 2: (left) Madi-s and some of main urban and architectural spaces of Isfahan (Namdarian, et al., 2016), (right) creating special urban spaces in a desert city based on Madi-s

- **Bushehr; climatic urban design from site selection to architectural details**

The Northern side of Persian Gulf has a special climate which is hot and humid. The average humidity is 70 percent and the temperature increases to 40 centigrade between May and July. The old Bushehr somehow is a contemporary city in comparison to long history of Iran. The city has been created around 300 years ago with a special plan to tolerate the effects of such climate on everyday life. We can see clearly climatic design initiatives according to wind in old Bushehr. The unique value of these initiatives is related to a deep connection between public and private space to use wind. It has caused a unique townscape in old Bushehr. In other word there is a hierarchy of climatic design respect to wind from whole city to buildings. Different ways of using maximum wind have created a visual diversity in urban facades (Ranjbar, et al.2011). The urban innovations regarding climate condition in old Bushehr can be summarized in these points:

- The location and site selection of Bushehr as a peninsula is a first step to catch wind in the city. In comparison with linear form of city it is more complicated to conduct wind into the city but the amount of wind is more. The special urban open spaces network has changed this threat to opportunity of catching maximum wind.
- According to effect of topography on wind flow, Bushehr position has a windward topography.
- With regard to climatic effects of density and height of built up area old Bushehr has an appropriate roughness that creates dentate texture in the face of wind flow in the sky. This specific height distribution provides the context for more wind disturbance and conduction of it to lower level.
- According to locating high-rise buildings among lower buildings, review of plazas in old Bushehr present this principle. The height difference sometimes is four floors.

- Location of high building at the edge of plazas in Bushehr conducts regional winds to pedestrian level and specific form of plaza provide more movement of wind and its distribution to streets that connects to plaza.
- Specific design of streets in Bushehr like their orientation, special profile, wall projection at first floor, special facad design, organic form, etc. increase the wind disturbance in main streets and alleys.
- There are a few dead ends and buildings have four side that relates to open space. So each side can catch different winds in different directions.
- The external walls of buildings in Bushehr are climatic facades. Different forms of windows, Shenshirs, Boons, etc. shows various methods of absorbing and conducting wind into residential spaces.

So, old Bushehr is an important case that presents a maximum use of wind for creating thermal comfort in both urban public spaces and residential spaces. The next importance is mixing these climatic designs with specific customs and daily life. (Ranjbar, et al.2011)

Figure 3: old Bushehr, smart design of a city where a climatic design integrated with townscape design and everyday life planning

These two case studies of Isfahan and Bushehr show the record of Iranian cities mitigation with difficult climate condition all over the country in the history. It means there was local knowledge about adaptation to climate because in the history general people were urban planner and designers. So a big question is rising that what happened in these days that Iranian cities are not so successful to mitigate and adapt to climate change? In other word there was a culture of mitigating climate changes in Iranian cities which we need to remind the memory of people about this culture. The next two sections analyze contemporary mitigation with climate change in two cities of Iran to provide a better context of comparing past, present and future of Iranian cities regarding mitigation and adaptation of climate change.

3.2. Tehran; an urban lab for environmental challenges

Based on our living experience in Tehran and data from virtual social networks, from a decade ago one term has been fixed in everyday dialogue of people of Tehran which is the air quality. Mostly in winter time when the inversion phenomenon is accruing more. Having 200 polluted days in recent years of Tehran highlights the environmental challenge of Tehran. Researches on the effects of climate change on Tehran microclimate reveals these change in different classification (Saligheh, 2015):

- Air stability
- Increasing average temperature
- Changing pattern of wind flow

These consequences of clime change have been intensified because of urban planning actions especially in terms of mobility plans and land use planning. Death rate resulted from air pollution around 4800 people a year, shows the impacts on health and everyday life in

Tehran. Through different researches the effects of urban planning actions on creating urban heat islands in Tehran has been understood. In other word, urban changes inner the city intensifies the climate change impacts. Looking at to the data of Tehran Municipality tell us that during the recent 12 years, highways has been developed from 304 Km to 548 Km with 80 percent growth. In comparison to pedestrian public spaces area, the data about highways show a parallel planning policy that is not consistent to pedestrian mobility. (Ranjbar&Motalaei, 2017) Critics are raise up when we look at Sadr's Elevated highway. A lot of money has been spent on the project that it was better to use such resource for developing public transport. Ranjbar & Mashhadi Moghadam (2017) research " Upgrading urban highways: issues and negative impacts based on a case study of Sadr's Elevated highway" results showe the highway has significant negative impacts in ecological dimension, including air and noise pollution and energy-consuming parameters. Versus the highway projects, developing pedestrian spaces and zones in Tehran has been increased during the last decade and it has been successful, but it's not sufficient for an 8 million inhabitant city. According to Samavati & Ranjbar (2017) research "The Effect of Physical Stimuli on Citizens' Happiness in Urban Environments: The Case of the Pedestrian Area of the Historical Part of Tehran", pedestrianization of the area has been effective in overall happiness. So, there is a need to dramatic change from car oriented mobility to clean types of mobility in Tehran. Tehran Municipality planning policies regarding to climate change in recent decades are paradoxical. This can be related to lack of a comprehensive plan mitigating and adapting climate change issue. Lack of a comprehensive mobility master plan is affecting in this way. It's time for Tehran to make a new decision because each year the air quality is decreasing. The case of Tehran is a significant urban lab which confirms the interaction of urban planning and design policies and climate change impacts. Besides doing researches to scrutinize this interaction, there is a massive need to change urban government thoughts which is the main problem of creating such situation.

Figure 4: comparison of a clean day and polluted day in Tehran, 2015

3.3. Ahvaz; maximum impacts of climate change on quality of life

Looking at virtual social networks in Iran like Twitter, Facebook, Telegram, etc. brings up climate change issue when a name is repeating; city of Ahvaz. Around 50 million Iranian people are active in virtual networks. Comparing with total population of Iran (80 million people) a repetitive issue can explain their concerns. The case of Ahvaz completely stimulated Iranian people about climate change impacts. Ahvaz is not big as Tehran, the city has 1.3 million population but the impacts of climate change somehow is more severe than Tehran. We can see the effects of climate change in terms of dust and sand storm which is coming into the city from the sources out of the city. The immigration statistics of Iran shows Khuzestan Province is on top of main regions which are losing their population. There is not 100 percent reliable research which shows the source of dust storm in Ahvaz but speculations introduces aridity and drought as a main source. This face of climate change has created land without green coverages as hotspots of dust and sand. Also has affected on decreasing surfaces of ponds and lagoons in regional level and international level in Iraq. So, a part of the challenge is in other country which is creating a hard situation to mitigate the problem. The effects of such phenomenon are a part of everyday life of people in Ahvaz. Staying long time at home, loosing electricity because of dust effects on urban electrical facilities, closing schools, changing detail of windows and doors, using masks for breathing, etc. in warm days that Ahvaz is experiencing 50 centigrade degree a non-place is creating.

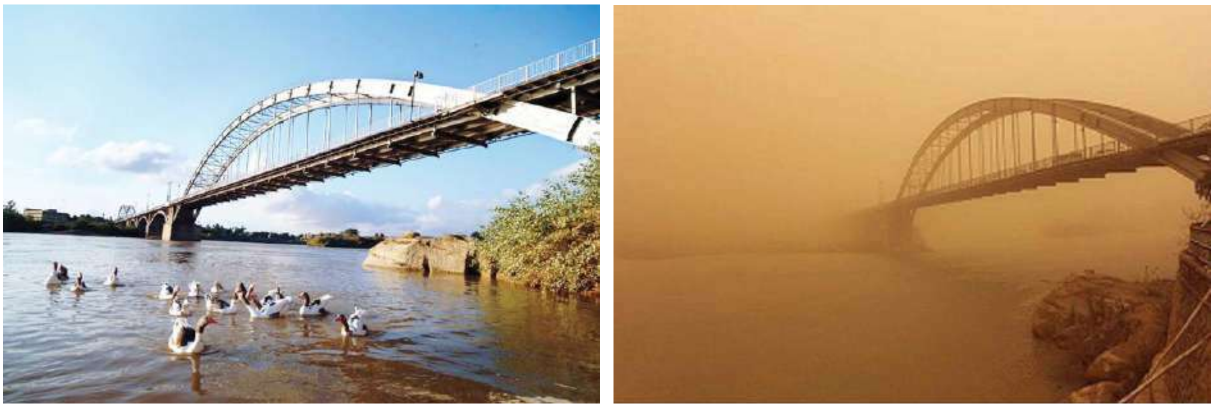

Figure 5: comparison of a clean day and polluted day in Ahvaz

What urban planning and design can do in this situation? Although with some solutions we can adapt the city to this change but the case of Ahvaz introduce a new perspective for urban experts to think in a wider context, to broaden their minds, to have comprehensive knowledge and to be more intellectual for walking beyond classic, formal and temporary solutions. Thinking on Ahvaz can be a valuable opportunity for other cities of the world to mitigate such effects of climate change.

4. Results

Seeking climate change impacts on urban planning and design in Iranian cities reveals an interactive dynamins. A fundamental issue which is leading to maximize hazardous effects of climate change in Iranian cities, is an emergent need to provide new urban planning and design guides and laws regarding this challenge. Nowadays, main urban planning document in Iran is “comprehensive plan” which is quite old and classic in substance and process. the nature of these guides is relating back to 3 decades ago. Iranian cities need climate change action plans in level of national regional and international. From urban design point of view, it’s needed to introduce new guidelines in green area management, street design and public spaces quality.

There is no ministry of environment in Iran which is compulsory for saving cities at this time. From educational point of view academic institutions in Iran need to change their syllabus regarding climate change. There is a lack of special course in teaching of urban planning and design discussing climate change in official syllabus. Convergence of urban faculties with environmental faculties in Iran should pursued as a key approach. So, urban planners and designers in Iranian cities should experience a massive change in broadening their thoughts to face urban challenge from international levels to local levels. It means classic education of urban planning and design should change regarding climate change issues.

Moreover, the Iranian Government should work on Iranian people public opinion to refer their origins in history regarding climate change. In other word the “Iranian culture of mitigating and adapting climate change” should be represented. In this way, we need more urban-based NGOs which are rare in Iran nowadays. Recognizing this culture by such NGOs facilitate to spread it out in Iranian people mind. So, more than temporary ideas we need to change people mind because climate change impacts are not temporary. Based on the historical background of Iran, the country should initiate an idea of Middle-east cities alliance to solve the challenges of cities like Ahvaz. It means that climate change mitigation and adaption is an urban-environmental-social-political process in Iranian cities.

5. Conclusion

Looking at the current literature of interaction of climate change and urban planning and design demonstrates more attention to “how to do “not “how to think”. The nature of climate change should be discovered more by urban planners and designers. This phenomenon is removing borders of cities, regions and nations. So, planners mind should be flexible and flowing in these scales. It’s also removing borders of knowledge. Maybe working in a group of planners, environmentalist, social experts, etc. is a good idea but it’s not enough for urban planning and design in climate change era. Planners and designers should sit on the center of environmental knowledge to be able to have innovative and long term solutions. It means it’s time of paradigm shift in urban planning and design theory regarding climate change because environment is encompassing cities whereas urban planning and design discipline is more concentrated what’s happening inner cities. Also, in the current literature the impacts of climate change on urban planning and design are general. We need to analyze more especially in urban design level where real life is happening. Urban design as main discipline related to urban form needs such change more than planning. If we should be more pioneer these two discipline should be mixed in form of “urban-environmental design”. New urban qualities should be introduced because of tangible impacts of climate change on urban spaces. It means starting a new urban knowledge. From administrative point of view, we should start a practical “Cities Alliance Mitigating and Adapting Climate Change” (CAMACC) because it’s a massive and enormous issue.

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Climate change impact in Andean cities in Bolivia: the Tiquipaya case and a community led New Urban Agenda for resilient planning

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Abstract

According to several UN (FAO Aquastat) featured studies, Bolivia belongs to the twenty countries with the highest renewable internal freshwater resources per capita and total renewable freshwater supply. Paradoxically, the rapid glacier retreat in the Tropical Andes is compromising the fresh water provision in many important urban centres in the middle term, including the large cities of La Paz and Cochabamba. The beginning of the rainy season during the last austral summer was again marked by several natural events in some of the most fragile urban and rural areas in the mountainous as well as plain regions. One of these events was the flash floods in Tiquipaya, Cochabamba. In this paper these elements are described, analyzed and possible solutions are proposed.

Keywords: climate change, vulnerability, land use, new urban agenda

1. Introduction

The rapid glacier retreat in the Tropical Andes of Bolivia is compromising the fresh water provision in many important urban centres in the middle term, including the large cities of La Paz and Cochabamba. At the same time, changes in the rain patterns in practically the whole country are causing severe damage to agriculture, farming and urban infrastructure, compromising as well the production of food, an economic branch in which more than 60% of the population works. Climate experts of the Global Atmosphere Watch monitoring system coincide in that Bolivia and other Andean countries are in urgent need to implement effective measures to improve their resilience to climate change impacts (Hoffmann, 2012). The recently adopted Habitat III New Urban Agenda is an example of what these measures should imply schematically. But what can this imply in practical terms is such a poor and vulnerable country?

The Tiquipaya flash floods is considered by the author very symptomatic. It is the result of the mixing of several elements, most of them human made, into a chain of events that resulted in a foreseeable tragedy for locals and destructive for their infrastructure. These include insufficient management of a fragile system of watersheds, human led destruction of natural ecosystems, overuse of agricultural soil, reduction of soil permeability, and a permissive (perhaps corrupt) attitude of authorities to settlements in vulnerable areas.

This paper discusses the threats caused by uncontrolled changes of land use in these fragile ecosystems, which are specially exposed to climate change impact. It discusses how it may be possible to implement effective impulses of the New Urban Agenda, some of them corresponding to traditional communal collaboration uses in this region. As well it suggests how low tech landscape and urban design measures should be incorporated to improve resilience and commit authorities and the local population to cooperate to reach results.

2. Climate Change Effects in Bolivia

Bolivia can be divided into three topographical regions: Andean, Subandean and Plains regions. They feature different average precipitation rates: Andean 500mm, Sub Andean 950mm and Plains 1870mm. The endorheic basins of the Altiplano region around Titicaca lake have a higher ETP (potential evapotranspiration) than precipitation, indicating vulnerability to water scarcity in these regions. According to a government study from 2007 (Ministerio de Planificación del Desarrollo, 2007), climate change will also contribute to glacier melting in the endorheic basins area.The fresh water availability per capita and year is 160m³ (year 2000), comparable to the one in Norway, one of the highest in the world. Therefore Bolivia is considered a world fresh water reservoir.

A World Bank study from 2013 based on remote sensing data, primary data of 268 weather stations and modelled climate change impacts on water balance identifies regions with potentially critical water availability. It recommends a "countrywide integrated national plan" for improving watershed management (Escurra, 2013). The study confirms that the mountainous regions may experience draughts and the lowlands floods. The data indicates a temperature increase 0,11℃ per decade in the Andean region of Bolivia, which is 0,05℃ higher than the global average.

In general terms, the World Bank funded study concludes that climate change will have an impact in both dry and wet scenarios, a decrease of average renewable surface water in the Altiplano and an increase of floods in the northern plains of the country.

To understand the effects for the poorest population of the country it is worth to mention that forty percent of the main water collection surface and water sources are concentrated in rural areas in Bolivia. Around 60% of the population depend from these resources in agriculture and food production, and here also most of the poor population is concentrated.

2.1 Climate Change Effects on fresh water availability in the Cochabamba region

Cochabamba and its surrounding valleys are a visible example of how rural poverty and poor watershed management are correlated.

The geology of the valley of Cochabamba will be described in the next section, but climate change effects can be named here.

- Secondary rivers' waters rarely reach the Rocha River during the dry season. Rocha is the main river in the central valley of Cochabamba;

- Lakes in the lower sites of the central valley, together with lagoons on the Tunari Cordillera are today water reservoirs. Some of them dry out during the dry season.

- Calculations of the beginning of the 2000s predict an overall deficit from 2015 onwards, which should be covered by the extraction of underground reservoirs. The cities in the mountains in Bolivia have been consistently served by glacier melting water. Climate change puts this balance since many years under threat.

- The public company SEMAPA has no other option but to purchase water from community reservoirs during the driest months of the year. Yet some of the distribution ducts are in bad condition and water drains into the ground before reaching treatment plants.

3. The Cochabamba valley, its environment and water situation

This section describes briefly the background mix of elements, some of them natural, some of them human made, that summarize the current technical, geological and environmental framework of the water provision in the metropolitan area of Cochabamba. These elements include the geology, geomorphology, rural poverty and insufficient water management and infrastructure. The social aspects and the commitment of the local population in the water issue can be described through the Cochabamba Water War of the year 2000. Further on, the Misicuni dam has to be mentioned, which can be understood as light at the end of the tunnel, but not yet the final solution.

3.1 Geology and Geomorphology of the Valley of Cochabamba

The valley of Cochabamba is geologically a very interesting setting. For long periods of time, this tectonic basin was occupied by a lake. It contains distinctive sediments in the deepest sites. The deepest point is 2470m, the highest is mount Tunari at 5030m. The average central basin plain height is 2600m.

Regrettably, literature with detailed information about the geology of the Cochabamba valley is very limited. This section is based on a study financed by the German Bolivian Agreement on Groundwater published in 2000 (Renner & Velasco, 2000).

Regarding its geomorphology, the central valley can be divided in three zones: (1) a mountainous zone, with high peaks and deep slopes that are prone to originate landslides and rock material that is carried down to the valley; (2) a zone of slope and piedmont, with mostly coarse grained material with high hydraulic permeability, coarser in the higher areas at the mountain edge and finer in the lower areas down the valley; and (3) a plain zone with older sedimentation, fluvial lacustrine deposits, fine materials where most populated areas are located. These areas are swampy and contain salt efflorescences.

Consulted Landsat imagery shows some alluvial cones or fans that are produced by stormwater carrying sediments and flowing at high speed due to the deep slopes. Under these cones water deposits have evolved as important reservoirs. (See document graphs and charts (Annex): rivers in the valley; geological map; schematic geological section; sediments map).

The zones of slope and piedmont and some central parts in the basin are important groundwater host formations. They contain complex multilayered aquifers with confined and semi-confined characteristics. However, not all these reserves are favourable for exploitation of fresh water.

3.2 Water balance and management in the Tiquipaya basin

All water provision systems in the Tiquipaya basin are used for crops irrigation, except the water from deep wells, which is mainly used for consumption. Outside the urban areas there is an important community involvement in irrigation water management. One example is the community water distribution of the river Khora called Machu Mit'a. This is one of the only rivers with a permanent flow throughout the year. The Machu Mit'a isi used to manage also lagoons, dams, small reservoirs and distribution trenches. The locals distribute water as equally as possible but use superficial irrigation, which is considered less efficient. The availability of water has dropped according to records since 1986.

There is also a growing number of private wells in the valley area and overall water scarcity. A study from 2004 estimates a deficit of 2 to 4% in ground water recharging every year (Sáenz et. al., 2005). Therefore management and water storing capacities need to be improved.

The economy in the rural Tiquipaya region is based on agriculture (mainly potatoes, quinoa, barley, beans) and cattle growth (sheeps, camelides). Sewage, drink water and electricity service is practically absent. Only the rural neighbour cities of Titiri and Totora have primary schools.

Even though the Cordillera of Tiquipaya has available water resources, they don't cover the demand of intensive agriculture. Urban developments are more profitable, which contributes to urban sprawl. Studies and infrastructure development for agricultural water provision did not change this. With new urban developments poping up in the area, the demand for domestic water and the need for sewage infrastructure will increase considerably in the next decade, which represents a serious challenge for planning and environment.

3.3 Cochabamba's water war of 2000

Cochabamba, neighbour municipality and the capital city of the department to which Tiquipaya belongs, witnessed the well remembered Cochabamba Water War in February 2000.

Bolivia's hyperinflation crisis of 1985 led to the adoption of last instance economic measures taken to avoid economic meltdown, most of them forced by global financial institutions, the World Bank being the main player. Among these was the privatisation of pivotal state assets, such as railways, communications, and hydrocarbon and aviation corporations.

As single bidder, an international consortium of construction giants and a minority of Bolivian investors acquired a 40 year concession to provide drink water, electricity and irrigation for agriculture. They were guaranteed 15% annual return of investment, adjusted to the US consumer price index. The subsequent law that was necessary to regulate the concession and the first contract executions of the company caused substantial social rejection. The unwillingness of government and company executives to negotiate a settlement heated up the tension to an extreme. After weeks of strikes, clashes and a toll of at least six deaths, the concession was revoked.

Cochabamba's water war is today a symbol of Bolivia's government traditional anti globalisation rhetoric, supported by the majority of the population. It was at the same time a platform for several work union leaders who joined years later current president Evo Morales in power. However at the same time it represents the failure of political leaders to find solutions, because the fresh water provision is still insufficient and the management poor.

Since then, the public water company SEMAPA has severe difficulties to negotiate credits by financial institutions.

According to last census data, only 46% of the urban population has a connection to the drink water services, the rest being serviced by cisterns to a much higher end user price.

3.4 The Misicuni Dam, some light at the end of the tunnel?

The Misicuni dam and complimentary infrastructure is a reservoir with connected turbines for electricity generation and provision of fresh and irrigation water with a capacity of around 800M m³ in its main dam.

The planning started in the early 1960s and could not be completed until 2017 for diverse financial and technical reasons. The installed generation capacity is 120MW and the projected fresh water provision for the region of Cochabamba is 1200l/s. Misicuni is meant to solve the water scarcity problems of the region for the next decades.

Misicuni was never considered financially viable, which made it nearly impossible to acquire credits for completion. Eventually, available cash from the revenue of natural gas exports and a redesign of the infrastructure to incorporate electricity generation improved the success perspectives and the project was concluded with national funds. Today the dam is serving for irrigation purposes and delivering energy to the national network. It does not provide fresh water for household consume because of a lacking proprietary pipe connection and missing capacities in existing treatment plants.

4. The Tiquipaya Flash Flood Disaster

The Tiquipaya flash flood of sixth of February 2018 occurred after a sequence of days of rainy weather that saturated the soil in the upper areas of the Tiquipaya Cordillera, which eventually collapsed as landslides. The accumulated sediments slid down to the valley covering streets and buildings very early in the morning, surprising most victims in their sleep.

But this is the short sight version of the story. A more detailed perspective reveals a series of elements, which combined generated an explosive cocktail. Because of the awareness about the fragile geology of the Tiquipaya Cordillera, as described in the previous section of this paper, and the ongoing deforestation, reduction of permeability and indolence of local authorities towards settlements in vulnerable areas, the Tiquipaya flash flooding and its outcome was a foreseeable event.

Nonetheless it is fair to mention that proprietary measures had been implemented long before the area became populated. Around 30 years ago, the watershed management was implemented by the PROMIC initiative. PROMIC was a watershed management project initiated by the Belgian development programme in Bolivia. It was established in Cochabamba in 1990 and discontinued its cooperation with Bolivian authorities in 2009. It was replaced by a local office called *Servicio Departamental de Cuencas*. It focused on five of the nine watersheds within the Tunari Cordillera.

According to PROMIC project descriptions, the Tiquipaya watershed area (27,23 km²) has suffered soil degradation and erosion in its higher streambed, which increases the risks of floods in the valley flats. Even though floods occur every year, the situation becomes more critical with the growth of illegal settlements and uncontrolled change of soil cover (Méndez Torrico, 2004).

Erosion in productive soils in the Tiquipaya Khora watershed is caused by inadequate soil management (high pressure on natural resources) and poorly prepared crops on inclined grounds. The natural and irregular topography intensifies the erosion process because of steep slopes, since only 10% of the topography has a slope under 18% (10°=. A reform of land ownership regulations adopted in the 1990s and its consequent land use changes meant a loss of 10% natural vegetal coverage, and half of the naturally dense grass cover was also lost. Agricultural productivity has still dropped due to bad quality seeds, inefficient water management, uncontrolled firewood use, lack of adequate technology, insufficient road connections, pests/ parasites, etc.

4.1 Aftermath reactions and analysis following the Tiquipaya event

Experts coincide that since 2009, when the cooperation contract with the Belgian project PROMIC finished, the watershed monitoring was not continued by the local authorities, thus the risks were not detected.

The unstable topography of the 39 micro watersheds of the Tunari National Park is acknowledged and a constant monitoring is mandatory to prevent disasters. A logical task in zones like this is to manufacture a risks map. This was not undertaken by authorities (Mazaneda, 2018).

The Tiquipaya flash flood from 6th of February 2018 killed five and damaged or destroyed 122 houses, most of them built in buffer zones along the river, which were foreseen as washland in the urban plan of 1981. Despite of existing regulations, some buildings had received build permit, a fact that may be related to corruption and land trafficking (Callapa Cabezas, 2018). One of the experts of the local engineers association warned about corruption tainted watershed management and irresponsible decisions taken to serve political interests. Despite of identified urban developments within washland areas, permits were issued in favour of political support (Carrillo, 2018).

5. Analysis and suggested interdisciplinary solutions in different domains

Water is no doubt a complex matter of multiple dimensions in Cochabamba, and not only there. As mentioned before, the recommendations for an improvement of conditions for water provision, environmental protection and soil consolidation need to be based on a common vision and combined measures. This means that authorities, citizens, farmers and other stakeholders need to hold an interdisciplinary collaboration that aims to create integral plans of operation.

The interdisciplinary discussion should contribute to elaborate integral strategies for improvement in at least three different levels: Agricultural areas, Tunari Natural Park and Urban setting.

The World Bank study mentioned before summarizes the importance of solving water issues in Bolivia because of four reasons: self reliance, increasing population regionally oriented economic development and preservation of local identities (Escurra, 2013).

The same study also warns that the increase on CO_2 concentration in the atmosphere will affect the canopy conductance negatively, leading eventually to an increasing annual river discharge by 3 to 16,5%. This confirms that green coverage reduction contributes to reducing evapotranspiration and floods.

5.1 Rural areas, Agriculture and Farming

The above mentioned PROMIC programme suggested a series of measures that should be implemented and would have a large impact on different issues (see annex table/ matrix).

Additionally, a constant erosion control would create long term jobs for local population in activities such as construction of chipas (gavions) for terrain strengthening, retention dams and water distribution trenches and general maintenance work.

Past examples in the area have shown that a proper watershed management has to start at the source of the basin up the mountain, instead of trying to mitigate effects in the lower valley. As well it is important to improve the framework conditions for a smooth implementation of activities. Because of bureaucracy and slow implementation, not all the objectives of past projects were met.

Previous changes in water and soil management techniques did improve productivity and soil quality. This was corroborated by local farmers, who obtained higher yields (2x - 4x) and benefited by more affluent water springs. This pays back any efforts.

Proposed Improvement measures on rural areas of the Khora Tiquipaya watershed would benefit as well from measures undertaken in the Tunari National Park (see below).

A proper Management/ recovery of degraded soil will:

- reduce superficial soil loss (humus),
- control water flooding energy/ flows of stormwater using cross-cutting dams built with rubble and timber,
- strengthen slopes and banks mechanically and with vegetation,
- speed up natural regeneration with the use of native species.

5.2 Soil consolidation and forest regeneration in National Park Tunari

The National Park Tunari has to establish its necessary institutional structure, as well as design a management plan and work on inventories of flora and fauna and protection guides. The park's role goes beyond the natural heritage protection. The impact of the Park in issues such as awareness building and participation can be crucial for the general soil and air quality preservation in the region of Cochabamba. Proper protection measures are necessary to control the urban sprawl of neighbour municipalities, especially Cochabamba, and also to use the chance to bring environmental education to a broader population.

More than that, the Park is an asset with opportunities for economic activity in areas such as eco-tourism, adventure tourism, science, sport and leisure activities, etc.

The University of San Simon in Cochabamba used freely available remote sensing data to count bush and forest fires of the last 10 years. The number of fires doubled in the last five years to about two hundred per year in average. Among the reasons are lack of control, slash and burn clearing techniques and negligence (Challapa 2, 2018). Forest fires at the edge to urban areas have as an effect an increased number of informal settlements that can barely be controlled with reduced budget of local authorities. An improved landscape design at the urban edge shall provide clearer boundaries. It could as well motivate more involvement of the population in reporting fire events. Vegetation loss also contributes to erosion and landslides.

Even though these observations relate to the region around Cochabamba, this phenomenon occurs country-wide.

In a newspaper interview, Prof. Ramiro Uriarte Ardaya, agronomist at the University of San Simon, recommends a stepwise reforestation, according to the adaptability of native species to increased altitude. This means more bushes in the summits, endemic trees in the mountain slopes as fauna habitat and decorative native species in the forest borders.

Native species that can be re-introduced, proposed location

- K'apa K'apa (*Lippia boliviana*): aromatic shrub. All heights, especially mountain summits
- Thola (*Baccharis dracunculifolia*). All heights, especially mountain summits
- Moto Moto (*Senna aymara*): flowering shrub. All heights, especially mountain summits.
- Retama (*Spartium junceum*): medicinal plant, deciduous shrub with yellow flower
- Kishwara (*Buddleja hypoleuca*): shrub/ tree with 4m max height. Middle heights, Lower slopes and riverisdes up to 3200 m above sea level:
- Aliso (*Alnus acuminate*): tree up to 20 height, good for city borders and forests at middle altitudes.
- Sauce (*Salix humboldtiana*): along water courses, up to 25m height, landscaping at city borders
- Alamo (*Populus nigra*): it is not a native tree, probably Asian, but it is well adapted and was introduced centuries ago. It grows up to 3500 m above sea level and can be used to cut winds at city borders.
- Molle (*Schinus molle*): evergreen tree, up to 15m height, ideal as ornamental tree at city boundaries with the park.
- Kehuiña (family *Polylepis*): robust shrub that can grow at all heights within the park, it used to cover ancient Andean forests, before extensively being sacrificed as firewood.

Other species already available in the national park to be considered: Chirimolle (*Fagara coco*), Algarrobo (*Prosopis juliflora*), Lloke (*Kageneckia lanceolata*), Chacotea (*Dodonaea viscosa*) K'inhi (*Acacia macracantha*).

A detailed study of existing species and extensive inventories, also for living fauna in the National Park Tunari are necessary to evaluate biodiversity issues and make proper decisions.

5.3 Applying the New Urban Agenda principles to improve Urban design, adaptation and reduction of vulnerability

On the urban scale the strategies to reduce vulnerability have to be integral as well. This relates to the first of five focus areas of the New Urban Agenda (NUA), namely *improving existing urban policies*. In developing countries the boundary between urban and rural zones on the plan is seldom clearly visible on site. In Tiquipaya authorities set in 1991 the elevation contour 2750 as the south boundary between the Tunary National Park and the urban zone. Along the rivers, also the washland boundaries have not been successfully implemented, as mentioned before.

The author of this paper considers that the solution should incorporate strong community participation and start with a horizontal discussion. Neighbours need to understand that they have the right to have a place to settle down as much as authorities have the obligation to make sure it is safe, but this can only happen when both sides cooperate.

Because of slow recharge and the few aquifer recharge sites, diverse studies estimate a deficit in seasonal recharge of 8,5M m³/year in the Tiquipaya watershed area (Saenz, 2005). For this reason, land use in the northern edge of the valley should not interfere water recharge neither threaten water extraction sites. Industrial use with potential soil contamination must not operate here. Agricultural activity must keep the amount of pesticides and fertilizers under strict limits. Contaminated waters must not pass through protected areas and industrial land use must be limited to the south of the valley, where water treatment plants should be located. This is addressed by the second NUA focus area: *designing and applying a solid urban legislation with rules and regulations*.

The buffer distance for the washland areas along the river within the urban limits of Tiquipaya is 60m (at the city outer line), 40m and 25m at its narrowest site, between the center line of the river and the outer border of the washland area. After last February floods however experts recommended increasing the buffer to 90, 60 and 30m (Pimienta, 2018).

Local planners urge to persuade settlers to move away from vulnerable sites or give up areas of their parcels that intersect the buffer zones. Authorities announced instead that settlers shall state to assume responsibility for any personal or material damage in their private property in case of being affected by floods. Proper landscape design and community collaboration can help to persuade more social responsibility in this issue. This point is addressed by the third focus area of the NUA: *Urban Planning and Design* with which locals can identify. Here especially guaranteeing a sustainable use of public space is crucial. The ancient community water distribution management Machu Mit'a is a perfect example.

The absence of reliable information, inventories, digital cadastres, etc. shows also the lack of proper data acquisition and management. Increasing the efficiency of the city implies better information about the existing resources. This relates to the NUA focus area four: *Urban Economy and Municipal Finance*. Also Weather and climate models cannot rely on interpolated data generated with a low density of monitoring stations. It is imperative to increase the number of weather stations extensively in the country to make sure reliable data is available, a better accuracy is possible and climate change effects can be more closely monitored. Only a reliable observation of climate change effects will improve decision making on vulnerability and adaptation.

The fifth focus area of the NUA addresses *local physical implementation*, which groups all the issues mentioned before into a proper preventive and smart planning, which is an investment towards a resilient and inclusive city.

6. Concluding Remarks

In the sense of the NUA, urbanization of the Tiquipaya valley is a logical development that may not be stopped any more. Planners should see it as an opportunity, a *tool for sustainable development* (New Urban Agenda, 2017), which improves social integration and equity.

The Economy in Bolivia has substantially improved in the last decade. Yet there is still a lot to do in terms of basic services, sanitation and transparency. It is urgent to educate, build and invest. And now that the dependency on foreign cash has changed, it is an opportunity to educate, build and invest.

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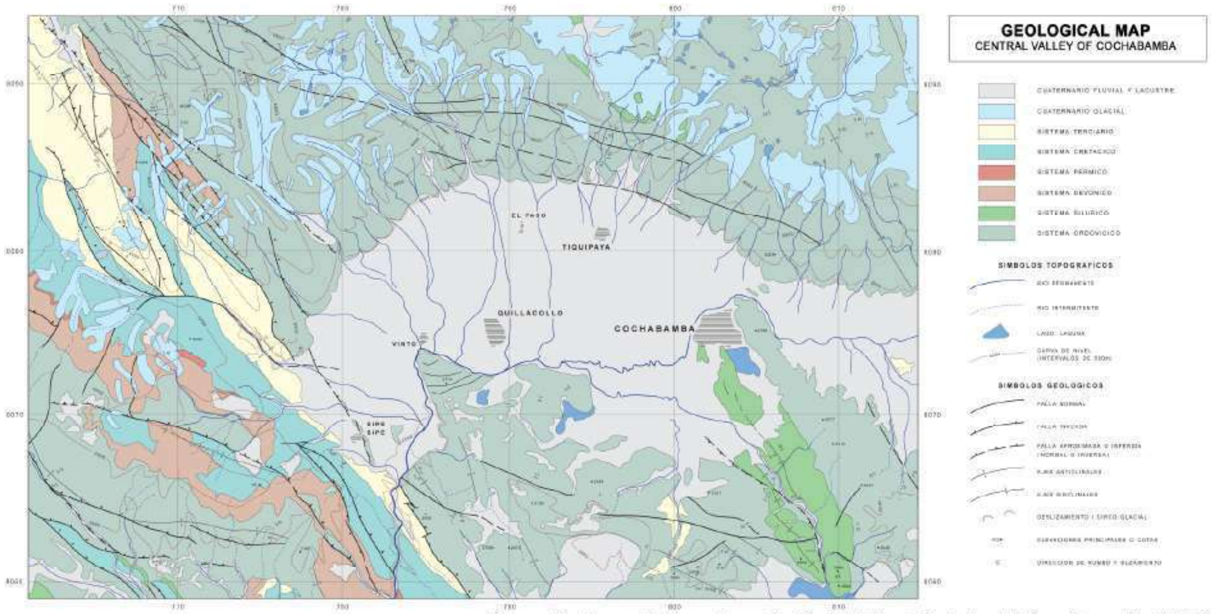
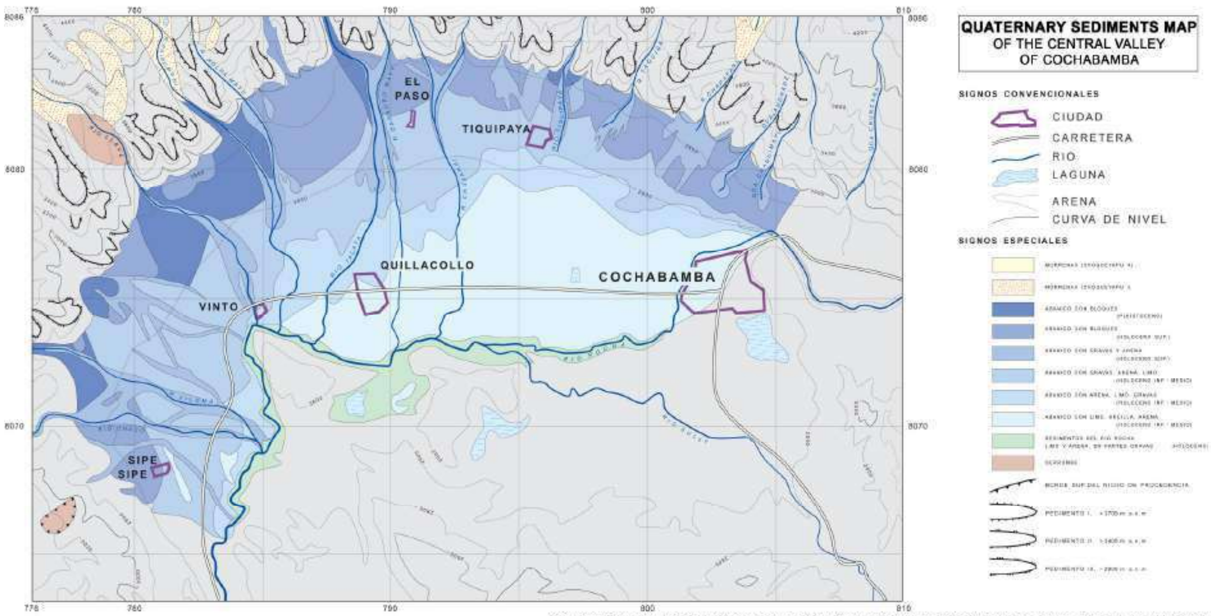
Annex Graphs and Tables



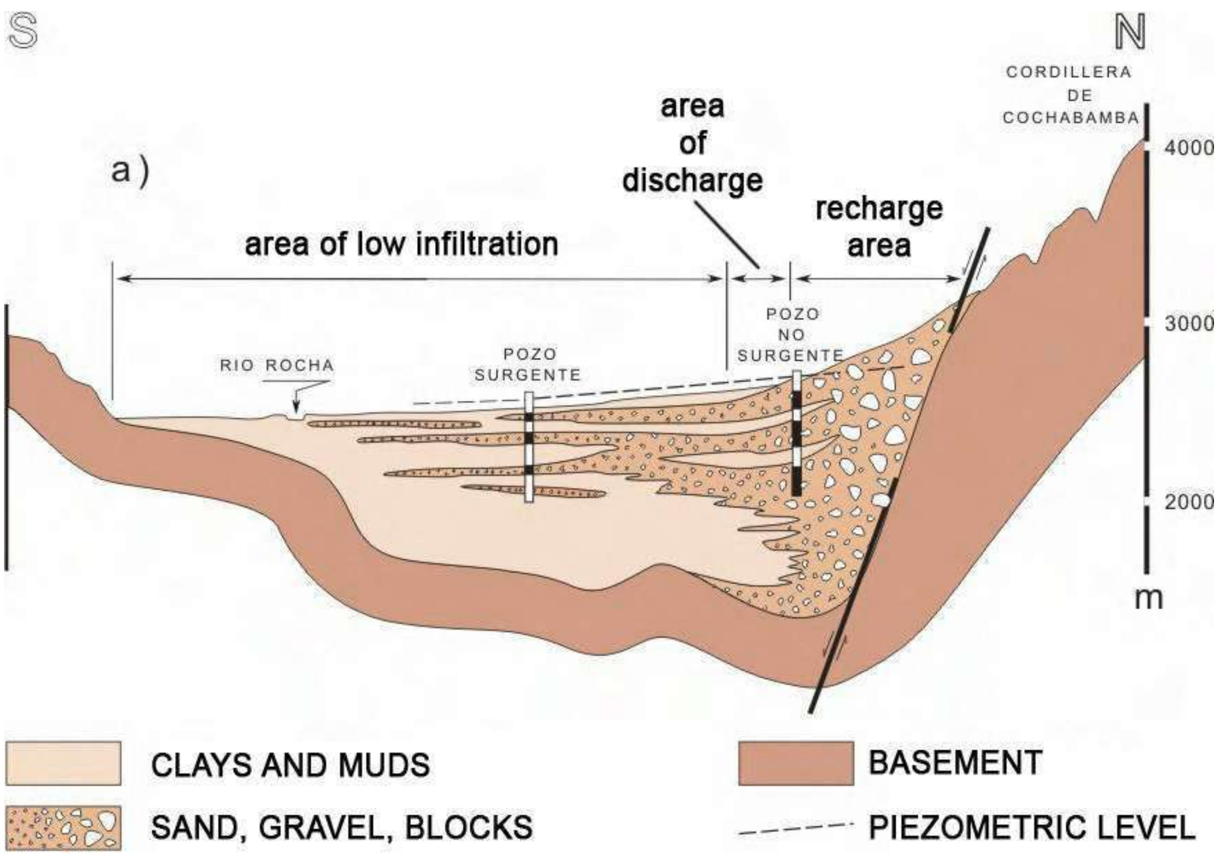
Source: "Geology and Hydrogeology of the Central Valley of Cochabamba", Sven Renner Et. Al. 2000

(1) Map: Geological Map of the Central Valley of Cochabamba



Source: "Geology and Hydrogeology of the Central Valley of Cochabamba", Sven Renner Et. Al. 2000

(2) Map: Quaternary Sediments Map of the Central Valley of Cochabamba



Source: "Geology and Hydrogeology of the Central Valley of Cochabamba", Sven Renner Et. Al. 2000

(3) Section: Schematic section of the Cordillera and Central Valley of Cochabamba

Activities ▶ / ▼ Objectives	Construction of hydraulic infrastructure	Water management	Erosion control	Slopes consolidation	Reforestation	Productive areas planning	Soil management/ conservation	Native grasslands management	Community training	Storm water control
• Reduce soil/ sediments washing	✓		✓	✓	✓			✓		
• Reduce slope erosion		✓			✓		✓	✓		✓
• Sustainable use of farmland						✓	✓	✓	✓	
• Native grasslands recovery						✓		✓	✓	
• Capacity building for farmers on efficient soil use						✓			✓	

Source: PROMIC project guidelines

(4) Matrix: Sustainable productive land management, activities and objectives

An assessment of effective approaches for adapting to the impacts of climate change on urban poor communities to make the urban area more resilient. - Perspective from Bangladesh

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1. Introduction

Climate change is imposing multi-dimensional threat to the humanity (IPCC 2014). This threat is compounding with unplanned rapid urbanization triggered by climatic events and disproportionate development pattern between rural and urban areas (UN-Habitat 2012). In the year 2008, more than half of the world's population started living in the urban areas and this trend will be upwards as per the projection (United Nations 2013). Additionally, majority of this urban population (three-quarter) and most of the mega cities (12 out of 23) are in low and middle-income nations of Asia (United Nations 2011). This extraordinary increase of urban population has been accompanied with high percentage of poverty (Satterthwaite and Mitlin 2013). Low income population living in the marginalized areas of the city faces various threats – tenure insecurity, extreme and variable weather, health risk, temporary pattern of livelihoods (Baker 2012). They are constantly adapting from the 'bottom' with their limited capability which is also challenged regularly by the disaster events and absence of appropriate policy and resource support from the 'top'(Dodman and Satterthwaite 2008).

Climate change is a multi-faced problem risking the cities of global south due to poor infrastructures and high investment agglomeration (WWF 2009). Governments in the global south are still portraying their adaptation strategies neglecting the urban poor (Banks et al. 2011). On the other hand local innovation and social-capital of low-income communities showing promising dimensions to integrate within the mainstream adaptation planning (Boyd and Ghosh 2013; Assheuer et al. 2013). In this study the potentials and drawbacks of 'top-down' and 'bottom-up' approach of climate change adaptation will be explored. The next section will demonstrate the theoretical arguments behind this debate. Pros and cons of both approaches will be investigated. Following that, empirical arguments will be presented largely from the context of Bangladesh. Insights from three field level case studies in three vulnerable cities (Dhaka, Khulna and Chittagong) will be drawn. Subsequent to it, the arguments will be reinforced with the findings of some other case studies in different context and scale. Finally recommending note will be drawn in the concluding section on the basis of both theoretical and empirical arguments recognized earlier.

2. Theoretical Arguments

In political science literature, a top-down method considers that, legislation and policies defined in the top-level will set precise goals and objectives. Through that explicitly provided framework it will be then directly converted into action 'on the ground'. On the other hand, a bottom-up approach addresses the significance of additional actors, other than 'policy makers' at the top, in determining the detailed specification of policies as they interact with one another in congested policy spaces and are finally implemented (Elmore 1979 cited in Urwin and Jordan 2008)

Sherman and Ford (2014) illustrated this debate for the context of climate adaptation– "*top-down* approaches are interventions in which local participation is highly managed and communities are viewed as the recipients of project outcomes, rather than partners in project implementation and design. Projects can be considered to be *bottom-up* when community members actively collaborate in the design and implementation of adaptations, as both project participants and staff members".

Literatures of policy implementation suggests that the merits of implementing top-down and/or bottom-up approaches depend upon the type of issue or policy under consideration (Sabatier 1986 cited in Urwin and Jordan 2008). To generate community awareness and support about the project top-down approach may work better initially, although it is essential to carefully judge the utility, appropriateness, and relevance of the project in a particular context (Sherman and Ford 2014).

Dutta-Koehler (2013) argued that local authorities do not have the complete knowledge about the impact and adaptation need in the field (city). They also fail to exchange knowledge with the peoples and share the experience of best practice. In contrast only focusing on the bottom-up approach or CBA (community based adaptation) in this particular context without criticism may lead inappropriate assumption and misleading judgement through not taking into account the nature and political implications of this approach (Ayers 2011; Dodman and Mitlin 2013).

In addition, both in the adaptation and development literatures dependence on external human resources has been usually discouraged by the bottom-up approach (Amaru and Chhetri 2013). This can be argued reversely by the deficiency of technical knowledge and management skills for the projects by the locals which can be complemented by the external trained stuff, through a top-down approach (Sherman and Ford 2014).

Furthermore, it is argued that active participation of the field level stakeholders, i.e. households and communities, in articulating and implementing climate change adaptation policies and programs (bottom-up approach) is critical because vulnerability is experienced locally and adaptive capacity and actions are best observed and realised locally (Fünfgeld 2010) However, the extent and effect of local action against climate change related threats remains inadequate without actions at other levels of governance (top-down approach) that address underlying drivers of vulnerability (i.e. emission mitigation, reducing poverty and inequality, appropriate land use and housing policy, tenure security etc.). Therefore, an integrated approach (combination of top-down and bottom-up) to build resilience among the urban poor is needed (Middelbeek et al. 2014).

Moreover, Baker (2012) advocated for "bridging communities and local governments to work together on local problems and prospective solutions". According to this proposition, for the urban poor or bottom-level actors, this imply, considering what the city can and cannot afford and its limitation is the primary step. Communities should proactively demonstrate what resources and capabilities they have rather than making demands and opposing government policies or programs that go against their requirements. For local governments, this means recognizing the contribution that the urban poor make to a city's economy and society and involving them in discussions about problems and priorities while formulating policies and programs. Through this amalgamate approach both immediate and long-term crisis in the urban poor communities can be addressed within the backdrop of limited resources and administrative capacity of the local governments (Satterthwaite et al. 2007).

Finally, Adger et al. (2005) stated that any adaptation to climate change policy/program can be appraised through standard principles of policy evaluation in quest of promoting *effective, efficient, equitable* and *legitimate* action in agreement with wider sustainability. However these criteria's are contested and context specific and are based on competing values.

3. Empirical Arguments

3.1 Bangladesh Perspective

Bangladesh – the top threatened country due to climate change induced sea-level rise, and extreme and variable weather events (flood, heat, storm, cyclone etc.) according to recent projections (Bondeau et al. 2013; IPCC 2013). The three major cities of the country - Dhaka, Khulna and Chittagong (inhabits more than 50% of urban population; Kawsar 2012); fall within the low-elevation coastal zone (LECZ) and ranked higher in terms of potential disaster risk by several predictive studies (Nicholls et al. 2008; WWF 2009; Maplecroft 2014). Echoing the global trend, disaster risk is compounding in the urban areas for the rapid urban population growth rate (2.96% for 2010-2015; United Nations 2011; 2013). This is followed by more low-income population (21.28% at urban poverty line in 2010; World Bank 2013) in the urban slums and squatters and adapting to climate variability with their limited capacity in the absence of any dedicated policy measures and integration within mainstream adaptation and urban planning (Banks et al. 2011; Roy et al. 2011).

3.1.1 Grassroots Coping Strategies in Karail Slum, Dhaka

Dhaka megacity currently resides 36% of the country's urban population (United Nations 2011; 2013), among which one-third (35%) lives is urban slums (CUS 2005; Angeles et al. 2009). *Karail* is one of the biggest slums of Dhaka, currently holding a population more than 100,000 (CUS 2005). Its location beside the high-end residential and commercial area (Gulshan, Banani and Mohakhali) and consequent opportunity in the service industry attracted this high amount of low-income people. Additionally, it location just beside and in some cases on the Gulshan lake poses both threat of flooding to the communities as well as pollution and encroachment to the lake.

Jabeen et al. (2010) conducted empirical work in Korail to investigate different types of coping strategies that people use. They explored that low-income (30% below 1USD/day/person), high population density, lack of proper utility services and tenure insecurity is the main driver of vulnerability. Inhabitants reported climate change as extreme and irregular climatic events such as – increased heat, irregular patterns and increased volume of rainfall and flooding. To adapt they employ mainly impact-minimizing actions such as - barriers across the fronts of doors, increase the height of furniture's, construct higher plinths and arrange higher storage facilities. To reduce the heat in the rooms creepers (leafy vines) are grown in the courtyards to cover the roofs and false ceiling material or canopy made out of cloths are used (see also Ahsan 2012). During the disaster they remain in their house for the fear of eviction. They cooperate and use their social capital during and after disaster to rebuild the structures, share foods and borrow loans to cope with the shock (see also Assheuer et al. 2013).

Tenure insecurity underpinning the vulnerability to the highest degree in case of Karail. Majority of its houses built on disputed government land and controlled by local political leaders. There is no formal provision of water, electricity and gas from the local government and inhabitants pay higher prices for this services (see also Hossain 2013). Different NGOs work in the area for providing water-sanitation, education, health care and micro-credit.

Jabeen et al. (2010) recommended supporting the local adaptation strategies by the inhabitants through providing utility services (for which recognizing their right by the city authority will be the first step) and government managed savings and credit system. They also argued existing coping strategies (local knowledge) utilizing the readily available materials and skills should be integrated in the urban/adaptation planning of city government (which is still undefined). This combination of top-down and bottom-up process will address the adequacy of both sides (resources scarcity of the local government and management skill of the local community).

3.1.2 Responses to Climate Change by Low-Income Households in Khulna

Khulna is the third largest city in Bangladesh located in the coastal region in the southwest. Currently inhabiting near about 1.7 million people, which is projected to be 2.8 million by the year 2025 (United Nations 2011; 2013). Near about 190,000 people living in 520 low-income settlements and slums during the year 2005 (CUS 2005; Angeles et al. 2009).

To analyze the individual, communal and institutional responses by the low-income households in Khulna, Haque et al. (2014) investigated questionnaire survey data of 550 households conducted by an INGO for one of their continuing projects and also performed several focus group discussions. They have stated that, residents of informal settlements in Khulna face a wide range of climate-related hazards. Some of these are sudden-onset events, including heat waves and cyclones; river flooding and water-logging; while others are slow-onset processes, including increased water salinity and rising average temperatures. In addition, the blending of minimal financial resources, poor quality of housing due to inadequate provision of basic services and increasing health cost burden create conditions in which people have extremely limited capacity to deal with any climatic shocks and stresses (see also Roy et al. 2012; 2013).

Align with people elsewhere in Bangladesh (Jabeen et al. 2010; Ahammad 2011; Mallick 2013) low-income inhabitants in Khulna are already taking a wide range of activities to react to climate related hazards. These are largely spontaneous or “impact-minimizing” rather than planned or “preventive”. To protect from heavy rain polythene sheets or empty cement bags are put on the roof and walls. Elevated plinth and building house on tilts technique is used to avoid water logging. During the flooding furniture’s are raised and stuffs are putted high near the ceiling. Perforated bamboo partitions are used as interior walls to allow the flow of air around the dwelling; and allowing vegetation to grow on the roof helps to keep the interior cool. The Khulna City Corporation (KCC) is mostly engaged in post-disaster relief works. The NGOs work in the city are more generally focused on community development (which can be seen as a way of strengthening adaptive capacity), as well as on providing emergency services during disasters (see also Roy et al. 2012; 2013)

However, Haque et al. (2014) argued that, “...none of these existing responses address the underlying social and political marginalization of the communities, which is the single most important feature contributing to their vulnerability” (see also Roy et al. 2011). Illegal inhabitants face the threat of eviction and absence of utilities, whereas legal tenant suffered due to very poor housing service offered by the owners in the absence of monitoring. First group do not want to invest for economic risk (eviction) and the second group do not receive NGO support due to nature of the settlement (Roy et al. 2013).

Haque et al. (2014) emphasised the permutation of top-down and bottom-up approach for effective adaptation planning through – ensuring tenure right by the KCC to encourage self-investment; using the skills and knowledge of the communities as the basis for far-reaching adaptation planning and action (bottom-up); development of climate-resilient livelihood strategies and providing autonomy and resources to local authorities to address local and urban development concerns (top-down).

3.1.3 Constraints of Pro-Poor Adaptation in Chittagong

Chittagong is the second largest city in Bangladesh currently inhabits more than 5 million population (United Nations 2011; 2013). Due to its hilly topography and close proximity to sea, it was affected severely in the last decade by storms, cyclones, flooding and land slide. Severe urban flooding due to poor drainage structure is now a common phenomenon. Exponential population growth around the port activities and high value of land, drive the low-income communities (more than 1.5 million; CUS 2005; Angeles et al. 2009) to live in the slums and squatters developed by the local elites through cutting down the hills (Ahammad 2011). Rainfall induced landslide is the major climatic threat for urban poor in Chittagong, evidenced by 128 person killed in June 2007 and affected 2,072 families in five informal settlements (Ahmed and Rubel 2013).

Ahammad (2011) conducted a review of existing literature as well as focus group discussions and interviews in three informal settlement areas that were affected by the landslides in 2007, namely *Matijarna*, *Batali Hill* and *Lebubagan*; with the goal to explore the constraints of pro-poor adaptation in Chittagong through the lens of – disaster preparedness, urban planning, NGO initiatives and national policy framework.

Ahammad (2011) stated that disaster risk reduction amid the low-income groups living in informal settlements is constrained by poorly defined roles for urban government agencies and little coordination between them (top-down approach). He also concluded that, “the roles of urban government agencies in Chittagong have not evolved [yet] in relation to climate change adaptation”. In addition, it has been surveyed that the adaptation capacity of low-income groups in Chittagong is highly correlated to the quality of their housing and the sites on which it is located. In contrast, urban government departments failed to take any initiative for arranging secure sites for relocating communities at risk. Moreover, informing communities about the potential risk and training them about emergency temporary relocation has been initiated by the authority, but failed due to weak institutional capacity and resources.

On the other hand, PROMISE–Bangladesh is a pilot project funded by the USAID and coordinated by the Asian Disaster Preparedness Centre (ADPC) has been initiated during 2008–2009. The project set up ward disaster management committees, which included community members, school teachers, a local ward commissioner and local residents from higher-income groups (bottom-up approach). Each committee sits once a month to discuss disaster preparedness. But how this committee will coordinate with the other government agencies is not defined. Additionally, the Urban Partnerships for Poverty Reduction (UPPR) project funded by DFID and UNDP (2007-2015), implemented in major urban centres of Bangladesh aimed to improve the livelihoods and living condition of urban poor, failed to incorporate most risked communities as the beneficiaries due to selecting only those settlements which do not have land tenure conflict. Though the official objective of the project is to include the communities at the highest risk.

3.1.4 Supplementary Arguments

- Sherman and Ford (2014) carried out a research to explore the ability of institution-oriented, top-down and community-oriented, bottom-up stakeholder engagement approaches to enable or constrain the implementation of adaptation projects in developing nations. They evaluated 18 adaptation projects performance from three Global Environment Facility's (GEF) adaptation programmes in light with the criteria's *effectiveness, efficiency, equity, legitimacy, flexibility, sustainability,* and *replicability*. This comparison revealed that community stakeholder engagement during project design and implementation, led to higher degree of performance in evaluation criterias of projects. In addition it has been explored that bottom-up approach in adaptation projects creates spin-off effects among the local stakeholders to inititate and run adaptaion interventions by themselves. This study also criticise the participatory method to be unsuccessful to actually empower the communities in both approaches as well as bottom-up approach for having a narrow focus, which prevents scaling up and replication (see also Dodman and Mitlin 2013).
- Amaru and Chhetri (2013) identified 45 adaptation projects through a bibliometric analysis to explore the degree of institutional intervention. They have considered only those projects which have a combination of top-down and bottom-up approach. Through rigorous further filtering and classification they have analyzed in detail 4 projects according to adaptation strategy employed (science, technology or information, experience and managerial). Finally they have concluded for the quest of combined approach as - "...the types of adaptation measures implemented primarily from the top-down may not promote local resilience in the long term; likewise, those measures implemented from the bottom-up require some level of collaboration from the top to maximize their effectiveness".

4. Conclusion

The combination of bottom-up (institution led) and top-down (community oriented) approach is more effective for adapting to the impacts of climate change on urban poor communities in cities of Bangladesh. This result can be echoed for the other countries of global south due to the resemblance in wider socio-economic context and governance characteristics. Urban poor communities in Bangladesh are adapting with their incredibly limited capacity. But this success in individual or communal level can be more strengthened as well can be scaled up (i.e. city/national level) if proper support (i.e. finance, management, tenure right) is provided by the local government. Conversely, resource scarcity and weak institutional capability of the city government can be compensated through utilizing local communities' knowledge and labour during adaptation policy planning and implementation. On the contrary, Community Based Adaptation (CBA) is still rural focused and urban climate change adaptation is still undervalued in global south. CBA can be an ideal combination of top-down and bottom-up if real empowerment or participation can be ensured and inappropriate assumption and mal-adaptation can be filtered. Which in turn will make the adaptation action more equitable, legitimate and efficient, the criteria's for 'effective adaptation'. In conclusion, urban climate change adaptation is still undermined in Bangladesh, with single dedicated project in NAPA

(MoEF 2009b), while nothing mentioned specifically in BCCSAP (MoEF 2009a). Moreover, in both of the policies specific actions to address the vulnerability of urban poor is still to develop. Developing appropriate policies simultaneously with addressing the immediate need of the poor is needed to achieve the current and future pro-poor adaptation goal.

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Global Urban Sustainability Assessment: A Multidimensional Approach

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Abstract. This paper examines a database of over 140 global cities including London, New York, Hong Kong, San Francisco, Los Angeles, Sao Paolo, Rio de Janeiro, Buenos Aires, Paris, Berlin, Stockholm, Moscow, Beijing, Seoul, Singapore, Shanghai, Sydney and Tokyo exploring linkages between different sustainability and smart city dimensions. It builds a comprehensive global CO_2 emissions model explaining 80% of the variance in urban CO_2 emissions across the globe. The results point towards a range of important variables capable of characterising urban CO_2 emissions: share of coal energy in the electricity mix, share of renewables, recycling rates, travel patterns and so on. Examples of the three leading cities, San Francisco, Stockholm and Seoul are discussed from the point of view of policies and performance. The assessment could be a valuable tool for policy makers and investors, and could help identify linkages between different sustainability dimensions as well as investment opportunities in cities with sustainability potential.

Keywords: multi-criteria decision aid, sustainable cities; indicators; sustainable development; environmental policy; smart city

1. Introduction

UNEP Green Economy Report highlighted urban sustainability as one of its important dimensions (UNEP 2011). This topic receives a lot of attention in the EU, USA and increasingly China and Latin America since the Rio Summit of 1992, the Rio+20 Summit in 2012 and, especially, in the light of the recent HABITAT III forum held in Quito, Ecuador in 2016. The new UN Habitat World Cities Report firmly links the New Urban Agenda with Sustainable Development Goals (UN Habitat, 2016). SDG 11 'Sustainable Cities and Communities' aims to 'make cites and human settlements inclusive, safe, resilient and sustainable' (UN, 2015b). UNECE and ITU have launched a new United for Smart and Sustainable Cities initiative in 2016.

Urban sustainability is defined as a multi-dimensional capacity of a city to operate successfully in economic, social and environmental domains simultaneously. Sustainable urban policy developments have been explored by Girardet (1993, 2004, 2014), Naess (1995), Hall and Pfeiffer (2004), Bithas and Christofakis (2006), Shmelev and Shmeleva, (2009), Hall et al (2010), Dassen, Kunseler and van Kessenich (2013), Hall (2014), Martin and Rice (2014). The multidimensional nature of an urban system defines a central analytical approach for sustainability assessment of cities used in this paper, namely the methodology of Multi-Criteria Decision Aid (Roy, 1996), following an approach outlined in (Shmelev, 2017).

The Rome declaration adopted at the UN Forum on "Shaping smarter and more sustainable cities: striving for sustainable development goals" in May 2016 declared that 'cities need to become smarter, with technological solutions deployed to address a wide range of common

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urban challenges' of sustainable development (UNECE & ITU, 2016). The EU's European Economic and Social committee considers smart sustainable cities to be a tremendous source of growth, productivity and employment. A smart sustainable city, according to UNECE, is an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, environmental as well as cultural aspects (UN ECOSOC, 2015).

Cities are contributing a significant share of global CO2 emissions (75%) and will experience tangible effect from its consequences. Bai et al. (2018) asserts that by 2030 millions of people and US$4 trillion of assets will be at risk from climate-change-induced extreme events. Founded in London in 2005 at the summit of representatives of 18 leading megacities, the C40 partnership currently numbers 89 cities from over 50 different countries aimed at taking action against climate change. ICLEI, Local Governments for Sustainability is uniting over 1500 cities towns and regions to build a sustainable future.

In this article we start by exploring a large database of over 140 global cities and search for meaningful relationships between various indicators in the global dataset. We then build a cross-sectional linear regression model, linking urban CO_2 emissions and various external, infrastructure, policy, behaviour and technology variables. The article concludes with a description of sustainability strategies and policies adopted in the leading cities of the world, which could help us to understand its success. The article is organized as follows. Section 1 offers an introduction to the topic. Section 2 discusses data and indicators used. Section 3 presents the results of regression analysis of linkages among sustainability indicators. Section 4 discusses the application of cross-sectional linear regression model for CO_2 to 71 global cities. Section 5 explores the sustainability strategies and policies in the most sustainable cities identified in our research. Section 6 concludes.

2. Indicators for Smart Sustainable Cities

Existing smart and sustainable cities indicator frameworks include the United Nations Guidelines and Methodologies on Sustainable Development Indicators (UN, 2007), EU Sustainable Development Indicators (EC, 2009), a Sustainable Development Indicators Frameworks (UNECE, 2013), a new ISO 37120 standards on Sustainable Development of Communities (ISO, 2014), a Sustainable Development Goals framework (UN, 2015), a Smart Sustainable City Indicator Framework (UN ECOSOC, 2015). These frameworks are discussed extensively in a range of comparative reviews: (Valentin & Spangenberg, 2000), Spangenberg (2002a,b), Spangenberg (2005), Kierstead and Leach (2008), Monfaredzadeh & Berardi (2015), Hara et al (2016), Manitiu & Pedrini (2016), Ahvenniemi et al (2017), Garcia-Fuentes et al (2017), Girardi & Temporelli (2017), Spangenberg (2017), Klopp & Petretta (2017) and Pierce et al (2017).

Recently there has been a growth of interest in indicator-based sustainability assessments for cities: (Shen and Zhou, 2014), (Mori and Yamashita, 2015), (Wong, 2015), (Yigitcanlar et al, 2015), (Wei et al, 2015), (Wei et al, 2016). The indicators following the International Urban Sustainability Indicators List proposed in (Shen, 2011) include the economic characteristics, such as income per capita; social and cultural dimensions, including unemployment rate, income differentiation rate in the form of a Gini coefficient and higher education level, and, finally, a wide range of ecological-economic or environmental dimensions, including the share of green space, CO_2 emissions, average PM_{10} concentrations, water use per capita per day, waste generation per capita per day and recycling rates.

Our comparative analysis of the three assessment frameworks (UN SDG indicators, ISO 37120 Sustainable Development of Communities and UNECE-ITU Smart Sustainable City Indicators) has shown a difference in focus, balance between economic, social and environment dimensions and some inconsistencies. The UN SDG indicator framework is more focused on the problems of developing countries and with its 249 indicators that are often defined in an imprecise way could become unmanageable. The ISO 37120 standard shows more precise definition of indicators, although social and environmental aspects are given slightly greater prominence at the expense of economic and smart indicators. On the contrary, the UNECE-ITU Smart Sustainable Cities Indicator framework is more balanced between different dimensions of sustainability and formulated with a lot of clarity and a forward-looking strategic vision in mind.

Selection of individual indicators for cities, chosen for the present paper, was based on an earlier sustainable cities framework (Shmelev and Shmeleva, 2009), inspired by our dynamic sustainability assessments carried out for countries (Shmelev, 2011, 2015) and adapted for the urban scale Shmelev (2017). The process of indicator selection for the study was performed in two parts. First, a large set of criteria was analysed, including economic indicators (income per capita at PPP, number of large companies headquartered in the city, creative industries employment), environmental indicators (CO_2 emissions per capita, share of nuclear energy, PM_{10} emissions, water use per capita, waste generation per capita, recycling rates) and socio-cultural indicators (unemployment rate, Gini Index of income inequality, life expectancy). After performing a Principal Component Analysis (Shmelev, 2017), identifying redundant variables and adding relevant dimensions, the set of criteria took its final shape numbering twenty criteria as a result of several iterations.

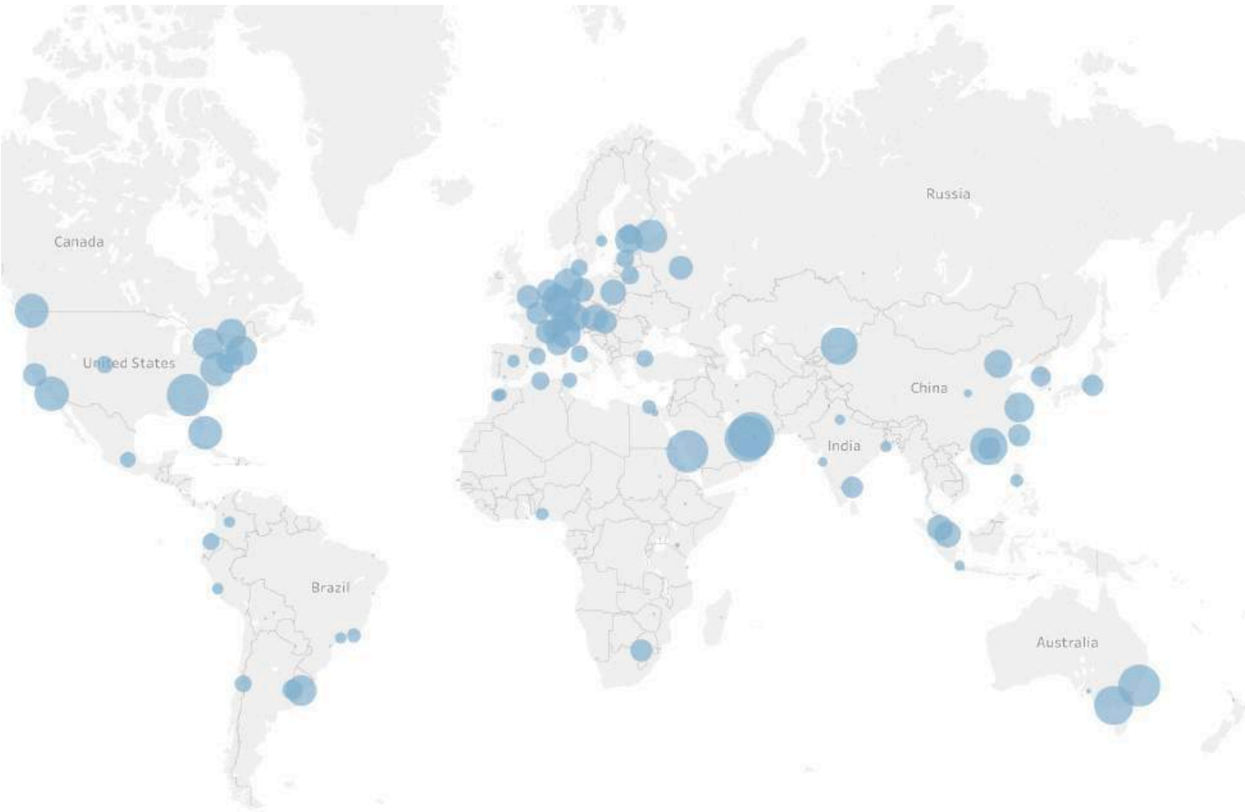

Figure 1. CO_2 emissions. Source: Environment Europe™ Sustainable Cities Database, http://environmenteurope.org/, 143 global cities, 2018

The Environment Europe™ Sustainable Cities database includes 143 cities in Europe, North America, South America, Africa, Asia, and Oceania. Our study draws on a wide range of sources from Eurostat (2016), city governments, UN Habitat, World Bank, CDP, Bloomberg. As a matter of example, we would like to illustrate the geographical spread of the Environment Europe database with CO_2 emissions data (Fig 1). CO_2 emissions are very high in Melbourne and Sydney, Dubai and Doha, Miami, Shanghai, Almaty and much lower in Stockholm, San Francisco, New York, Tokyo, Rio de Janeiro, Paris and Madrid.

3. Cross-Section Regression analysis

Our goal in this section was to test several hypotheses regarding the inter-disciplinary links among urban sustainability dimensions. The hypotheses were derived from the assertion in the UN Guidelines on Sustainable Development Indicators (UN, 2007), which emphasised the interdisciplinary connections between sustainable development indicators. The exact formulation of the hypotheses is based on our previous research outlined in Shmelev and Shmeleva (2009), Shmelev (2017) and Shmelev and Speck (2018).

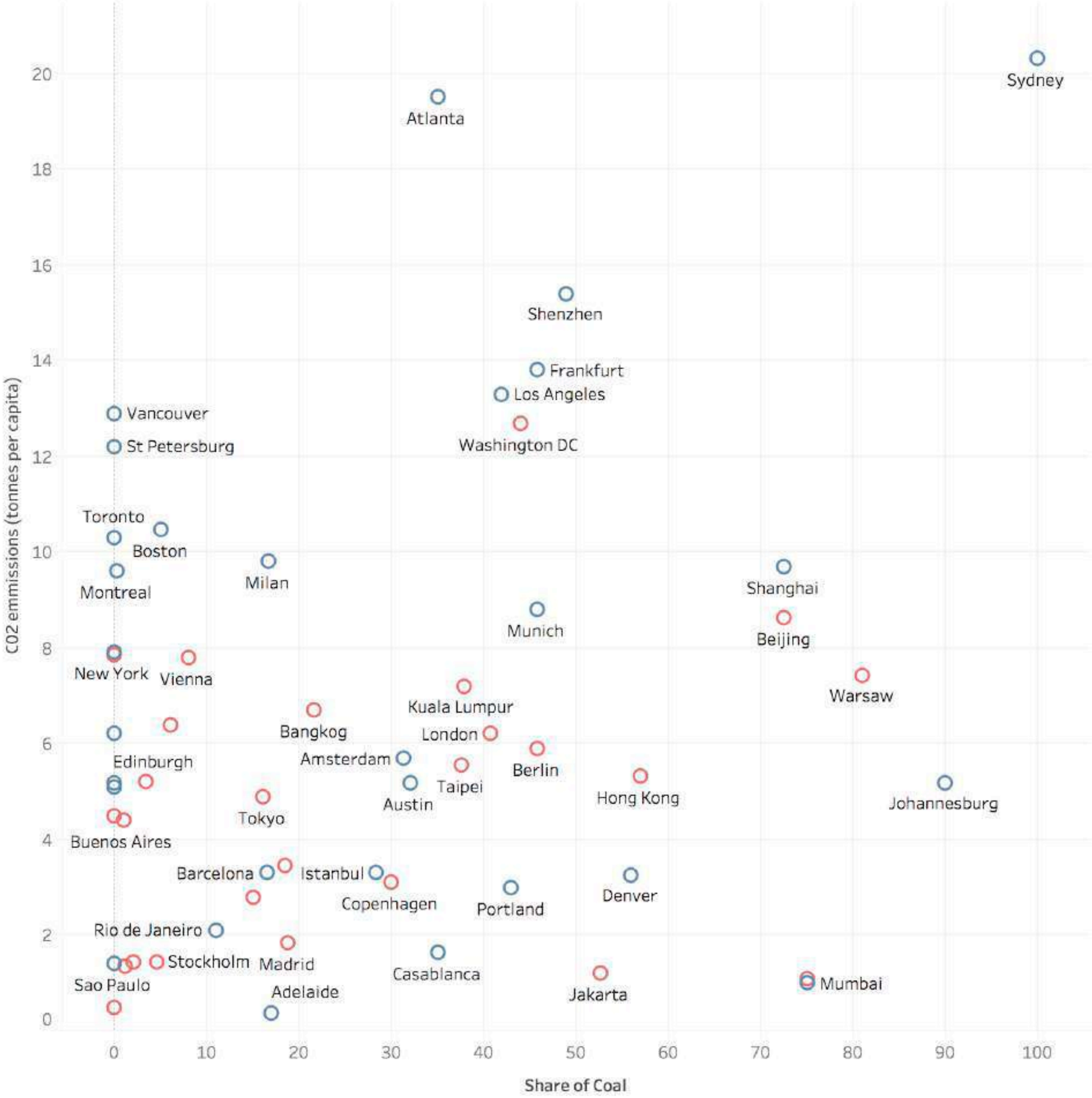

Figure 2. Correlation between CO_2 emissions and the share of coal in the energy mix for global cities. Source: Environment Europe™ Sustainable Cities Database, 2018.

The confirmation of our hypothesis of a highly significant correlation between the amount of CO_2 emissions and the share of coal, the most carbon-intensive technology at present in the energy mix (Figure 2), reinforces the need for an urgent transformation and decarbonisation of the energy sector. Such cities as Sydney, Warsaw, Hong Kong, Denver, Portland, Los Angeles, Washington, Shenzhen have above-average levels of coal in the energy mix and exhibit high per capita CO_2 emission. On the other hand such cities as Sao Paolo, Rio de Janeiro, Bogota, Quito, Madrid, Adelaide, Copenhagen, Rome have relatively low share of coal in the energy mix and lower levels of CO_2 emissions per capita.

A significant correlation between CO_2 emissions and the share of trips made by walking, cycling and public transport has been confirmed (Figure 3), which enriches our understanding of this wonderful urban planning tool for improving air quality and making the cities greener.

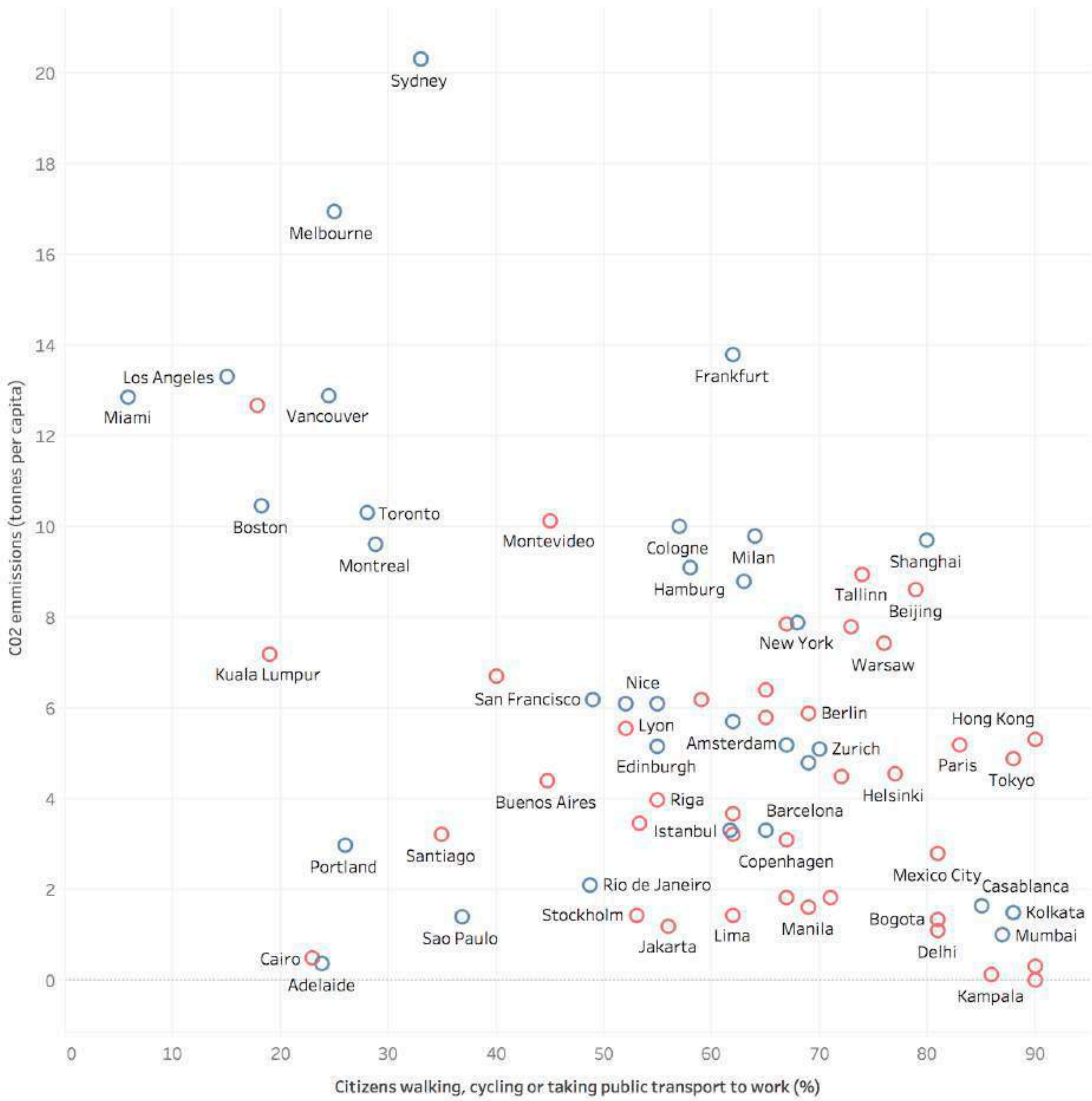

Figure 3. Correlation between CO_2 emissions and the share of trips made by walking, cycling and taking public transport. Source: Environment Europe™ Sustainable Cities Database, 2018

Such cities as Stockholm, Mumbai, Bogota, Delhi, Mexico city, Paris, Amsterdam, Seoul, Barcelona, Sao Paolo, Berlin, Singapore, Moscow have a significant percentage of trips made by walking, cycling and using public transport and are associated with lower per capita CO_2 emissions. On the other hand, such cities as Sydney, Shenzhen, Almaty, Los Angeles, Miami, Kuala Lumpur, Boston, Vancouver, Toronto rely on a private car in a much more pronounced way and therefore have significantly higher CO_2 emissions per capita.

The role of renewable energy in reducing CO_2 emissions in global cities has been confirmed at a very high level of statistical significance (Figure 4). This clearly reinstates the tendency in such cities like Sao Paolo, Bogota, Montreal, Stockholm, Rio de Janeiro, Zurich and Copenhagen that are largely powered by hydro energy to have lower per capita CO_2 emissions. At the same time cities like Sydney, Atlanta, Almaty, Frankfurt, Miami, St Petersburg, Shanghai, Boston, Los Angeles, Vancouver, Shenzhen that tend to have lower levels of renewables in the energy mix, tend to exhibit higher per capita CO_2 emissions.

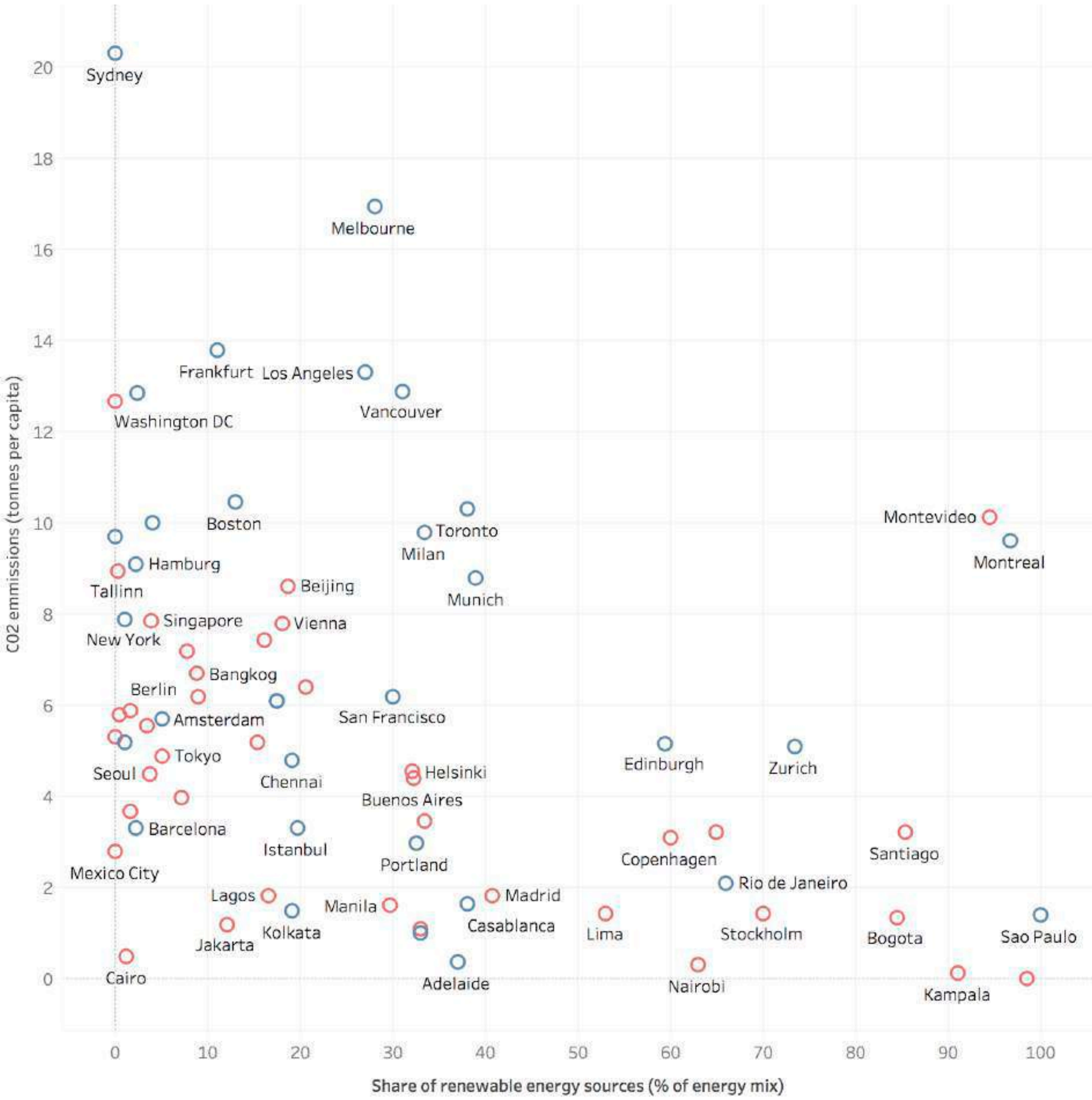

Figure 4. Correlation between CO_2 emissions and the share of the renewable energy for global cities. Source: Environment Europe™ Sustainable Cities Database, 2018

The hypothesis of a strong water-energy nexus, whereby larger CO_2 emissions tend to go hand in hand with higher water consumption has been confirmed. Figure 6 presents an illustration of such phenomenon and shows cities like Los Angeles, Almaty, Atlanta, Miami, Toronto, Kuala Lumpur using larger amounts of water with higher per capita CO_2 emissions. At the same time, cities like Bogota, Lima, Lagos, Madrid, Adelaide, Barcelona, Copenhagen, Seoul, Rome exhibit lower levels of per capita CO_2 emissions accompanied by lower water consumption.

The research outlined above forms an important step in creating multivariate regression models explaining variation in key urban sustainability indicators, such as CO_2.

4. Urban CO_2 function

Based on the global data covering 71 cities, contained in the Environment Europe Cities Database we were able to generate a regression that captured 80% of the variation in urban CO_2 emissions across the whole world (Figure 5). Urban CO_2 emissions tend to decrease with the increasing daily mean temperatures in the city (Table 2). On average, higher temperatures result in reduced need for heating and associated CO_2 emissions. At the moment, we cannot take into the account increased electricity consumption due to air conditioning. Cities with an OECD capital status tend to exhibit significantly lower CO_2 emissions possibly as a result of higher technological development in public transport systems, electric cars and pedestrianisation as a new trend in urban planning and design.

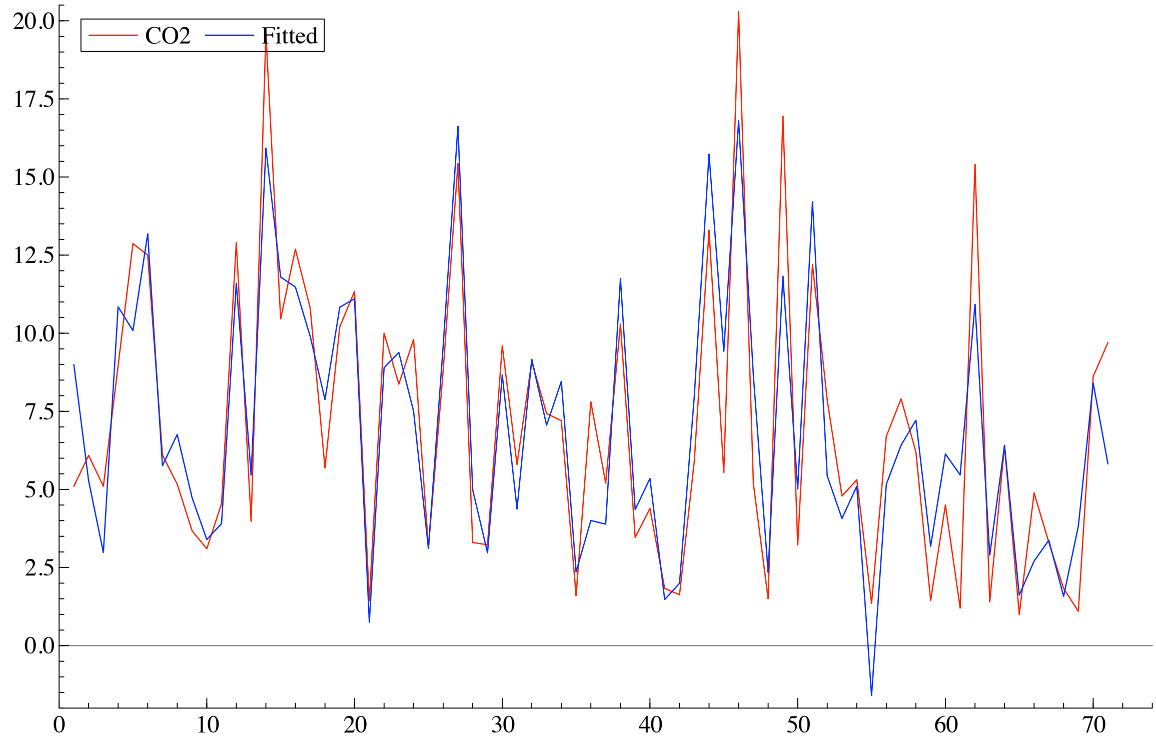

Figure 5. Global Urban CO_2 Emissions Linear Regression, (Environment Europe™ Cities Database, 2014 data).

The large share of renewables in the energy mix tends to reduce urban CO_2 emissions according to our results. On the other hand, the share of coal in the energy mix tends to increase urban CO_2 emissions. And additional behavioural variable, representing the share of trips made by walking, cycling and using public transport is shown to reduce urban CO_2 emissions (Table 1), which compared to petrol-based combustion engine cars generate less harmful GHGs. Paradoxically, higher recycling rates under every else being equal, tend to increase CO_2 emissions as additional amounts of energy are need for complex recycling (statistical significance of this factor is lower, but is it still significant at 10%). The next variable, CO_2 tax is reflecting the existing structure of incentives globally and shows an effect to reduce CO_2 emissions, however statistical significance of this factor is lower.

Table 1. CO_2 regression coefficients in the linear urban regression

Variable	Coefficient	Std.Error	t-value	t-prob	Part.R^2
Constant	15.2640	1.023	14.9	0.0000	0.7794
Daily Mean Temperature	-0.234784	0.04427	-5.30	0.0000	0.3087
OECD Capital Status	-2.29855	0.6474	-3.55	0.0007	0.1667
Share of Renewables in the	-0.0376761	0.01115	-3.38	0.0013	0.1534

Energy Mix					
Share of Coal in the Energy Mix	0.0486420	0.009920	4.90	0.0000	0.2762
Share of Trips made by Walking, Cycling and Public Transport	-0.113082	0.01036	-10.9	0.0000	0.6543
Recycling Rate	0.0692216	0.01286	5.38	0.0000	0.3150
CO_2 Tax	-0.0306765	0.01428	-2.15	0.0355	0.0683

Source: Environment Europe Cities Database, 71 observations, R^2=0.805394

Overall, this equation 'explains' 80% of the variance in the global CO_2 emissions. Such model can be used for out-of-sample forecasting.

5. Most sustainable global cities

Below we will explore some of the most sustainable and smart cities globally trying to explain how they achieved their remarkable success, paying particular attention to climate-related issues. Among the most successful cities are San Francisco, the US high tech and sustainability hub in the most economically successful state of the US, California, which is equivalent to the economy of France in size, as well as two national capitals: Stockholm and Seoul (Figure 6), which stems from our previous research in sustainability benchmarking.

San Francisco

San Francisco leads our ranking in Economic and Environmental Dimensions worldwide, which corresponds to the World Economic Forum ranking. The Strategic Plan of San Francisco for 2016-2020 has a mission 'to provide solutions that advance climate protection and enhance quality of life for all San Franciscans'. The Strategic Plan has five goals: 1) Promoting Healthy Communities and Ecosystems; 2) Leading on Climate Action; 3) Strengthening Community Resilience; 4) Eliminating Waste; 5) Amplifying Community Action.
In particular, Goal 2 uses an active target to reduce greenhouse gas emissions by 40% by 2025 and has the following subgoals: maximize energy efficiency in existing buildings; reduce dependency on single occupancy vehicles by improving access to sustainable and affordable modes of transportation; commit to ambitious carbon reduction targets across city agencies; continue to share San Francisco's practices and lessons to show the world what is possible; decarbonize the energy used for heating and cooling buildings; accelerate shift to 100% renewable grid electricity by 2030 and maximize local on-site generation of renewable electricity through policy development and investment; decarbonize the transport sector by facilitating deployment of electric and zero-emissions vehicles.

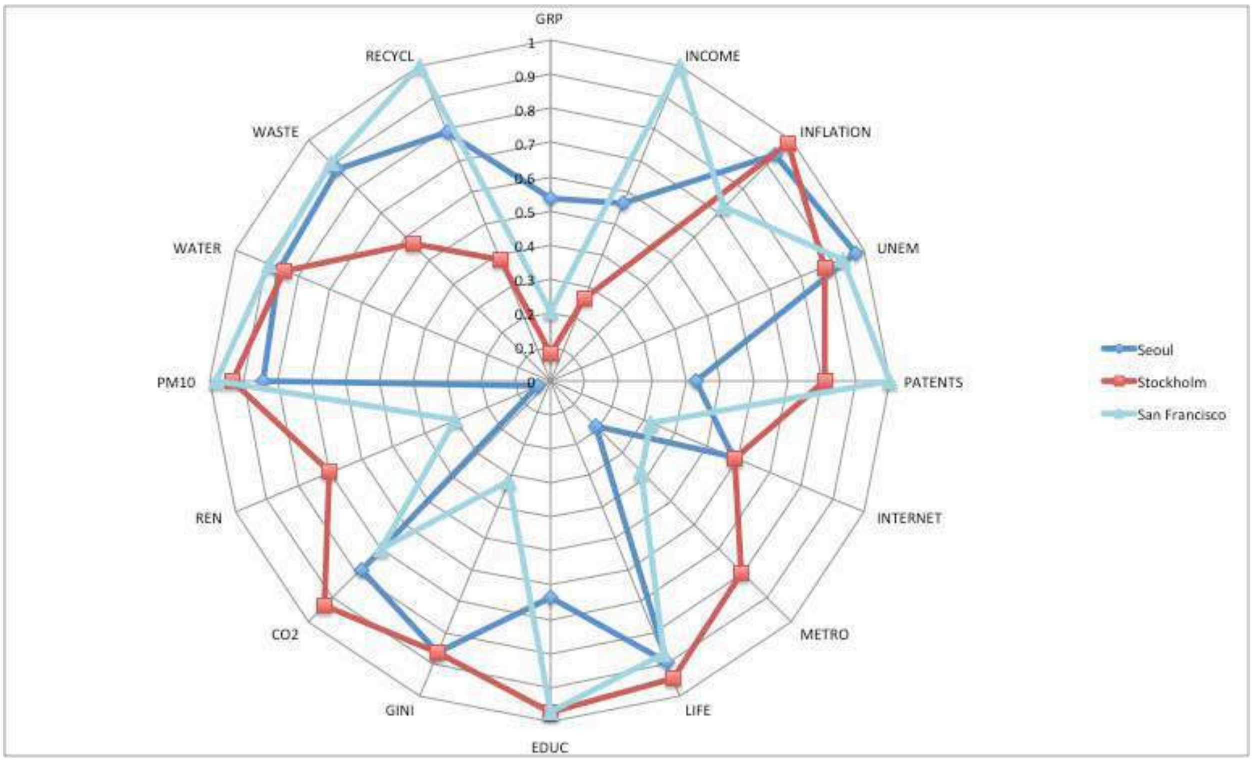

Figure 6. Comparison of the most successful cities globally: San Francisco, Stockholm, Seoul. Further away means better performance on each of the indicators.

San Francisco is one of the world leaders on recycling (80%), generating very small amounts of municipal solid waste per person (195.4 kg per year). 49% of the trips made by citizens are carried out by walking, cycling or using public transport. San Francisco Generates 6.2 tonnes of CO_2 per person per year and generates 30% of its energy through renewable sources. In the field of air quality San Francisco exhibits low levels of PM_{10} pollution at 15.77 $\mu g/m^3$, which is within WHO limit of $20 \mu g/m^3$. It has a reasonably diverse systems of underground public transport.

Economically, San Francisco is one the most vibrant places in the world. With high per capita income of 88518 USD at PPP in 2010 prices, inflation is low at 3.8%, unemployment at 4.4%, which is three times lower than Los Angeles. San Francisco is a world innovation hub with 3.24 patents registered per 1000 inhabitants, which is higher than Boston. Income differentiation in San Francisco is high, illustrated by a Gini index of income inequality of 0.51. Such relatively high income inequality could limit San Franciso's performance in the social dimension.

Stockholm

Stockholm has received a prestigious prize of a 'European Green Capital' in 2010. The city of Stockholm adopted Environmental Program for 2016-2019, based on complementarity between environmental protection and human needs. The six priority areas of this programme include: sustainable energy use, environmentally friendly transport; sustainable land and water use, resource efficient recycling, a non-toxic Stockholm, a healthy indoor environment. Our research shows that along with a serious concern about the environment, Stockholm exhibits extremely strong economic performance. Sweden is consistently ranked high in the World Economic Forum Global Competitiveness Index. Sweden is a very open economy and outperforms USA, Japan and Brazil by attracting approximately 4.7% of GDP in foreign direct investment per annum. At the same time, it invests in the range of 3.7% of GDP in research in development, which considerably higher than the EU average of 1.8%. Sweden and Stockholm managed to decouple economic development from the growth in CO_2 emissions as a result of technological modernisation in the 1970s with the extensive use of hydropower and nuclear energy as well as successful application of environmental taxes since 1991 (Shmelev & Speck, 2018). Stockholm aims to be fossil fuel free by 2050 and is actively involved in new programmes on green urban transport.

The Stockholm economy is largely innovations-based with the number of new patents registered (2.62 per 1000 inhabitants) higher that all other regional European centres including technological giants like Copenhagen, Munich, Zurich. Stockholm outperforms Tokyo. At the same time Stockholm is characterised by very low inflation, in fact deflation at 0.04%. The level of higher education in Stockholm is 58% of all the residents aged 25-64. Stockholm, representing the Nordic governance model, is characterized by high level of taxation as % of GDP and a reasonably low Gini index of income inequality (0.3).

In the environmental dimension Stockholm is characterized by low CO_2 emissions at 1.44 t per capita. One of the possible reasons for such low CO_2 emissions in Stockholm could be its active reliance on renewable energy. Stockholm occupies one of the leading positions in Europe on the share of renewables in the energy mix (70%), following Zurich. Stockholm's performance on renewables is considerably better than other European cities – Copenhagen, Edinburgh, Madrid, Rome, Moscow, Vienna, Paris, London, Amsterdam. On the other hand, according to the data on the share of all trips made by walking, cycling and using public transport, Stockholm is unfortunately not in the lead, following Vienna, Madrid, Moscow, Amsterdam and London at a modest level of 53%.

Another important parameter for 'explaining' low CO_2 emission levels is infrastructure, which gives affordance to use public transport by residents. In this regard Stockholm is characterized by a highly diversified system of underground networks with 108 underground stations per 100.000 inhabitants. This is better than most European cities: Madrid, Amsterdam, London, Rome, Berlin, except Paris. Air quality in Stockholm is at a good European level with an average annual concentration of PM_{10} at 26μg/m^3, which is nevertheless higher than the maximum recommended by the World Health Organization of 20μg/m^3. Better air quality is observed in such European cities as Edinburgh, Madrid, Zurich, Amsterdam and Vienna: it is worse in London and Paris. In the field of circular economy, Stockholm generates rather large amounts of municipal solid waste of 597 kg/person per year, 31% of which is recycled. Other European cities practice less resource-intensive lifestyles: Madrid, Amsterdam, Berlin, London, Paris, Vienna. Recycling rates are lower than Stockholm in Madrid, Rome, Paris, Copenhagen, and higher in Vienna, London, Berlin and Amsterdam

Seoul

In November 2017 Metropolitan Government of Seoul adopted 17 Sustainable Development Goals and 96 targets. Seoul Plan 2030, and urban planning document, covers three central dimensions: environment, society and culture, and the economy and includes 30 urban development indicators. Among Seoul's strategic priorities are reduction of Seoul's reliance on nuclear power, energy efficiency and sustainable energy action plan, increasing female participation in economic activities. Already in 2013, the International Telecommunication

Union issued a Smart Cities report devoted to Seoul's achievements. The Seoul's Smart City programme includes fast optical wire and wireless network, Seoul began distributing second-hand smart devices to low-income families, established a u-Seoul net in 2003, which connected major public buildings, offices and municipalities via a fiber-optic cables arranged along Seoul's underground tunnels. The Smart Work Center was established to allow government employees to work closer to home and 30% of staff were covered by this initiative in 2015. Seoul's open governance model implies a strong system of community mapping, through which citizens could raise concerns about their neighbourhoods and communities. Seoul's smart metering project aims to reduce electricity consumption by 10% and in 2012 a pilot project covered 1000 families with smart meters. The Open Data Square covers information on general administrative work, welfare, culture and tourism, city management, environment, safety, education, health, industry, economy and transportation. Smart solutions are used in Seoul to optimize personal travel of citizens, planning routes, choosing green transport solutions and reducing carbon emissions.

Seoul's metropolitan area maintained a significant share of Korean economy approaching 50% in 2013; at the same time Seoul metropolitan area provided employment for 50% of the country's population. Seoul's unemployment rate of 2.3% in 2014 was at the level of regional leaders like Beijing and Singapore, but lower than that of Tokyo. Seoul has a significant rate of residents with higher education (40.6), which is slightly lower than Singapore but higher than regional centres Beijing, Hong Kong, Shanghai, Shenzhen, and is higher than similar levels in Berlin, Vienna and Rome. The reasonably low Gini index of 0.3 underlines the values of equality in Korean society and is considerably lower than that of regional leaders like Singapore, Beijing, Hong Kong. Inflation in Seoul is low at 0.71%, which is comparable only to Copenhagen, not mentioning deflation in Stockholm. According to our model, which uses the Smart and Sustainable Urban Development Indicator Framework, the number of patents registered per 1000 inhabitants in Seoul is at a very respectable level of 1.4 per year.

In the environmental field, CO_2 emissions per capita measured in Seoul on an annual basis at 4.5 are lower than regional leaders Tokyo, Hong Kong, Singapore, Beijing, Shanghai, Shenzhen. Compared with European cities, Seoul is dominated by Scandinavian cities that traditionally exhibit very high performance: Stockholm, Copenhagen, but is performing better than Paris, Amsterdam, Berlin, London, Vienna, Munich. Seoul also outperforms San Francisco, New York, Montreal, Boston, Washington, Los Angeles.

Recycling is definitely one of the main strengths of Seoul with 63.5% of all collected municipal solid waste being recycled. Green space in Seoul is not particularly abundant at 1.39 m^2/ per person, which is lower than Tokyo, Beijing, Shanghai, Barcelona, London, Paris, Stockholm, Berlin, Rome and Copenhagen.

6. Conclusion

In this article we focused on global cities; the centres for economic activity and the cities that are responsible for a considerable share in global CO_2 emissions and produce substantial volumes of waste. The application of cross-sectional regression allowed us to produce a robust CO_2 emission model for cities. The key factors affecting the CO_2 emissions for cities we identified are: the share of coal in the energy mix, share of renewables, share of trips made by walking, cycling and public transport, mean annual temperature, OECD capital status, recycling rates and CO_2 taxes. All the factors combined contribute to the 80% of the variation in urban CO_2 emissions worldwide. The multidimensional sustainability assessment identified sustainability leaders: San Francisco, Stockholm and Seoul. The results have put the performance of individual cities within the global context and presented the indicator-based sustainable development performance of individual cities within a coherent framework. Learning from best practices and worst cases in this context provides an invaluable insight for policy reform to create smarter, greener, more compact, socially diverse, economically strong and less polluting cities around the world.

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The impact of climate change on potential use of vacation homes

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ABSTRACT:

The aim of the study is to lay out how changing climate may affect the future use pattern of three selected vacation home areas in Norway. This study is mainly based on eleven qualitative in deapth interviews with vacation home owners in Trysil, Oppdal and Kragerø, but also to some degree questionnaire survey among a larger sample of vacation home users in Norway. Climate scenarios were also developed about future conditions in the case study areas. These were compared to the interviewees perception of possible changes the last years and thoughts about climate change influence in the vacation home areas. In the study we have looked at how the current weather conditions influence the current use pattern, mainly frequency of use and time of year, activities performed in the vacation home areas that have relation to weather conditions and the (climatic) motivation for these activities, when relevant. Based on information about the current use pattern, the aim of the study is to present results as an assessment of the potential change due to climate change.

According to the interview interpretation shorter skiing season in the mountain areas and more mild and wet weather in general is likely to influence use pattern in future. If the winter season becomes shorter, this would affect the attractiveness of the cabin negatively for some of the interviewees and likely reduce the number of visits somewhat.The middle period in spring (April-May) can also become longer in the mountain areas. Some interviewees would drop to go to their cabin in this period, where it is not much snow around and not good to go hiking either. However, weather conditions are likely to influence choice of activities but not necessarily the use frequency of the cabins. Vacation home users seem to be most likely to choose the activities made possible by the conditions. Smaller changes in general, eg. more rain, seem to influence time spent on each outdoor recreational trip and choice of place to go to. In case of fewer skiing trips at the cabin users are likely to go more trips on foot instead and the hiking period in the montains is likely to become longer.

The results indicate that only part of the motivation for using mountain vacation homes is related to weather conditions. When important part of the motivation is skiing, less snow is likely to influence use pattern. However, for many of the interviewees the motivation is related to performing recreational activity in the nature and use is connected with love for mountain nature. This explains why the interviewees say they would choose activities made possible by the conditions. Common motivation is also need to change place, family gathering and relaxing, which is indipendent of climate.

Warmer climate may most likely make use more attractive by the coast. In Kragerø, more storms are however likely to make water based activities more difficult. Apart from this, the period for going to none-primary dwelling might get longer because of milder climate. In addition, motivation for use of the cabins in Kragerø is strongly connected to family gathering and place identity and use is therefore not likely to change in spite of warmer climate.

Most often vacation home users are likely to try to adjust their activities to the conditions. The results suggest that sustainable planning of vaction home areas and the nearest towns should take into account the need to meet variety of activities that could be of interest for vacation home users and that are not sensitive to climate.

Vacation home planning, perceptions of nature and climate change

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ABSTRACT:

This study focuses on perceptions of nature and climate change in relation to Norwegian vacation home planning, ownership and use. The analysis draws on data from planning documents, two survey questionnaires both with respondents from Greater Oslo and in-depth interviews from owners/users of vacation homes in Norway. The data largely reveals an anthropocentric outlook from both the planning side and the user side, resulting in a neglecting of nature and climate changes related impacts and effects.

Vacation home ownership and use in Scandinavia is relatively high and combined with its use pattern and material composition it results in high environmental impact. Different rationales justifying such (not necessarily recognized) detrimental environmental behavior have been promoted throughout time. These are among other recreational motives (including "escape" from urban areas), rural economic development, and social place attachment. However the most prominent and most persistent throughout Norway is a special historical/traditional relatedness to nature. A traditional life *in* nature, which still is part of the national heart and soul. The practice of vacation home use is therefore argued to be part of being "truly" Norwegian. The narrative therefore has both the social and natural dimension of promoting national identities that have great environmental consequences. In the meantime local and national political bodies use vacation home developments to promote a narrative of rural economic growth. For the mainstream economic perspective these combined narratives of traditions and economic growth, therefore provide an optimal opportunity of justification.

However, from an environmental and climate change perspective the phenomenon of vacation home ownership can be seen among others as excessive housing consumption and economic expansion into amenity rich natural areas. A phenomenon, which also include considerable climate impact while itself being vulnerable to climate change. These perspectives have largely been neglected previously in research. This study will remedy this by looking at how planning documents promote the narrative of the "true" Norwegian as vacation home owner. In addition, the study will supply with data from surrey questionnaires and qualitative interview data. This in order to investigate how the common public understanding of climate change impact and behavioral changes, in relation to the narrative are conceived. Illuminating the two sides, of planning and users, will highlight to what extent there exist a neglect on anti-anthropocentric views on climate change and consequences as well as impacts on the natural environment in general. Such knowledge will help inform which measures might be needed if a transition towards a more climate and environmentally friendly vacation home phenomenon is to be planned for.

Conclusions: Planning documents for most parts take a point of view from human recreational and economic needs, arguing that nature is a place for human experience and expression. Such experience and expression is often justified in traditional Norwegian life. Users, i.e. questionnaire and interview participants reveal that there is little concern towards natural harm and climate impacts from vacation home ownership and use. Most interviewees state that their ownership and use of vacation home are most likely not to change due to climate change impacts, while most owners of vacation homes prefer the most environmentally detrimental form of vacation home spatial organization. Still, almost all vacation home uses (both interview and survey data) state that nature experience (including escape motives) are the main motives for engaging in ownership and use. This constitute a dilemma to planning. This study have brought new insights forth and thereby significantly contributed to the body of knowledge within the field of vacation home research as well as climate change planning.

The Effect of Climate Change on Ghana's Cities

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Ghana is not isolated from the changes in climate the world over. Impacts of climate changes include floods, drought, heat waves etc. The impacts of climate change have exacerbated the negative issues arising from urbanisation. In reducing these challenges policies and strategies have been developed, and then mainstreamed into governance to ensure implementation. Ghana's perspective of climate change impacts on cities and resilience are discussed.

Introduction

Osman-Elasha, (2009) described climate change as a constraint to development. This is due to impacts generated in the advent of a climate change. The key events due to the change in climate in Africa include severe floods and drought, sea level rise and ocean acidification, increased water demand and reduced water availability, heat waves and spread of disease to new areas (e.g. malaria), more damage from high wind in storms, and disrupted crop calendars, with different pests, diseases and water requirements. As a result of industrialisation in developed countries, unfortunately developing countries however are more susceptible to threats in the changes in climate, thus they cannot be disregarded. This is due to the fact developing countries lack the resources to adapt and mitigate to impacts of climate change. Satterthwaite, (2006) in justifying why the low or middle-income countries cannot be overlooked stated that (i) these nations represent three quarters of the world's urban population, (ii) the world's population growth in twenty years would increase in these countries and will subsequently have a major impact on future greenhouse gas emissions, and (iii) these countries have a large and growing proportion of the world's population at risk from floods, storms and other climate change impacts. Currently, countries at risk are the least responsible for greenhouse gas emissions. Most cities in Africa are at risk from extreme weather events independent of climate change because of the lack of investment in basic infrastructure. It is of the essence that the quality of infrastructure in cities minimises the additional risks, generated by climate change.

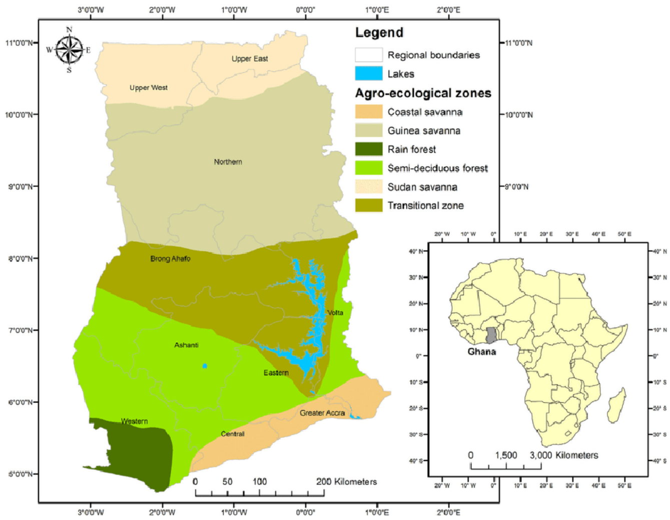
In Ghana, the unparalleled population growth, high rate of urbanisation and unplanned spatial expansion have exceeded the capacity of the city services and infrastructure. These challenges have caused the cities to be susceptible to natural and man-made disasters including floods, seal-level rise, building collapse, disease outbreaks, fire etc.

Temperatures in all ecological zones of Africa are rising, while rainfall levels are generally reducing and patterns have become unpredictable. But the focus of this paper is on the climate of Ghana since the country's independence, how its change is impacting the process of urbanisation and the country's infrastructure, and how the nation has been able to withstand the shocks and stresses so far. In addition, we discuss what measures the government has adopted to enhance resilience of cities and to ultimately promote sustainable development.

Climate Patterns in Ghana - From Independence to Date

Ghana's location in the world is affected by tropical storms, and the influence of the Atlantic Ocean and the Sahel. The seasons in the country comprise the dry season (December- March) and the rainy season (April-November). The southern zone of the country is the rainiest, with a precipitation of between 1,500 - 2000 millimetres (60 inches) per year. The northern part is the driest, where rainfall is about 1000 millimetres (40 inches) per year. In regards to temperatures, it is usually about 35°C (95°F). During the dry season, also referred as the Harmattan season, a dry, dust-laden wind blows from the desert. The air is dry and nights are cool.

From the year 1961 to 2000, there has been progressive rise in temperatures and decrease in mean annual rainfall in the country. According to UNEP and UNDP (2010), Climate Change is patent in Ghana through: (i) Rising temperatures, (ii) declining rainfall totals and increased variability, (iii) rising sea levels, and (iv) high incidence of weather extremes and disasters. The country has six (6) agro-ecological zones defined on the basis of climate, reflected by the natural vegetation and influenced by the soils. They include (i) Coastal Savannah, (ii) Rainforest, (iii) Deciduous Rainforest, (iv) Transition (v) Guinea Savannah, and (vi) Sudan Savannah (see figure 1). The average annual temperature has increased to 1°C in the last 30-40 years. It is anticipated that temperatures will continue to rise, while rainfall is also forecasted to decrease in all agro-ecological zones (see tables 1 and 2). Historically, temperatures risen are likely to continue in the future, thus it is predicted that average temperatures are estimated to increase between 0.8°C and 5.4°C for the years 2020 and 2080 respectively. Also, within the same era average rainfall is estimated at decline between 1.1% and 20.5%.



Source: Rhebergen, T. et al 2016

Figure 1: Map of Ghana showing the six agro ecological zones

Year	Sudan Savannah	Guinea Savannah	Transition	Deciduous Rainforest	Rainforest	Coastal Savannah
2020	-1.1	-1.9	-1.9	-2.2	-3.1	-3.1
2050	-6.7	-7.8	-8.8	-8.8	-12.1	-12.3
2080	-12.8	-12.8	-14.6	-14.6	-20.2	-20.5

Source: Minia et al. (2004) cited in National Climate Change Adaptation Strategy 2010

Table 1: Scenarios of Mean annual change in rainfall (%) for ecological zones

Year	Sudan Savannah	Guinea Savannah	Transition	Deciduous Rainforest	Rainforest	Coastal Savannah
2020	0.8	0.8	0.8	0.8	0.8	0.8
2050	2.6	2.5	2.5	2.5	2.5	2.5
2080	5.8	5.4	5.4	5.4	5.4	5.4

Source: Minia et al. (2004) cited in the National Climate Change Adaptation Strategy 2010

Table 2: Scenarios of Mean annual temperature change for ecological zones

From the above table, it is obvious that the challenges inherent in all zones are extreme weather patterns of flooding, drought and high temperatures. On the other hand, in the transitional zone projected trends that are most likely to pose the major problems are the early termination of rainfall which is likely to convert the current bimodal regime to a unimodal regime.

In respect of sea level rise, Ghana has over the last 40 years experienced an increase of 2.1 percent in sea level. There is also the possible increase to 5.8 cm, 16.5 cm and 34.5 cm by 2020, 2050 and 2080, respectively (MESTI 2012). This is anticipated to affect cities and towns within 30 metre contour of the national coastal zone where about 25% of the population lives. It is of essence that five (5) cities are along this coastal zone of the nation with significant infrastructure including the national capital, Accra and the Metropolitan areas. The coastal areas are already extremely vulnerable to flooding and erosion. Erosion, submergence and sea water intrusion will lead to the loss of economic, ecological, cultural and subsistence values through loss of land, infrastructure, and coastal habitats.

The change in climate affects the nation's economic outputs and livelihoods, and subsequently Ghana's long term development prospects. It is worth noting also that thriving cities are crucial for national economic growth and innovation. On the contrary, an urbanisation process obstructed by climate change-induced hazards and limits, while guided by poor planning or lack of it, burdens the entire national economy.

Ghana's Cities - Urbanisation and Infrastructure

Over the past thirty (30) years, Ghana has experienced significant structural transformations. The total population of the nation has doubled from 1984 to 2013. Urban population has increased from less than four (4) million people to about fourteen (14) million people. In comparing urbanisation in urban areas to the national population, it is observed that there has been an increase from 23 percent in 1960 to 51 percent in 2010 thus exceeding the rural population. It is projected that by 2030 urban population in the country will be 22.6 million (World Bank Group, 2017). Africa in totality has been showing similar trends between years 1975 and 2015 the share of its urban population living in cities of over five (5) million increased from zero (0) to 3.4 percent, whiles the share in cities of five (5) to ten (10) million increased from 1.5 to 2.3 percent. The share in cities of one (1) to five (5) million increased the most from 3.2 to 12.5 percent, while the share in cities of 500,000 to one (1) million increased slightly from 3.3 to 3.5

percent. At the same time, the urban population share in cities of fewer than 500,000 inhabitants has decreased from 17 to 14 percent (LAPII Volume I, 2015).

Ghana's rapid urbanisation is characterised by the concentration of population, investments, economic activities and services in a small number of key cities. Three (3) major cities, including Accra, Kumasi and Sekondi-Takoradi, constitute fifty (50) percent of the total urban population. Due to their economic importance, they have engulfed smaller cities and towns having physically exceeded their administrative boundaries. Consequently, challenges arising from this development include low density expansion at peripheries reaching towns and villages that are about 100 kilometres from the centre (urban and peri-urban sprawl), ribbon development along feeder and trunk roads, and cluster patterns that lack basic services and social amenities including inadequate affordable housing. This in effect puts the expanding urban population at risk from natural and man-made disasters.

The capital of Ghana is Accra which forms part of the Greater Accra Metropolitan Area (GAMA). GAMA has a 2016 projected population of about 4.6 million inhabitants. It is predicted to more than double to 10.5 million people by 2040. It is located in the southern part of Ghana along the coast of West Africa. It occupies a total area of about 3, 245 square kilometres. Its coastline however, is 225 kilometres. Access to services is determined both by their availability and affordability. Due to proximity to infrastructure, access to services is mainly determined by location. On the other hand, affordability is determined by household's ability to pay for available services as a result of cost and income. Also, due to rapid urbanisation, the administrative boundaries at the local government level are experiencing outward expansion and proliferation of informality. This has also resulted in under serviced and infrastructure deficient communities, with increasing congestion, high levels of pollution and limited employment opportunities. Also, the urban sprawl in GAMA has brought about a change in the urban form.

Why Climate Change Matters

Evidence has proved elsewhere the negative effect of climate change on economies of nations. An example is the landslides in Sierra Leone in 2017. It is affecting Ghana's economic outputs and livelihoods too; hence the nation's long term development prospects are threatened. The country is particularly susceptible to climate change and its variability due to reliance on sectors of the economy that depend on stable weather, like agriculture, energy production and forestry. Though it is tricky to forecast, it is anticipated that the nation can look forward to more intense weather events like torrential rains, excessive heat and severe dry winds to challenge national development agenda. The increased occurrence and harshness of the climate conditions for instance, droughts and floods are potential factors to slow, delay, destroy and sternly impair land use activities and the functional qualities of infrastructure developments. It is imperative that the projected annual temperature increase of 2.2° to 3.5°Celsius - which is mostly marked for the dry season - is notably higher than the average (1.5° to 3.0° C) for the African continent. This poses a potential burden for housing design and real estate development, and has already necessitated an increased demand for energy for domestic cooling of homes.

In Ghana, it has been argued that the hot weather conditions experienced in the three northern regions have primarily accounted for “un-liveable” settlements in the dry season and so compelled the increased migration to cities and towns in southern Ghana. These population movements are apt to cause interference in the functioning of the existing energy supply, water supply, sanitation, transport, residential accommodation and communication networks of the newly inhabited areas. The migratory flows influence the running of the affected cities in the southern zone of the nation, most obviously by compounding slum development. In addition, an extremely high temperature due to climate variability is likely to also sway communication infrastructure. For instance, telecommunications data and computer centres with large quantities of heat in electronic circuits could possibly be damaged due to increased temperatures and heat waves.

Some cities in Ghana portray marked sensitivity to drought. The country has one of the lowest conversion factors of precipitation to runoff, at an average of 15 percent. Thus, major rivers basins in the nation pointed out 30 percent decrease in runoff in previous years. The country's hydroelectricity facility obtained from the Akosombo and Kpong dams have experienced critical low water levels in the past years, thus threatening hydroelectricity supply for domestic and industrial services. This has also necessitated the authority in charge (Volta River Authority) to operate below capacity. In the 1990s, the dams were partially shut down and only 85 percent of electricity needed to meet manufacturing sector was generated. This caused the economy to experience impediments such as unemployment, power rationing on factories and processing plants. Most severe impacts of droughts are accounted in the three northern regions on the socio-economic conditions of the residents.

Climate variability is particularly manifested in major changes in the rainfall patterns. Severe droughts may give way to rainfall. However, these are often torrential and apt to cause extensive runoff disruption which leads to damage to houses, bridges and utilities installations. It is worth noting that other parts of the Ghana are naturally flood prone areas. World Bank Group (2017), recorded that over the last 40 years floods have affected four (4) million people in Ghana, mostly river floods (the Volta River System), and urban areas especially Accra. It significant to note the severity of the floods has caused the loss of lives as well. The floods in 1996 record the highest deaths of 411 people to date (ibid). The table below recounts disasters in the country as a result of floods and drought that affected the greatest number of people and caused greatest number of casualties.

Year	Type	Total people affected	Total deaths
1983	Drought	12,500,000	-
1984	Epidemic	-	103
1991	Flood	2,000,000	-
1995	Flood	700,000	145
1996	Epidemic	-	411
1998	Epidemic	-	67
1999	Flood	324,602	52
2001	Flood	144,025	-
2007	Flood	332,600	56
2008	Flood	58,000	-
2009	Flood	139,790	-
2010	Flood	-	45
2011	Flood	81,473	-
2011	Epidemic	-	101
2014	Epidemic	56,469	249
2015	Epidemic	-	85

Source: World Bank Group, 2017

Table 3: Top Devastating Disasters in Ghana (1983-2015)

Impact on Urban Infrastructure

The impact of floods in Ghana’s cities leads to the temporary or permanent destruction of roads, including highways, bridges, culverts and flyovers. For instance, urban road networks in Accra have experienced near collapse in recent years as a result of bitumen being washed away by floods. Recent torrential rains occurring in the country, though unrecorded, are believed to have caused various degrees of damages to the telecommunication infrastructure like the cell phone masts, internet hubs, transformers and aerial telephone cables. It is observed that as a result of the top soil being washed away due to flooding, the buried copper and optic cable network have been destroyed. The National Disaster Management Organisation (NADMO), the institution responsible for disaster management spends an estimation of 85 percent of its resources and efforts to address issues related to hydro-meteorological disasters. Again, in 2007, the Government of Ghana spent $1,290,644.70 on floods relief victims in the Northern sector, Central and Western regions of Ghana exclusive of the various contributions made by the development partners. In June 2018, the city of Accra experienced some disasters after a heavy rainfall where people were trapped in the homes and vehicles leading to the death of two and four missing people.

It has become vital to address these urban development and resilience challenges. Proactive investment in urban resilience is essential to minimise the risks from recurrent disasters. It is intended not to only mitigate future risks of disasters, but rather protect existing infrastructure and housing, reduce poverty, and promote investments and shared prosperity. The following discussion presents approaches and policies that the country has adopted to reduce the effects of climate change in the nation.

Improving Resilience to the Effects of Climate Change in Ghana’s Cities

In order to enhance Ghana’s current and future development to climate change impacts it is critical to build resilient cities and ecosystems. In 1995, the nation was among other nations who ratified the United Nations Framework Convention on Climate Change (UNFCCC), and therefore have responded to the challenges institutionally and through policies, strategies and actions. The discussions below will review a number of such documents in Ghana, as they illustrate approaches on how the nation plans to withstand future shocks and stresses of cities and continue pursuing sustainable development.

The Ghana National Climate Change Policy (NCCP)

The Ghana National Climate Change Policy (NCCP) was prepared in 2013 and launched in 2014. Its vision is to "ensure a climate resilient and climate compatible economy while achieving sustainable development through equitable low carbon economic growth for Ghana". The government response to climate change is to recognise the policy as a development agenda and to ensure that it is mainstreamed into other policies and all sectoral activities in order to achieve sustainable national growth. The three objectives of the policy are effective adaption, social development and mitigation. However, it gives priority to adaptation over mitigation. Five strategic areas identified are: (i) energy and infrastructure, (ii) natural resources management, (iii) agriculture and food security, (iv) disaster preparedness and response, and (v) equitable social development. NCCP also identifies ten programme areas to address critical issues. Expressed as actions, these are: develop climate-resilient agriculture and food security systems; build climate-resilient infrastructure; increase resilience of vulnerable communities to climate change risks; increase carbon sinks; improve management and resilience of terrestrial, aquatic ad marine ecosystems; address impacts of climate change on human health; minimise impacts on access to water and sanitation; address gender issues in climate change; address migration; and minimise greenhouse gas emissions.

The programme areas also identify towns and communities that the policy themes and strategy would address. To build climate resilient infrastructure Nzulenzu in the Western Region of Ghana is identified as well adapted to annual flooding of the Amanzule wetlands. Flood homes in Buipe in the Northern Region are also targeted as a focus area to increase resilience of vulnerable communities to climate related risks.

National Climate Change Adaptation Strategy

This is a ten-year strategy expected to span from 2010-2020. It is expected to (i) ensure a consistent, comprehensive and a targeted approach to increasing climate resilience and decrease vulnerability of the populace; (ii) deepen awareness and sensitisation for the general populace particularly policy makers about the critical role of adaptation in national development efforts; (iii) position Ghana to draw funding for meeting her national adaptation needs; (iv) strengthen international recognition to facilitate action; (v) facilitate the mainstreaming of climate change and disaster risk reduction into national development. The strategy has been listed in ten (10) priority programmes. Aside the government, the private sector and the civic society organisation have been identified to implement the programmes in the strategy.

Ghana National Climate Change Master Plan Action Programmes for Implementation: 2015–2020

This document is a five-year plan of action focused on the ten policy areas obtained from National Climate Change Policy. These policy areas have underlined programmes and actions expected to be implemented within a specified timeline and an estimated budget. For the purpose of this paper, the second policy area, focused on the need to build climate resilient infrastructure has programmes like (i) Build capacity to design climate-resilient infrastructure (ii) climate–resilient sectoral and local development planning, (iii) ensure that key infrastructure is climate proof, (iv) flood prevention activities, (v) flood prevention activities, (vi) develop climate infrastructure for key services, and (vii) protection of coastal resources and communities.

In conclusion, rapid urbanisation in Ghana appears to be a national change, the unprecedented population growth, unplanned spatial expansions have exceeded the capacity of cities to match up. This has subsequently created housing shortages, urban sprawl, and informal settlements separated from essential city services and infrastructure. These challenges have made cities exposed to natural and man-made disasters and the effects of climate change have also intensified these vulnerabilities. Planners and the populace as a whole have recognised the impact of urban sprawl and poor infrastructure on the changing climatic patterns in country. Thus, climate change actions have been institutionalised and integrated into mainstream development policies, plans and programmes at the national, regional and local levels. Also policies and strategies have been developed as a guideline to be implemented. Institutions responsible for service provision have been decentralised so as to minimise the dependency at the national level and ensure maximum service provision at the local level. The success of all these strategies and actions that have been developed and implemented on climate change need the participation of all stakeholders that will lead to a thriving, competitive and inclusive cities.

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Endogenous resilience – integrating urban informality with climate change planning in Pacific Small Island Developing States

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Synopsis

This paper demonstrates pathways for building on the resources, networks, and latent capacities of urban informality to enhance the climate resilience of urban systems. Post-disaster case study research from two Pacific Small Island Developing States is used to illustrate conceptual and practical opportunities for urban planning to complement endogenous resilience.

1. Introduction

Resilience is a contested and emergent concept that is increasingly being applied to cities (Tyler & Moench 2012). Building on a complex, interdisciplinary discourse that draws on theoretical developments within ecology, engineering, psychology and economics, resilience "now rivals sustainability as a major organizing principle or "buzzword" for urban research and policy" (Meerow et al. 2016, p.12). The concept, however, has sustained substantial criticism from social scientists, with applications to complex social settings – such as cities – being argued to lack mechanisms for assessing subjective sub-system values and frameworks for the consideration of rights, equity and justice (Davoudi et al. 2012; Olsson et al. 2015).

Informal settlements are classified by the United Nations Human Settlements Programme (UN-Habitat) as comprising household dwellings lacking in one or more of five key characteristics: improved drinking water; adequate sanitation; durable housing; adequate living spaces; and secure tenure (UN-Habitat 2016). As such, these areas are defined by their existence outside of the institutional norms and structures that underpin city-scale governance and planning. Nonetheless, analysis of informal settlements – which provide housing for an estimated 880 million urban dwellers globally (ibid) – demonstrates a rich array of informally-derived coping mechanisms, capacities, and non-institutional social structures that are able to be activated during climate-related shock or stress events (Seeliger & Turok 2014; Jones 2016).

Observations of these capacities have resulted in a number of contemporary additions to resilience thinking that articulate 'endogenous' enactments of urban resilience, capable of operating at a sub-city level independently of 'exogenous' impositions such as those driven through top-down, resilience-enhancing interventions and capabilities (for instance disaster management systems and climate adaptation planning processes) (Ziervogel et al. 2017). In attempting to address the inequities and subjective issues referred to above, an understanding of the interface between exogenous and endogenous modes of resilience stands to benefit both the implementation of climate resilient development initiatives, and the conceptual application of resilience thinking to socially contested urban systems.

Following Helmke and Levitsky's Typology of Informal Structures and Systems (2004), this paper draws on observations of these interactions in the capital cities of two Pacific Island Countries: Port Vila, Vanuatu and Honiara, Solomon Islands. These enactments have been identified through household interviews with 6 informal settlement communities, focused on rural-to-urban migrant community members who provide a dialectical understanding of their newly inhabited urban domain (Massey 1990; Lawson 2000). This primary data has been integrated with institutional interviews, the review of policy and development project documentation, and spatial analysis of secondary socio-demographic variables, providing a multi-faceted understanding of how informal climate resilience can be enacted – and interact with – climate resilient development at a city scale.

Section 2 of this paper provides an overview of urbanisation in Pacific Small Island Developing States, setting out a rationale for focusing on these relatively under-studied urban environments as case studies in informal climate resilience. Section 3 outlines the conceptual framework that has been developed iteratively throughout this research project to explore the interplay between institutional and informal enactments of climate resilience, centred upon the aforementioned migrant dialectic. Section 4 demonstrates case study evidence of endogenous resilience, interacting with institutionalised urban functions in differing ways. Section 5 summarises wider reflections on these findings for urban climate resilient development, highlighting the importance of building on endogenous resilience in the process of planning rapidly growing cities through changing climatic shocks and stressors.

2. Pacific Island Cities

Small Island Developing States (SIDS) are a grouping of countries and associate non-UN members that are recognised for their unique development challenges, being characterised by extensive coastal and marine environments that are argued to limit the deployment of mainstream development models (Connell & Corbett 2016). Depicted in Figure 1 below, SIDS merit specific attention in a number of international development processes and agreements, including the Hyogo Framework for Action, the Paris Agreement, the Sustainable Development Goals, and the New Urban Agenda (UN 2005; UNFCCC 2015; UN 2016b; UN 2016a). Much of the rationale for this special attention stems from their high levels of economic and physical exposure to natural disasters and climate change hazards, such as sea level rise, storm surges, cyclones, and ocean acidification (Butcher-Gollach 2015).

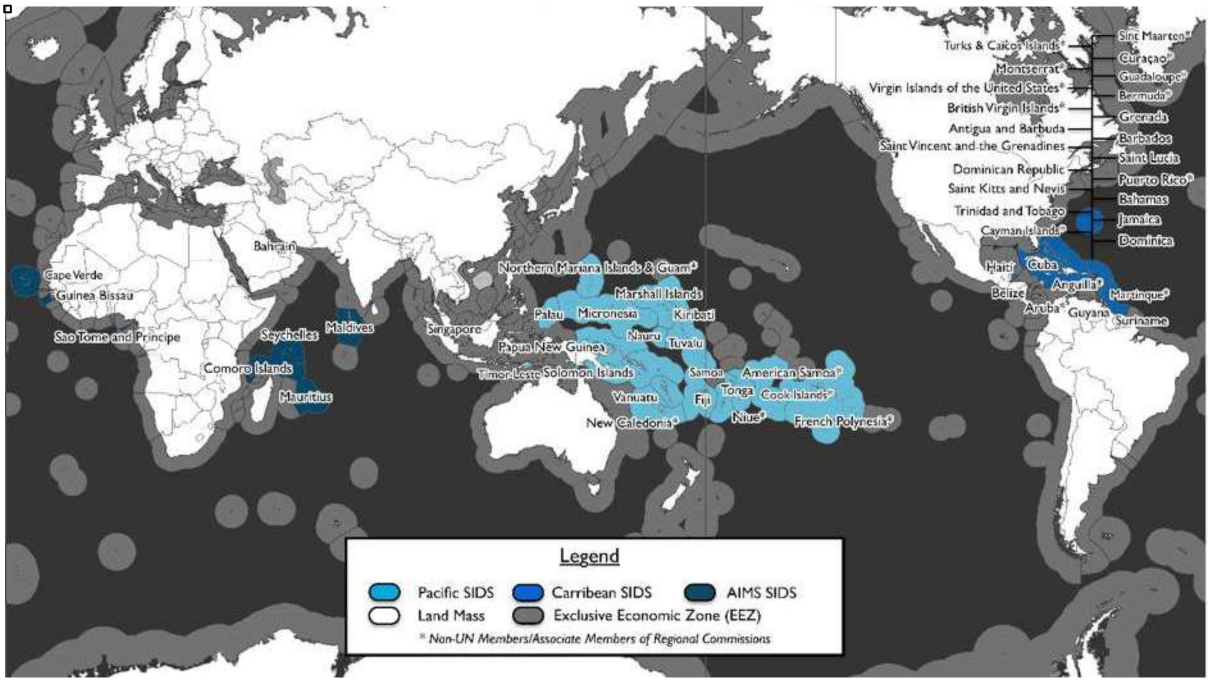

Figure 1: Groupings of Small Island Developing States (SIDS) (Trundle 2016)

Recent disaster events highlight the risks posed to SIDS by climate-related natural disaster events. The impact of Tropical Cyclone Pam on Vanuatu in 2015 was estimated to result in a total economic cost (comprising both damages and losses) of US$449.4 million, equivalent to 64.1% of the country's national gross domestic product (World Bank 2015). Despite being smaller in spatial distribution, severe flash flooding in Honiara in 2014 (known as the 'April Floods') had a similar impact at the city-scale, with damage and loss of US$107.8 million equating to roughly 10% of the more substantive Solomon Islands economy (SIG 2014).

Analysis of a series of annual country-level natural disaster risk assessments by the United Nations University's Institute for Environment and Human Security (UNU-EHS) puts these events in a wider international context. An assessment of risk reporting from 2012-2016 found Vanuatu to be the nation-state facing the most severe level of natural disaster risk globally, with the Solomon Islands ranked 6th over the same period (Mucke 2015). These rankings were determined as a function of both exceptionally high natural disaster exposure on a per capita basis, as well as an observed lack of adaptive and coping capacities at a national scale. The work of UNU-EHS echoes similar findings in urban-focused disaster risk analysis, with a Natural Hazard Risk Atlas developed in 2015 identifying Port Vila as the most at-risk urban environment out of a global sample of 1300 cities (Verisk Maplecroft 2015).

Pacific SIDS are expected to gain another 3.9 million urban inhabitants by 2050, from a 2010 baseline of 1.6 million; a rate of increase 3.5 times greater than the projected global average over the same period (Bedford & Hugo 2011). Within the Pacific SIDS group urbanisation levels and projected rates of change, however, vary substantially. Although more than half of the global population now live in cities, urbanization in the South-Western Pacific has lagged substantially behind the rest of the Asia-Pacific region (see Table 1).

	Share of Population Living in Cities			
Region	**1990**	**2000**	**2010**	***2020 (projected)***
World	42.6 %	46.4 %	50.5 %	*54.4 %*
Asia	31.5 %	36.8 %	42.2 %	*47.2 %*
Pacific (incl. Aust., NZ)	70.7 %	70.4 %	70.2 %	*70.4 %*
Polynesia	40.1 %	41.2 %	42.4 %	*44.7 %*
Melanesia	19.9 %	19.0 %	18.4 %	*19.9 %*
Solomon Islands	**13.7 %**	**15.7 %**	**18.5 %**	***23.0 %***
Vanuatu	**18.7 %**	**21.7 %**	**25.6 %**	***31.0 %***

Table 1: Regional Rates of Urbanisation 1990 – 2010 (UNDESA 2012)

The sub-region of Melanesia in particular has one of the lowest rates of urbanization in the world, with an estimated urban population share of 18.4% in 2010 (UNDESA 2012). However, over the last few decades a step-change in rural-to-urban migration has been observed. The population of Greater Port Vila for instance, grew at an annual rate of 7.7% between 1999-2009, in contrast to Vanuatu's national annual average rate of 2.5% (Trundle 2017). Similarly – and despite the Solomon Islands experiencing prolonged civil unrest and violence driven by informal peri-urban settlement around the capital – Greater Honiara grew at an average annual rate of 5.4% over the same period, compared with an annual rural population growth rate of 1.8% (SINSO 2013).

Despite housing an increasing share of their respective national populations, the presence of critical infrastructure and national institutions, as well as the co-location of most donor and non-government organisation headquarters, Pacific cities have undergone limited critical analysis; many having been isolated from customary land ownership during colonial rule, with urban residents engaged in the cash-economy being functionally disconnected from 'traditional' subsistence-based livelihoods (ADB 2010; Jones 2016). There has therefore been neither detailed consideration of the potential impacts of climate change on Pacific cities, nor analysis of how best to develop climate adaptation plans and policies pertinent to these rapidly growing urban centres (Mitchell et al. 2016).

3. Identifying Informal Climate Resilience: A Research Framework

Resilience is defined here as the ability of a system to cope with, recover from, adapt, or transform in response to a shock or stressor, as measured by an acceptable return to or maintenance of system function. This definition builds on Olsson et al.'s typology of Socio-Ecological Systems (SES) and Ecological Resilience, which identifies a need to differentiate between divergent meanings and attributes of resilience when applied to social and ecological case studies (2015). This ontological approach is reflective of cities being dynamic, non-equilibrium, transformative systems; a characterisation that is consistent with the rapid population growth and urban development processes discussed above (Folke et al. 2010).

Urban climate resilience – that is, applications of resilience thinking to urban systems, specified to climate-related current and future shocks and stressors – is applied through a more nascent body of literature. As part of this research, the use of resilience thinking in relation to urban planning for climate change has been reviewed, with related terms plotted in Figure 2 (analysis based upon a review of full-text, peer-reviewed publications in the *ProQuest* literature database). Notably, although frequency of explicit reference to 'urban climate resilience' is small in comparison with less specified resilience concepts (such as ecological, community or disaster resilience), applications of urban resilience and climate resilience have accelerated over the last decade substantially, with a focus on climate change and cities evident in a substantial number of these respective publications (Sharifi 2016).

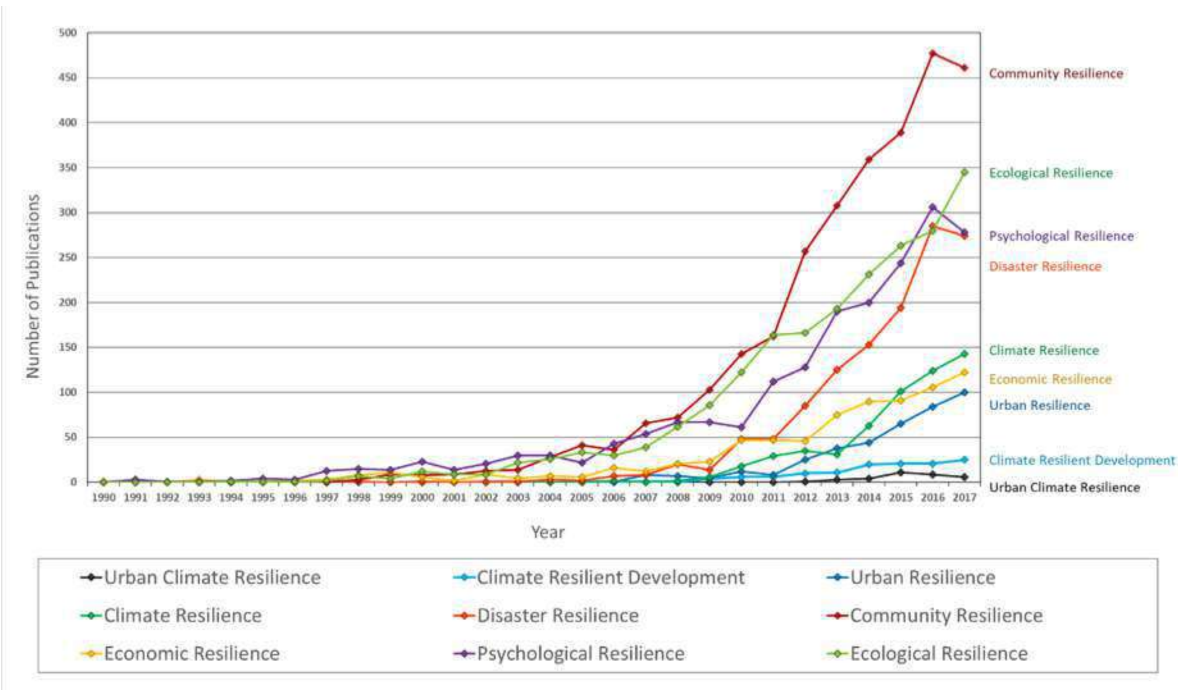

Figure 2: Groupings of Small Island Developing States (SIDS) (source: author)

As noted by Jabareen (2013), Meerow and Stults (2016), and others, the application of resilience within urban contexts is, however, much more prevalent in practice than in theoretical, peer-reviewed sources, having been promoted widely through city networks such as the Asian Cities Climate Change Resilience Network (Tyler & Moench 2012), ICLEI – Local Governments for Sustainability (Meerow et al. 2016), and the Rockefeller Foundation's 100 Resilience Cities Initiative (Da Silva & Moench 2014). Although informed largely by socio-ecological systems based resilience theory, the uptake of conceptual frameworks, such as Gunderson and Holling's Nested Adaptive Cycles 'panarchy' heuristic (2002), and emulation of theoretically espoused resilience characteristics (such as redundancy, inclusivity and predictability) has been varied (Meerow & Stults 2016). This lack of theoretical rigour has reinforced criticisms of the use of resilience thinking in heavily contested, politicised systems such as cities; at best, with these applications being little more than as a 'buzzword' (ibid), and at worst, imposing structural functionalist ideologies to reinforce neoliberal economic paradigms that "depoliticize social change" (Olsson et al. 2015, p.6).

Most critically, as Olsson et al. note, "one person's resilience may be another person's vulnerability" (ibid). This observation is particularly pertinent in reference to informal settlements, a domain where a lack of institutional control is often interpreted as a weakness in the city system (Seeliger & Turok 2014). The occupants of these settlements often represent the poorest urban migrants, with viewpoints, knowledges and resources derived domains beyond the city itself (Lawson 2000). In the Pacific, such migrants draw heavily on experiences of subsistence livelihoods, well beyond the global economic paradigms and urban institutional processes discussed above (Jones 2016).

As an initial output of this doctoral study, a conceptual framework for examining informal climate resilience in rapidly growing cities has been developed, as shown in Figure 3. This framework incorporates the nested institutional frameworks that operate in many of the urban settings within which climate resilient development initiatives are applied – as reflected in the vertical axis, allowing for consideration of Gunderson and Holling's nested adaptive cycles (2002). Enactments of informal climate resilience are then able to be considered in light of these institutional initiatives from the perspective of informal settlement households, embodied in the migrant dialectic shown at the centre of the horizonal axis of the same figure.

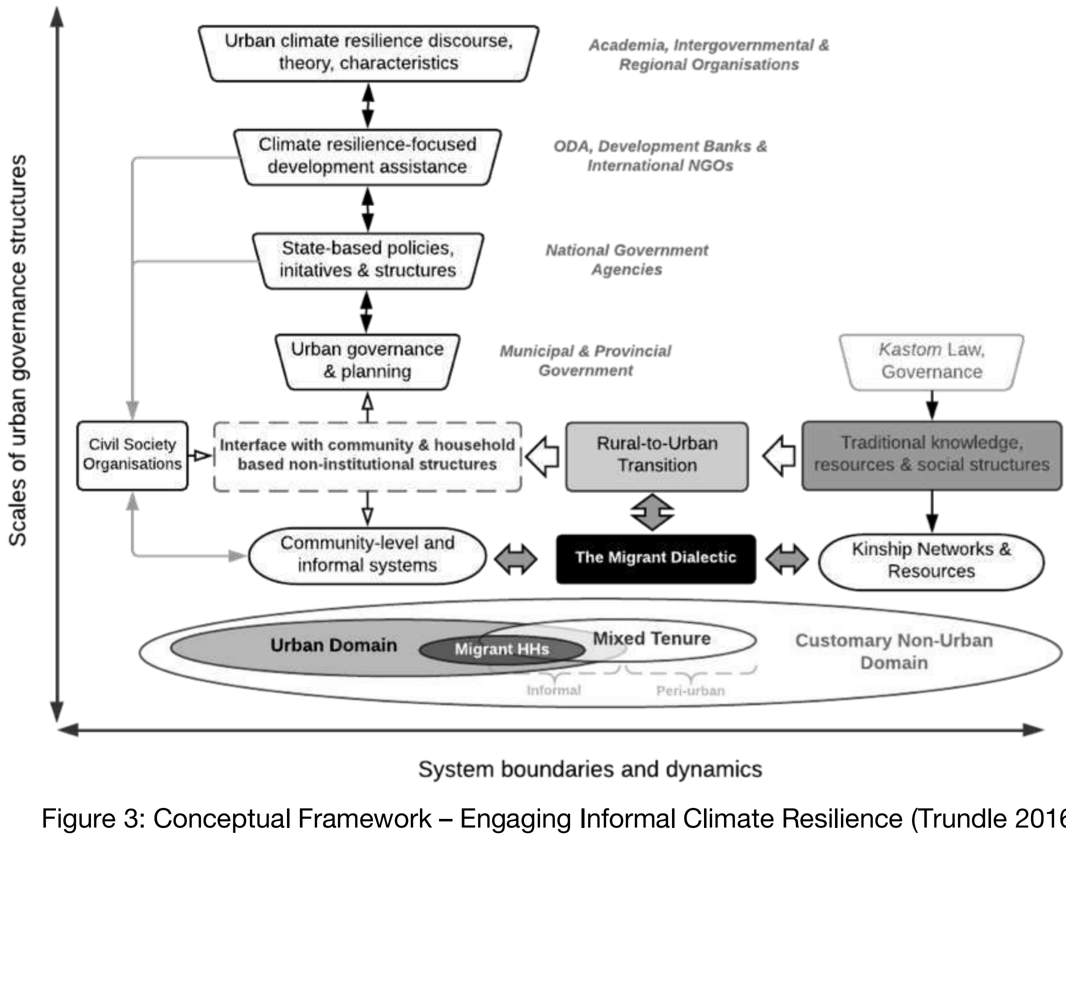

Figure 3: Conceptual Framework – Engaging Informal Climate Resilience (Trundle 2016)

A third 'axis' not able to be depicted in **Error! Reference source not found.** is temporal, rather than spatial or scale-based, but nonetheless underpins the adaptive cycles central to Gunderson and Holling's Panarchy model (Gunderson & Holling 2002). As noted by Holling in his earlier work on the model's adaptive cycle (Holling 2001, p.395):

> "The α phase is the stage that is least examined and the least known. It is the beginning of a process of reorganization that provides the potential for subsequent growth, resource accumulation, and storage. At this stage, ecological resilience is high, as is potential. But connectedness is low and internal regulation is weak. There is a wide stability region, with weak regulation around equilibria, low connectivity among variables, and a substantial amount of potential available for future options. Because of those features, it is a fertile environment for experiments … it is a time of both crisis and opportunity."

This phase provided a focal point in the two case study cities, with the aforementioned April 2014 floods and Tropical Cyclone Pam grounding the enactment of informal climate resilience in two recent and significant climate-related shock events.

4. Enactments of Informal Climate Resilience – Case Study Evidence

A mixed methods case study approach was taken in this doctoral research, centred upon semi-structured, qualitative interviews with migrant households in 6 informal settlements, as well as interviews with institutional representatives. These datasets have been integrated with secondary spatial data and the review of policy and project documentation, as outlined in Section 1. Fieldwork was conducted in mid-2017, with follow up visits to each community conducted in late 2017/early 2018.

Analysis of qualitative findings has been conducted through the thematic coding of interviews, a sample comprising institutional representatives (n=26) across each of the two case studies, as well as informal households grouped by city and community (n=57, 77 participants). Preliminary outputs from these interviews formed the basis of a series of follow-up workshops with each informal settlement community (n=6, 140 participants), as well as one customary land owner group (18 participants), allowing additional feedback and data gathering with a focus on perceived and potential interactions between informal and institutional modes of climate resilience specific to each settlement area.

A complete set of findings is not able to be presented in this paper, however examples of enactments of informal climate resilience have been identified that interact with institutional resilience across each of Helmke and Levitsky's four institutional-informal domains (2004). These domains reflect differing baseline levels of formal institutional functionality, as well as the alignment – or lack thereof – of values between formal and informal actors, and are classified as being: (i) complementary; (ii) substitutive; (iii) accommodating; and (iv) competing. Recurrent themes relating to resilience enactments across each of these domains are described below.

4.1 Complementary Informal Climate Resilience

Examples of enactments of informal climate resilience that addressed formal institutional gaps, or enabled local outcomes within the formal institutional urban framework abounded in the 6 case study communities. Most prevalent were adapted or hybrid applications of traditional disaster management techniques and knowledge, which provided a crucial source of resilience in each of the informal settlements, despite the highly modified urban conditions and limited resources that were accessible to the communities.

Examples included the use of traditional 'thinning' techniques on backyard '*sup sup'* garden crops, where leaves along the trunks of edible plants such as cassava were removed to prevent breaking during cyclonic winds and allow them to rapidly 'bounce back' following the shock event. Other applications included the reinforcement of a traditional 'A-frame' housing structure using vines and bamboo, procured from forested areas adjacent to a peri-urban community. Instances of traditional disaster response knowledge being used to supplement evacuation centres were also evident during Tropical Cyclone Pam, as summarised by one interview respondent from Etas Community in Port Vila:

> "Before Cyclone came last time, a lot of people from Banks they were hiding in caves when the cyclone hit. So we started looking for caves too here like … to me, I felt the cave was much safer. And we didn't hear any effects of like wind, we were just … it was quiet inside. We got solar, we watched laptops, movies. During the big Cyclone Pam. (ETHH3)"

4.2 Substitutive Informal Climate Resilience

Substitutive enactments of informal climate resilience were defined as those that replaced ineffective formal institutional procedures and rules. Most prevalent in this regard were the variety of faith-based community structures and associated organisations, reflective of the high levels of Christian religious xobservance in each country. As summarised by one interview participant:

> "Especially from here you go down [the valley], and it's a community. From here, valley inside lo … community has different churches. The church for one community, so they *controlem olsem* people, how they live. The church pastors, when things, problems, *em* different *lo* every community but you mention at church and they go 'oh, lets meet after prayer', bell, *em* ring and community talk about this, it's good. How we *respectem* every people of the community, *pikinini*, the women, elderly people in the community too." – JBHH4

Variation, however, within these structures reflected differing levels of institutional connectivity. In Blacksands, a peri-urban community to the west of Port Vila, a 'local' church provided a critical support structure for the community, conducting fundraising to support those who lost their homes during Tropical Cyclone Pam. The church structure itself, however, was reduced to a basic A-frame and tarpaulins 2 years after the cyclone hit (having previously been built out of corrugated iron), unable to be rebuilt using more 'permanent' methods due to complex informal land tenure arrangements with customary owners. The lack of connection to international church structures also prevented reconstruction through institutionalised church funds, with international faith-based donors disconnected from the community.

In contrast, the church central to the community of Ontong Java Settlement – at the Mataniko River mouth in central Honiara – provided extensive disaster response structures, staffing, and training to its community. It also housed the city's only early warning system for tsunamis and cyclones, which was connected to the National Disaster Management Office, demonstrating the 'fuzzy' boundaries between informal and formal capabilities in such settings.

4.3 Accommodative Informal Climate Resilience

Informal systems and structures that contradicted the intended function of formal rules – without directly undermining formal institutional authority – also contributed substantial to the resilience of both Port Vila and Honiara. In particular, the misalignment Western, planned understandings of both the household unit, and the shared nature of access to urban services and utilities, undervalued the connectivity and redundancies within informal settlements.

In terms of housing allotments for example, land was not understood to be defined in relation to a single nuclear family, but instead is traditionally occupied by an extended family network, consisting of multiple houses surrounding the head of the extended family network. This arrangement is depicted in Figure 4, which illustrates a representation of the Wind Valley community chief's formal allotment area. Although this arrangement does not comply with formal land use requirements, it does provide a critical basis for community-level resilience, enabling the sharing of resources such as standpipes, kitchens and sanitation facilities across multiple households.

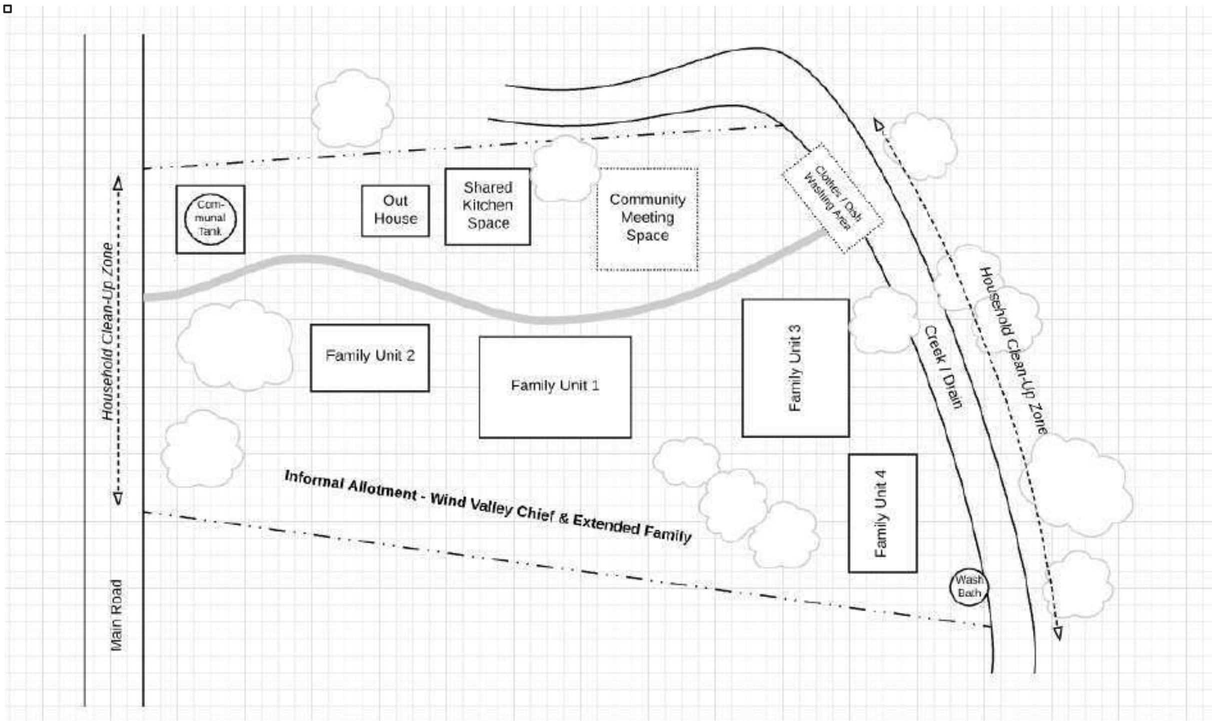

Figure 4: Multi-household allotment use in Wind Valley Community, Honiara

Other critical accommodative tenure arrangements included the use of semi-rural areas at each city's fringe for subsistence food production. As one household respondent reflected:

> "the [land owners] just provide us their land to plant food while they use the land for their project. Plant anything they want … Only families who came here first, and buy big land, acres of land, and so they just ask us to go and plant food. So that's where we now, like we said it is God's blessing, he can help us even though the land where we are staying is not enough, we can get food from the other land." (ETHH2)

4.4 Competitive Informal Climate Resilience

Most problematic were enactments of informal climate resilience that were in direct conflict with formal institutional functions. These often reflected contested or high-value urban assets, no more so than the critical resource of potable water. In the case of Jabros informal settlement, to Honiara's south, this also reflected the potential to transition from 'accommodative' to 'competing' function, as highlighted in the quote below:

> "First, when we first settled here, we have our stream here. And then, the Solomon Water come and then, Solomon Water come and pipe it …when we arrive here we used to use our stream, then they take it from us." JBHH1

Elsewhere, a lack of consideration of informal structures and tenure variation had resulted in conflict over a climate resilient development initiative, with some members of the community of Etas – a large area with mixed tenure and a number of sub-community groupings – actively undermining what they perceived to be inequitable distribution of the initiatives benefits:

> "First time somebody help us with water pipe, but like he put a pipe to each home and then some they used it but they didn't pay. And then, because, this land... people got angry, and they started cutting up the pipes" ETHH3

This lack of understanding of informal structures severely undermined institutional efforts to enhance Etas' climate resilience, with the 6000-strong community instead reliant on a stream estimated to be 2 hours walk from the settlement for drinking water, despite this source being heavily polluted by an upstream landfill site, and running dry during periods of drought.

5. Opportunities & Challenges: Urban Planning for Climate Resilience

As the examples provided in Section 4 demonstrate, informal structures have the potential to contribute to, but also undermine, urban planning for climate resilience. Equally, the lack of effective mechanisms for engaging informality within institutional frameworks is limiting, and in some cases also undermining, a rich array of locally-derived resources, structure and forms of knowledge that contribute to the overall resilience of urban systems. Critically, it is often informal structures that are most effective and defined at household and community scales, with their interface with institutional capacities reflecting the predisposition of urban climate resilience practice to operate at a whole-of-city level. As shown in Figure 5, this can exclude fundamental building blocks of resilience that draw on both non-institutional and non-urban capacities.

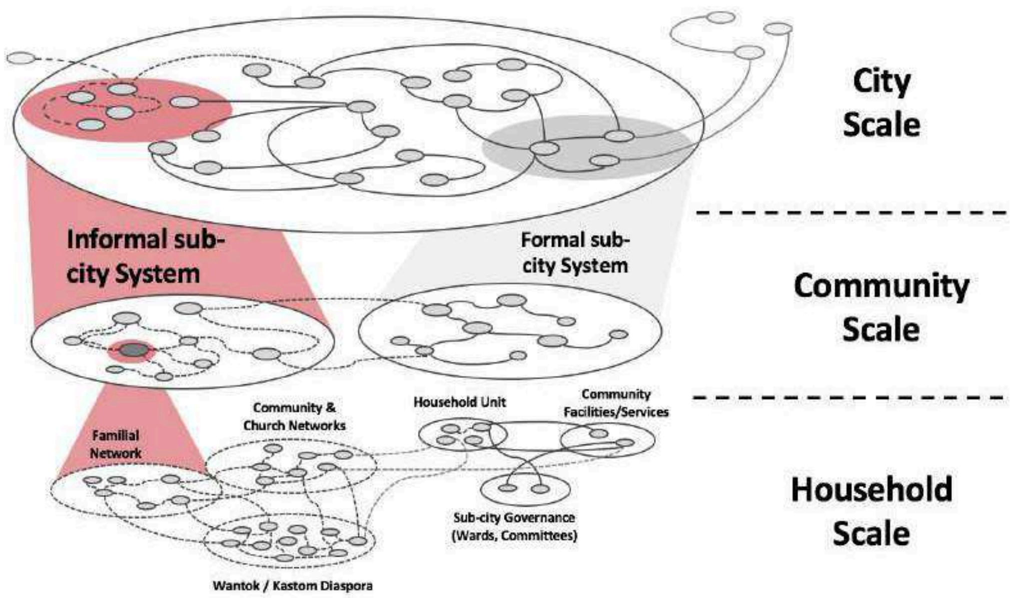

Figure 5: Informal climate resilience across multiple urban system scales

By engaging actively with informal settlements, economies, and systems within urban climate resilience frameworks as a discrete sub-city component of city systems, urban planning has the opportunity to build on a vast array of latent urban resources that are fundamental to the livelihoods of more than 880 million urban inhabitants (UNDESA 2012). With a further 2.5 billion people projected to occupy cities by 2050 (Sassen et al. 2017), there is little doubt that urban informality will continue to increase globally, and will require new mechanisms for adapting to shocks and stressors such as those generated or worsened by anthropogenic climate change.

Ziervogel et al., in their seminal article on endogenous resilience, note that "the concept of "negotiated resilience" might help to account for the situated power and political dynamics that commonly drive risk management and resilience-focused governance approaches (2017, p.9). This approach is predicted on an understanding that resilience is subjective and as such contains assumed values and distributive powers that require safeguards and principles beyond normative characterisations of urban climate resilience properties (Tanner et al. 2015).

These yet-to-be-developed mechanisms represent the most critical challenge to urban focused climate resilient development initiatives, if they are to engage with informal settlements in a systematic, but equitable, manner.

Although Pacific SIDS are in many ways unusual environments for urban analysis, their positioning at the fringe of global urbanisation presents unique insights into alternative modes of urban livelihoods and resilience-building, drawing on subsistence livelihoods, customs and traditional knowledge. While more developed cities try to establish shared community infrastructure, improve urban biodiversity and food production, and enhance local hazard awareness, these qualities are already prevalent in the informal settlements of the South Pacific. Instead of imposing Western frameworks for urban planning into such environments, an opportunity instead exists to exchange planning approaches for mutual benefit.

6. Conclusion

This paper presents some of the outputs of a doctoral study examining how informal social structures, resources and non-institutional networks are contributing to, and being engaged by, efforts to build climate resilience in Port Vila, Vanautu and Honiara, Solomon Islands. Findings were derived from a series of semi-structured interviews conducted across 3 informal settlements in each of the two cities, as well as with institutional representatives involved in climate resilient development initiatives.

By examining the dialectical position of migrant households within informal settlements, a vast inventory of informal climate resilience enactments have been able to be mapped out, both in direct response to two major climate-related shock events, and in relation to generalised resilience qualities. These enactments have then been classified in order to better understand the nature of their interaction with formal institutional objectives and functions, with a number of key themes highlighted in Section 4.

Learnings from both case studies suggest that more can be done to better support endogenous modes of urban climate resilience, with both exogenous climate resilient development programmes and the wider discourse of urban climate resilience lacking effective mechanisms for negotiating the core functions of a city-system through transformative shocks and stressors. Without a strong grounding in rights-based principles of equity and justice, resilience thinking will struggle to maintain conceptual relevance in rapidly growing, climate-vulnerable cities such as Port Vila and Honiara.

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Place-based adaptation solutions for South African settlements

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ABSTRACT:

South African settlements were planned and continue to develop in maladaptive ways with the most vulnerable households living on the urban periphery in sprawling settlements, far removed from the formal urban economy, public transport and amenities. The spatial configuration and the ways in which land is used and developed in South African settlements is often unsustainable and place communities and settlements at risk of, among others, the impacts of climate change. Place-based adaptation of the built environment, cognisant of the urbanisation challenges, will protect the development gain, contribute to the resilience of settlements and address their development goals. The objectives of the presentation are to: 1) Briefly present the evidence of the future risk trajectory of South African settlements as the rationale for the type of adaptation options that were selected from good practice examples. 2) Discuss the general urbanisation challenges and development goals of South African settlements in light of climate change adaptation. 3) Explain the process of how place-based adaptation options were linked to each settlement's risk profile. 4) Consider the implications for policy and practice in South Africa as well as other countries with similar development contexts. For this body of work, climate change projections over South Africa were downscaled to an 8x8 km resolution. The projections allowed researchers to model future hazard trends to better understand the impacts of climate changes on settlements. Combined with future vulnerability scenarios, the future risk trajectories of settlements in South Africa could be determined. A menu of adaptation options in the urban planning domain were compiled from examples of good practice. Based on the future risk trajectory, the urbanisation challenges and development goals of South African settlements, specific place-based options were proposed per settlement. The finding include that, based on climate change projections, South African settlements will in future generally become hotter and drier. Risk of future extreme events in settlements include flooding, drought, coastal and inland storms, and heat waves. This complicates the urban context even more. Key challenges include water, food and energy security, poverty, informality, inequality, service and infrastructure backlogs, lack of funding, capacity and political will to implement adaptation options, etc. Adaptation options that are place-based and context-specific will be showcased, while also reflecting on the process of developing these adaptation solutions. This body of work will 1) assist municipalities to adapt urban planning and development practices to climatic changes in line with development goals, 2) influence policy development at the urban planning/climate change adaptation nexus, and 3) identify priorities for mainstreaming climate change adaptation into local development planning. The project findings, methodology and outcomes will be of interest to many other countries with similar development and capacity challenges at the local scale as South Africa.

The role of spatial development in the energy and climate transition

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1. Synopsis

This paper is focused on how spatial development can contribute to the energy and climate targets. Focus points will be defined to indicate the role spatial development can play and a research by design exercise will be discussed. To conclude, policy recommendations in general and specifically for Flanders are formulated.

2. Introduction

Themes like nature, housing, mobility and environment have been part of spatial development for many years now. An additional focus which is receiving more and more attention (Sijmons, 2014; S. Stremke, 2017; Sven Stremke & van den Dobbelsteen, 2012; Van Kann, 2015) is the theme of energy. Just like the other themes, a structural link between spatial development and energy is needed according to these authors. Energy policy has consequences regarding the spatial design of our environment and the other way around spatial design and spatial policy also determines the energy systems.

The white paper of the spatial policy plan Flanders (Vlaamse Regering, 2016) acknowledges the challenge of the energy transition and links it to strategic objectives of contributing to a robust European energy network, living environments with a high quality of life generating a surplus of energy, reducing mobility by concentrating new developments near collective transport nodes, safeguarding energy services provided by open spaces and facilitating the generation of renewable energy in every type of land use. The spatial development principles as defined in the whitepaper are based on using less energy by avoiding wasting energy, increasing the energy efficiency by spatially stimulating the exchange of energy, facilitating the localization of renewable energy sources and bundling energy infrastructure.

This paper wants to contribute to already existing knowledge on the role of spatial development in the energy and climate transition. It aims to clarify and illustrate the possibilities and opportunities of spatial planning in Flanders to contribute in reaching the international long term targets regarding energy and climate on different scale levels from neighborhood to region. This is done by analyzing how spatial planning can contribute in an integrated way to the three energy targets: minimizing the energy demand, maximizing the energy efficiency and promoting the generation of renewable energy. At the same time, the overall goal of Flemish spatial development to stop further land take of green fields and even reduce the amount of land take is taken into account. The overall spatial strategies of doing more with less space, reusing space and reversible use of space are used as a framework to formulate concrete policy recommendations regarding space and energy. Its conclusions are based on a research project commissioned by the Spatial Development Department Flanders and the Environment, Nature and Energy Department and executed by Tractebel – Engie (Wauters, Dhondt, Fremault, & Corens, 2017).

3. Energy and space, what are the challenges?

Here, an overview will be given of the most recent insights regarding the relationship between spatial elements on the one hand and energy demand and generation on the other hand, with a specific focus on small scale energy generation, mobility and buildings. Existing literature and good practices are explored and analyzed in order to be able to indicate what the role of spatial development is. By confronting policy intentions concerning the spatial development with the desired developments on climate and energy, we can look further than a mere one-way approach in which spatial development is dependent on the objectives of energy and climate policy. This means we also explore the reverse connection: in what way can climate and energy policy contribute to the objectives of spatial policy. In order to concretely link the energy targets to the spatial context, the most important spatial elements for each sub target is analyzed.

3.1 Reducing the amount of energy used

Following the Trias Energetica (Duijvestein, 1998; Lysen, 1996) and the new step-strategy (Van den Dobbelsteen & van der Grinten, 2008) the first sub target is to reduce the amount of energy used, because the less energy we use, the less (renewable) energy needs to be generated. Within this sub target four elements should be addressed. First of all, the demand for transport should be reduced. In order for spatial policy to contribute to lowering the demand of transport, a location policy focusing on reducing the need for transport by concentrating different types of activities (like logistical centers, office and industrial areas, recreational zones and housing areas) in each other's proximity. The location of these activities influences the number of movements and the distance. The highest gains are achieved when daily activities are located close to each other. A second element would be to stimulate the use of sustainable transport options by either reducing the amount of motorized transport (by walking or biking) or using collective transport. Again location policy is an important factor. If activities are in each other's proximity walking or using a bike would become more attractive, while a smoothly operating collective transport systems relies on enough critical mass to be efficient. Moreover, facilitating sustainable transport options also requires providing the right type of space, like a network of bicycle lanes, parking spaces for car sharing, infrastructure for public transport and multimodal hubs. A third element is reducing the energy use in buildings. Energy use in buildings is mainly determined by the size of the building, the surface volume ratio and insulation. Focusing on smaller and more compact buildings and less detached buildings combined with higher insulation standards would help to reduce the energy use in buildings. In certain cases, renovation of existing buildings will not be possible or wanted. Demolition and new development (with new typologies) will offer a better solution. Moreover, because of the dispersed ownership of buildings in Flanders it is challenging to renovate buildings on a larger scale. Facilitating collective approaches for renovations could offer opportunities. The fourth element, which is also crucial to realize the first three elements, is spatial efficiency. A high spatial efficiency is needed to offer a sufficient amount of services on a short distance to reduce the need for transport. Moreover, transport over short distances is more easily made sustainable. Higher densities facilitate the organization of public transport. Building more compact is an integral part of spatial efficiency. However, each area has its own challenges, therefore a place-based approach is crucial. Using higher densities will however only be accepted if the overall quality of life does not decrease. It is therefore crucial to not only look at the individual building, but also at a district or city level making connections between buildings and green and blue infrastructure (Wauters et al., 2017).

3.2 Increasing the energy efficiency

The second sub target would be to increase the energy efficiency. First of all, the efficiency of buildings could be increased by improving the way energy is produced and transported within and between buildings. Examples are using collective installations both for generating energy (solar panels, geothermal energy) as well as distributing for instance heat (heat networks); replacing outdated installations; recover energy surpluses by introducing heat cascades and generating heat close to the place where it is used (Wauters et al., 2017). When individual energy end users are interlinked their energy need can be brought down to 1/5th of the need of independent users (Posad, 3E, Universiteit Gent, & Resourcedesign, 2016). Secondly, increasing the energy efficiency in transport is mainly a matter of technology and infrastructure. Spatial planning has only a small role to play here (Wauters et al., 2017).

3.3 Increasing the amount of renewable energy

The last sub target is to increase the amount of renewable energy. Two spatial elements within this sub target are put forward. This is first of all the use of renewable energy within buildings. The use of renewable energy can be subdivided into two components. First of all, there is the use of renewable energy generated elsewhere, the large scale renewable energy projects. Switching to renewable energy sources, like wind, sun, water and biomass, would require using more space compared to the conventional sources, because these renewable sources are a lot less energy intensive compared to fossil fuels (Sijmons, 2014; van Noordt, 2016). Moreover, the potentials of these different sources are much more place-based (Posad et al., 2016) with, for instance, the possibility to generate electricity with water power being dependent on the availability of water and a sufficient amount of height difference. On the other hand, renewable energy can also be generated on a smaller scale making it possible to integrate the generation into the built up environment, like solar panels, smaller wind turbines, biomass power plants and CHP. But although these smaller scale energy generating facilities and storage are more easily integrated into the buildup environment, they still need space and an intelligent integration. On the other hand, the great variety of landscapes in Flanders could also offer possibilities for different forms of local energy generation, local energy cycles and connecting producers with consumers (Architecture Workroom, Boeijenga, Vink, LIST/GRAU, & H+N+S Landschapsarchitecten, 2013). These opportunities could contribute to innovative spatial-energy strategies. Local renewable energy generation could also have adverse effects, like creating self-sufficient energy islands or supporting spatial developments in unwanted areas. A collective approach towards this local generation seems to be needed. Generating energy locally should not only be stimulated on the level of a building, but also on different scale levels. Generating, distributing and storing energy locally is however a very complex issue demanding expert knowledge, which is not always locally available. Spatial policy could play a facilitating role in tackling this complexity also paying attention to the three dimensional component. The second spatial element in increasing the amount of renewable energy is the use of renewable energy in transport. Again, transport can use renewable energy generated elsewhere, like explained above. Secondly, clean fuels could be used for transport. Although this is not influencing the direct spatial needs of transport itself, it does influence the location and type of distribution points. At the moment it is still very uncertain which fuel source will break through, whether these are electric vehicles, vehicles on natural or biogas or vehicles on hydrogen or even some other type of fuel. Spatial planning therefore needs to be flexible and able to quickly respond to changing trends to facilitate these new developments. New forms of transport also enable new mobility concepts; this could also have an impact on the spatial configuration. A system where cars are shared would for instance need a different type of parking facilities (Wauters et al., 2017).

4. Focus points for spatial policy

Integrating the energy and climate challenge into spatial development is more than only taking certain specific measures or using specific instruments. Climate and energy goals need to be an integral part of spatial policy. Based on the insights explained above on the relationship between space and energy, and on the analysis of several successful international examples, five aspects are put forward in which spatial policy has a clear role to play and these aspects should therefore become focus points for spatial policy when regarding energy. All of these aspects are illustrated by good practices to elaborate them into more detail and to inspire policy measures.

4.1 Active spatial policy

At the moment spatial planning connected to the theme of energy is mainly following the needs put forward by energy policy, acting merely reactive. But, in order to achieve the ambitious goals of climate policy, it will not be sufficient to only play a facilitating role. Upgrading the existing urban structure and mitigating the adverse effects of previous measures will demand a more pro-active type of policy. Moreover, the actions needed from an energy transition point of view could be used as a lever to realize spatial quality. Examples would be to support large scale renovation projects, actively supporting new housing typologies with a higher spatial efficiency, investigating how the local potential for generating renewable energy could be improved by increasing the spatial efficiency and extending energy networks to enable local energy generation. At the moment most examples of an active spatial policy are connected to mobility projects. Reorganizing (car) mobility plays an important role in both small and large scale projects. The overall goals are twofold: on the one hand an increase of the quality of live is pursuit by reducing noise, enhancing air quality and reducing spatial impact, on the other hand more space is dedicated to alternative forms of transport (Wauters et al., 2017). In Barcelona, for example, so called 'Super Blocks' are created with large car-free zones for bicycles and pedestrians and ring roads with good public transport and other facilities. This project proves that large changes or investments are not always necessary to achieve improvements (Joanneum Research & UNDP, 2017). In a new brownfield development in Amsterdam, Buiksloterham, developers are obliged to take a number of sustainability measures regarding energy, resources, climate and mobility. Only those project proposals that reach a high level of sustainability are selected. Moreover, the municipality of Amsterdam regards geothermal energy as one of the most important renewable energy sources. In order to facilitate the use, an underground energy plan is made. This plan offers a framework for new geothermal systems with the goal to avoid negative interferences and to use the potential available to the fullest (Metabolic, Studioninedots, & DELVA Landscape Architects, 2016).

4.2 Collectivizing interventions

Challenges in both the housing and in the transport sector are asking to be tackled in a more collective way, especially on a lower scale level. Examples could be local energy initiatives, collectively improving the sustainability of the housing stock, extending collective types of transport and providing collective facilities for new sustainable types of fuel. For certain energy projects, collectivizing is essential in order to make the project profitable (Wauters et al., 2017). For other cases, like in the example of Vauban, Freiburg, collectivizing interventions is a way to reach sustainability goals that go beyond the scale of the district itself. In Vauban collectivizing certain measures goes hand in hand with participation. Collectivizing could also be a way to involve larger groups of residents with the energy and climate policy, reducing the resistance towards certain projects at the same time. Executing projects in a collective way can be done on many different scale levels. On the level of one building, on the level of a building block, a district or even a whole city several examples can be put forward like cohousing, exchanging renewable energy, heat networks and so on. An important issue to be able to collectivize projects is a clear framework from the government that facilitates collective action. This could be done by either administrative simplification or active policy. Governance is also needed in order to align different initiatives. When looking at the case of Freiburg, collectivizing, in the form a citizens building assemblies, has proven to be the key to reach higher densities without decreasing the quality of life. On the one hand less space is used by providing collective facilities like collective heat production, collective forms of transport and collective outdoor areas, while at the other hand energy use is reduced and housing becomes more affordable. The revenues and added value are used to finance the greater investments in insulation and energy generation (Salomon, 2009). Another example of a collective project is a new housing development in Naaldwijk, The Netherlands. In this district 146 houses and a nursing home are heated by residual heat from the adjacent green houses in summer. This residual heat is stored underground and used during the winter, while the cooled down water can be used in summer to cool the houses (KAW Architecten, 2017).

4.3 Place-based policy

Demographic and geographical differences need to be taken into account within a place-based approach to be able to use local opportunities and neutralize local obstacles. Rural areas with a shrinking population need other approaches compared to suburban districts with young families. Moreover, the efficiency of renewable energy sources knows important regional differences. Most of the existing energy projects take site specific characteristics into account. Custom made solutions are applied in order to tackle local challenges. A one size fits all solution is not possible regarding energy projects (Wauters et al., 2017). A special example of place based policy is Geneva where planning of energy production and consumption is directly combined with spatial planning. A total integration of energy aspects within spatial development projects is achieved by adjusting the regulations. This approach recognizes the need to not only focus on the individual level of buildings to achieve the climate targets, but instead to focus on the whole territory of Geneva and its land use. In this canton energy concepts are developed at a district level. Based on an analysis of the locally available resources, the needs, the actors and infrastructure a strategy for sustainable energy supply is developed at region, city, district, quarter and neighborhood level. Part of the strategy is also to inform individual residents, based on the above mentioned analysis, about the most suitable heating system like geothermal, heat network and so on (Favey, 2013). Rotterdam as well has a clear place based approach. The Rotterdam Energy Approach and Planning (REAP) offers a scheme with which each neighborhood can sustainably be redeveloped. The REAP methodology is a newly developed practice to become climate neutral for both new developments as well as existing neighborhoods. It is based on the principle already explained above: to first of all reduce the energy demand, secondly to reuse residual energy and lastly to apply sustainable energy sources. Originally there was a fourth step to meet the remaining energy demand by using fossil fuels as efficiently as possible, but the first three steps should make this last step unnecessary. Based on the different types of housing typologies recommendations are made to undertake actions for each of the three steps (Tillie et al., 2009).

4.4 Tuning different policy levels and policy fields

There needs to be a higher degree of alignment between spatial policy at the one hand and other policy fields at the other hand. Prospective studies and investment plans for improvements on existing infrastructure or extension of infrastructure for instance, needs to align spatial opportunities. Connecting energy generation with a clustering of different functions could increase the energy efficiency, while existing heat sources could facilitate development of new functions with a heat demand. When (inter)national good examples are analyzed one of the conclusions is that they do not focus only on the energy- and climate transition. Often these projects also want to realize other goals like city-development. By combining diverse goals, the project also gets interesting for other users or initiators (Wauters et al., 2017). For example, in Gent Dampoort a project on building block renovation took other goals besides reducing the use of energy into account, like security (fire safety, reducing the risk of CO-intoxication), health and the quality of the environment. In the end the project produced a manual in order to inspire and guide other possible projects towards building block renovation. Forging alliances is one of the crucial elements to guarantee success. Existing instruments were integrated into a unique partner cooperation (Canfyn, 2013). The case of 'Hammerby' in Stockholm, Sweden is another good example of how different sectors need to be integrated. In Hammerby the goal is to close all the cycles (of water, waste, materials, etc.) This necessitates the cooperation and adaption between many stakeholders and government institutes. On the other hand, synergies can be achieved by this type of interdisciplinary planning of energy, water and waste flows (Gaffney, Huang, Maravilla, & Soubotin, 2007). At the moment most of the newly developed projects have no relationship with other projects or with their direct environment. In order to facilitate an integrated approach, regarding both energy consumption and energy generation as well as water management, traffic policy and so on, different scale levels need to be included. Moreover, combining or even integrating spatial planning with other sectors, like mobility, housing or energy has also proven to result in more effective policies.

4.5 Awareness & training

Spatial policy only has a limited impact on the way projects are executed. Creating awareness with all the involved actors like architects, therefore remains a crucial aspect in developing climate and energy friendly projects. Good practices are needed in order to show how certain changes can be achieved in the field. Furthermore, a change in attitude and behavior is needed to fully realize the energy transition. A shift from private to collective transport, from dispersed to dense urban areas and from energy wasting to energy saving attitudes is not only a matter of spatial development, people using that space are the most important factor. Communication and direct knowledge support is needed. Many of the cases already mentioned invest a great amount of their attention towards participation and communication. By involving a high number of participants in an early stage knowledge can be exchanged and build up (Wauters et al., 2017). The example of 'Leuven low traffic inner-city' combines participation with awareness raising. The project started with an initiative of local residents wanting to convince people of the advantages of a car free inner-city. Through a website an awareness campaign is being conducted by informing residents, visitors, merchants, restaurants, schools, businesses, service providers and the local government and motivating them to participate (Platform Autoluwe Binnenstad, 2017). One of the most known international examples of climate and energy friendly cities is Copenhagen, it aims to become the world's first CO2 neutral capital by 2025. Although Copenhagen is already scoring high points on mobility (mostly by bike and public transport), housing (space saving apartments) and energy efficiency (using district heating), still more can be done concerning saving energy, the modal split and reuse of waste. This is why one of the six action areas is focused on 'Copenhageners and Climate' in which 9 initiatives are dedicated to information, consulting and training (City of Copenhagen, 2009).

5. Research by design, case of Veurne, Flanders

To further specify and evaluate the role of spatial development within the energy transition a research by design exercise was executed on a concrete case. By applying some of the insights derived from literature and international examples, further insight can be achieved into the possibilities, limitations and conditions of measures in a Flemish context.

The case of Veurne deals with a typical Flemish allotment area from the second half of the 20th century. This neighborhood, 'Voorstad', is an example of the dominant living environments in Flanders in the second half of the 20th century. The neighborhood itself developed between 1970 and 2000 and is characterized by an aging population, low population density and houses which are no longer adjusted to the current living standards. Moreover, the projections for demographic developments predict a shrinking population by 2030. It's location, however is relatively good, with a close proximity to the city center, although the connections towards this center are rather poor, resulting in a high use of the car for all movements. Due to the good location and changing population, it is expected that the neighborhood will enter a period of high dynamics. The goal of the research by design exercise is to analyze how this neighborhood can transform towards a more sustainable neighborhood, keeping the existing local specificities into account, but also the energy challenges and focus points like explained above.

5.1 Using densification as a principle for energy transition in a neighborhood

The first principle that is applied to the neighborhood 'Voorstad' is densification. Densification principles have been investigated from different angles the last years like affordable housing and landscape, but less from the energy and climate point of view. Many new principles regarding densification have been put forward, but at least in Flanders, not much is moving. The different principles regarding densification have been put together in a matrix in figure 1. The x-axis represents the scale of densification and the number of involved owners. Starting with one plot, over several plots to a small building block. The y-axis represents the intensity of the extension. From small extensions using the existing footprint to a complete renewal of a building block.

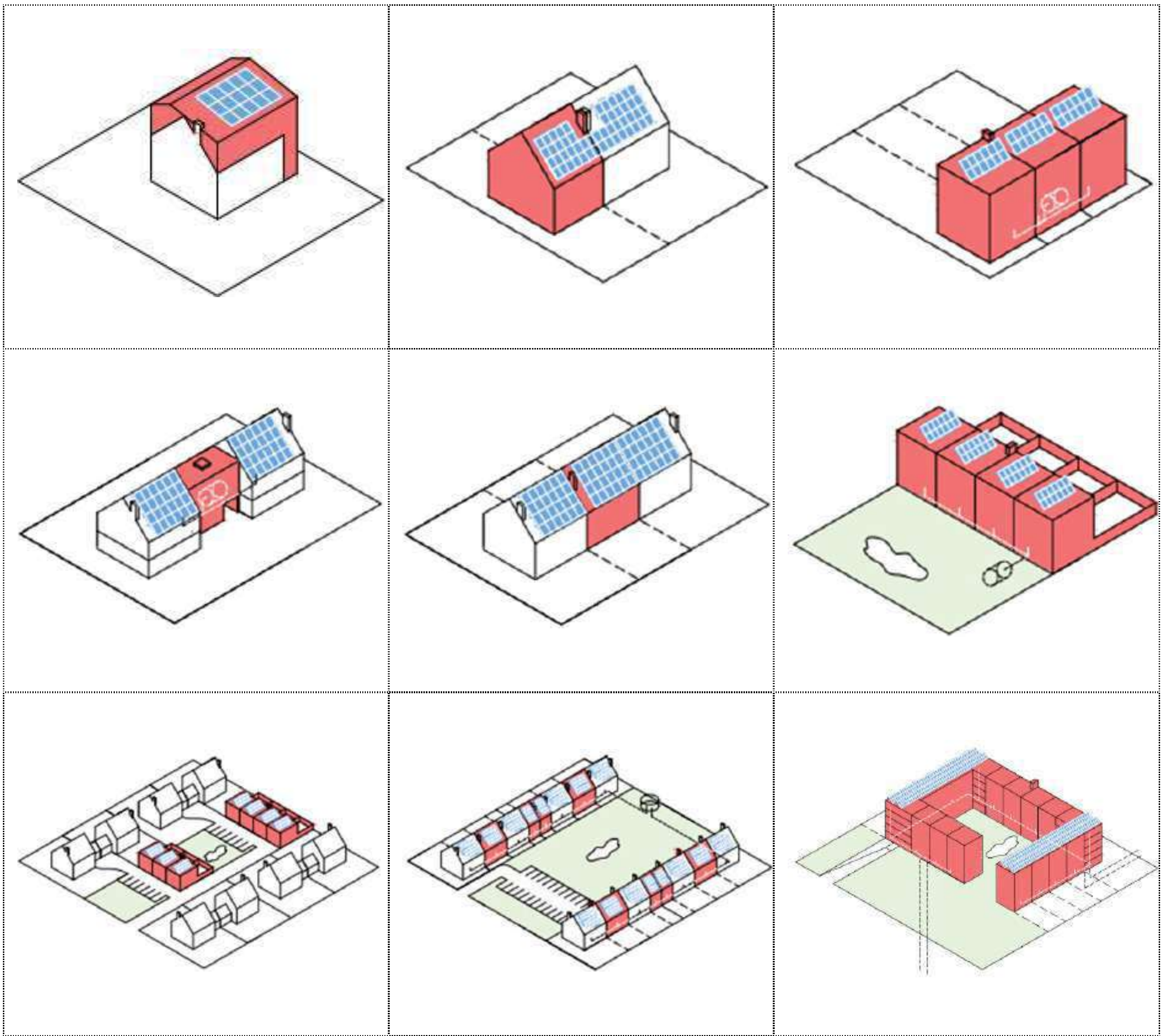


Figure 1: Principles of densification

Based on these principles a scenario exercise has been done that analyzed each individual building on its quality. By using a decision tree choices can be made not only for individual buildings, but also for neighboring houses and the whole block. This analysis made it possible to decide which interventions were needed for each building. Each plot realized progress concerning sustainability. Every densification strategy achieved either higher compactness, a better orientation, higher densities or collective energy production, or a combination of these components. Profits are not achieved by one large investment but by combining several small scale interventions, that enabled residents to take their own initiative.

5.2 Reducing car dependence to minimize energy needs

The second principle is focused on mobility and encouraging walking, cycling and using public transport (in that order) instead of the car. By adding more fine-grained connections for walkers and cyclists and by paying attention to the organization of the infrastructure, for example the width of a footpath, walking and cycling can be encouraged while using the car discouraged. Figure 2 shows the design principles. Most research on applying these principles has been done in newly developed, highly urbanized areas, while there is a lack of research on how to do this in existing allotments, like the neighborhood in Veurne.

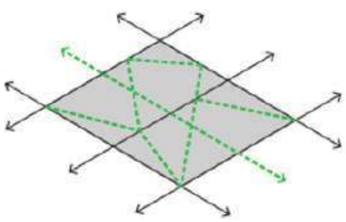
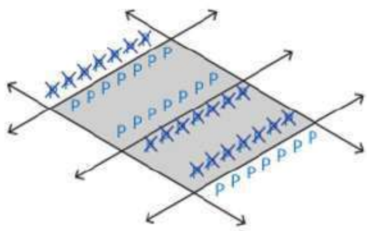
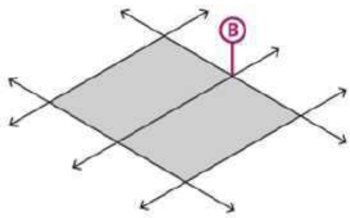
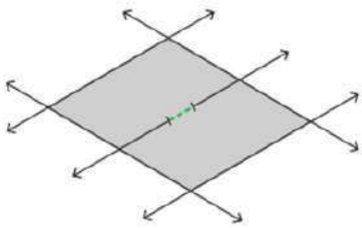
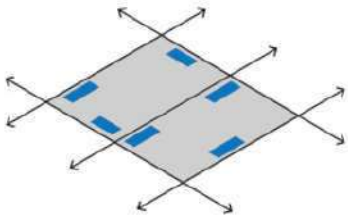
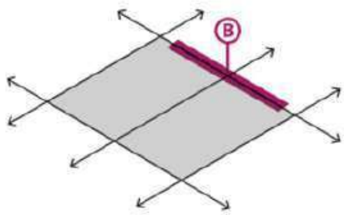
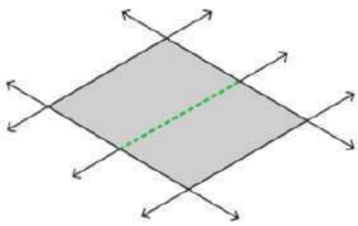
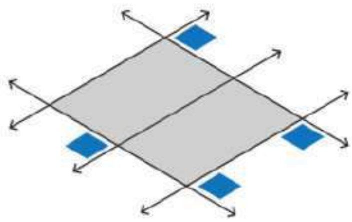
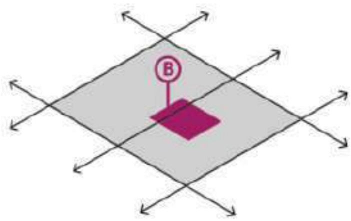
Increasing the comfort of pedestrians / cyclists	**Discouraging car-use**	**Improving public transport**
 Fine-grained network for pedestrians and cyclists	 Less parking lots	 Public transport stop next to neighborhood
 Car-free streets	 Collective parking & car sharing	 Public transport stop & amenities next to neighborhood
 Car-free neighborhoods	 Collective parking & car sharing outside neighborhood	 Public transport stop & amenities in neighborhood

Figure 2: Principles for mobility

By analysing and categorizing the existing road network in Veurne a differentiated strategy for each road can be developed based on the above principles. Three main road loops could provide sufficient accessibility, while roads outside these loops could be downgraded to infrastructure for bicycle and pedestrians on which cars are not allowed. Collective car parks farther away from the houses are introduced to further minimize the amount of cars in the neighbourhood. To increase the accessibility by foot and bicycle to the city centre new connections for this type of transport is added.

5.3 Spatial instruments

When analyzing the existing instruments for spatial development in Flanders, it becomes clear that these instruments are adequate to accomplish the measures like indicated above. Most larger and middle sized towns are already using these instruments with success. However, smaller towns and 20th century allotments are not. They could use support in creatively implementing a variety of proposed measures to create more sustainable neighborhoods. When doing this they should first of all examine the location of the neighborhood: does it have enough potential to further develop? A second step is to analyze the urban planning structure: is this robust enough? The third step would be to zoom into the buildings themselves: are they still qualitative enough to keep or adjust? (Wauters et al., 2017).

6. Policy recommandations

An active, place-based approach that takes local specificities into account and makes use of local opportunities seems to be needed to facilitate the energy transition. In this part several recommendations towards spatial planning in Flanders at different policy levels are given.

6.1 Location policy

First of all, a smart location policy is needed (Wauters et al., 2017). Structural improvement of the performance of the urban system is only possible when spatial policy in Flanders drastically changes its course towards reduction of mobility. Allowing developments like housing areas and business parks to take place on sites which are not suitable undermines all other efforts. This issue is also deeply connected to the subject of land take. Flanders has one of the highest built up and sealed up areas of the world, stopping a further increase of land take would therefore greatly facilitate increasing the spatial efficiency and redevelopment of brownfields. Selecting suitable sites for future developments is crucial and could be based on the study recently executed by VITO on the value of nodes (Engelen et al., 2016). This “node-value” is based on accessibility by public transport and the availability of services. Further research however is still needed to elaborate on this ‘node-value’. Should it for instance also need to include aspects of renewable energy availability or other aspects like quality of life, safeguarding flood prone areas and so on. An integral assessment framework is therefore needed.

6.2 Interventions within existing urban fabric

Serious energy reductions can only be achieved when the attention of spatial development is shifted from new green field projects towards transforming the existing built up areas (Wauters et al., 2017). Special attention needs to be given to frequently occurring situations in Flanders like the 19th century belt and the 20th century allotments. Transforming and redeveloping housing types which are difficult to upgrade should not be treated as a sacred cow. For some badly located sites the only solution is to demolish the buildings and relocate them. This strategy is not only beneficial from an energy perspective, but will also have other benefits like creating more open space for other functions like green-blue infrastructure. These type of actions will only be possible if there is a high sense of urgency both within the general population and within policy makers and should mainly be applied within those sites with a low ‘node-value’. This also necessitates the development of policies for shrinking regions, where demographic scenarios are predicting a decreasing population. People are leaving because there are no jobs, low services or a bad connection towards other places. This leads to a downwards spiral, where lower population densities trigger those services which are still there to close down. Shrinking areas could demonstrate important potentials as well to realize the goals towards climate and energy. In these areas the existing spatial structure could be changed by focusing on strengthening the cores, increasing urban densities in those cores and clustering services.

6.3 Urbanize

Although most attention in the last decades has been put on urban areas resulting in many urban interventions, the challenges remain, particularly when focusing on mobility. In Flanders urban areas are regarded with anxiety by most inhabitants as places which are lacking green spaces and privacy. The administrative boundaries of urban areas do not coincide with the functional boundaries, resulting in a suboptimal (collective) transport system and lack of investments in bicycle highways. But besides the transport system, a change in the mindset towards housing typology within the functional urban areas is also needed. Within cities, neighborhoods are mixed and vibrant places where several functions and typologies exist side by side, whereas in the 20th century suburban sprawl a mono-functional organization dominates. Transforming from a mono-functional ‘housing area’ towards a ‘city neighborhood’ will decrease the need for transport, increase the spatial efficiency and reduce depopulation (Wauters et al., 2017). Cities are highly dynamic environments, where innovations are tested, also regarding new energy solutions like new ways of living together (co-housing), exchanging energy or collaboration (circular economy). Facilitating these types of dynamics by giving them space to experiment could support the discovery of new spatial solutions.

6.4 Space for renewable energy

The urban sprawl greatly influences the possibilities to realize larger scale energy projects. Although Flanders has a similar density as Denmark and Germany, the share of renewable energy generated by wind turbines is remarkably lower. Open spaces are scarce, reducing the opportunities for wind turbines and increasing the amount of people negatively affected by wind turbines. The spatial structure of Flanders can however be changed, like examples from the past show. In the SIGMA-plan, large areas were designated as ‘overflow’ areas for rivers, preventing other, more populated areas to be flooded. The new spatial policy plan Flanders also focuses on a structural change within the built up area: by intensifying built up area around well connected nodes and reducing the built up space in other areas, space is opened up for other functions like placing wind turbines. Prioritizing the energy transition, also in spatial policy, needs long term visions and the development of financial instruments to support the already existing instruments (Wauters et al., 2017). Active policy can be supported by mapping renewable energy potentials and using these potentials in a place-based approach.

6.5 Supporting local governments

At the moment many local governments in Flanders are struggling to make the right choices regarding energy and spatial development. The region of Flanders, but also the provinces can play an important role in supporting those governments. First of all, Flanders could serve as a knowledge broker towards local governments. Much research has already been done at the regional and provincial level that could be beneficial for local governments, making sure these insights also reach the lower levels should be one of the tasks. This could be done by supporting the development of concrete projects either by providing ready to use instruments like assessment frameworks or energy potential maps or by providing a pool of experts that could give input. Second of all, the local level can be supported by providing new types of collaboration and financing models, which can be used within new developments. Lastly, there is a need in Flanders to start experiments which can inspire other municipalities. The existing good practices are mainly located in foreign countries, with other spatial specificities and planning practices. Starting innovative experiments which are representative for the Flemish context and take local specificities into account are therefore crucial. Moreover, these experiments should not stop at just providing a masterplan, they should follow the project towards realization and even beyond (Wauters et al., 2017).

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The Ground Beneath Our Cities

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Abstract:

The subsurface is important for cities. Cities not only expand outward and upward, but also downward. The more use we make of subsurface space, the more surface space we free for the one function that cannot do without daylight and fresh air: living. Increasing urbanisation challenges the sustainability and resilience of cities world-wide. At the same time, often overlooked are the resources and opportunities in the ground beneath our cities. This is one of the reasons why a European network of specialists joined together with the aim of improving the understanding and use of underground space. The participants of COST Action TU1206 Sub-Urban (2013-2017) display a cross-section of skills and knowledge of subsurface issues in 31 European countries and 26 cities. After sharing their experiences, the common pathways (and pitfalls) to improve collective planning of the subsurface became more evident. A key recommendation from this work is improving communication between the urban planners and the subsurface experts.

1 Introduction

Exploitation of underground space is not new, as is well documented (Admiraal & Suri, 2015;Bobylev, 2016; Campbell et al., 2017; Mielby et al., 2016; van der Meulen et al., 2016). Geology plays an important role in how cities develop with regards to the subsurface, as exemplified by Reynolds & Reynolds (2015). However, there is still a lack of usage of geological information: data and knowledge, when it comes to underground space that can reduce risk and increase cost reliability, cost efficiency with re-use of data in projects and build sustainable and resilient cities for the future. Most cities expand on the surface, but this expansion has its limits (Wang, 2015). As Wang (2015) points out, the subsurface is an untapped new frontier for cities. We differentiate between the built environment and the natural environment. To achieve resilient and sustainable urban development the two should go hand-in-hand and not compromise. That is the motivation behind the work of the Sub-Urban network.

This paper will present the collective work of the network COST Action TU 1206 Sub-Urban that was active from 2013 to 2017 with its final action dissemination in April 2018. The aim for the Sub-Urban network was and still is to increase the awareness of the possibilities and challenges that lie in the ground beneath our cities (TU 1206 Sub-Urban, 2012). At present, the subsurface is regarded when it gives an economic possibility, such as mining or other resources, but more commonly when challenges occur, such as unforeseen problems in tunnel building, sink holes, collapsing foundations and many more examples (van der Meulen et al., 2016; De Stefano et al., 2015). During the Actions four years the network increased to 31 participating countries and 26 city partners. The core structure was the Geological Surveys in Europe collaborating on common challenges; how to increase the awareness of the subsurface in urban planning and make the most of the information Geological Surveys collect and manage (Campbell et al., 2017). The principle rule was that each country should bring at least one collaborative city partner into the network, so that the planners' view and understanding of the challenges and possibilities got a strong voice. Other institutes such as Universities etc. were also welcome to join (TU 1206 Sub-Urban, 2012).

2 Underground space in European cities

Although all cities are different in historical and cultural setting, the challenges they experience are surprisingly similar (van der Meulen et. al., 2016). Increasing urbanisation confront the sustainability and resilience of cities world-wide (Admiraal & Suri, 2015). The obstacles of the subsurface are plentiful, such as cavities (De Stefano et al., 2015), and unforeseen ground conditions. At the same time, often overlooked are the resources and opportunities in the ground beneath our cities, with examples from Oslo, Rotterdam, Glasgow, Odense, Ljubljana and Lisbon.

2.1 Oslo – value of the underground

Oslo city, the capital of Norway, is one of the fastest growing cities in Europe. That requires urban planning not only above ground, but also below ground. Especially public transportation is in focus, to enable commuting within reasonable distance and time from the city boarder and surrounding areas. The in-the-making Follo railroad is estimated to 3 billion Euro, while existing subsurface infrastructure has an estimated value of 11 billion Euro with planned constructions at a budget of additional 6.2 billion Euro (Bekkhus et al., 2018 *in prep*; Venvik et al., 2018). Since the underground constructions are out of sight, their value and function is often not appreciated compared to constructions at surface, such as buildings with impressive architecture.

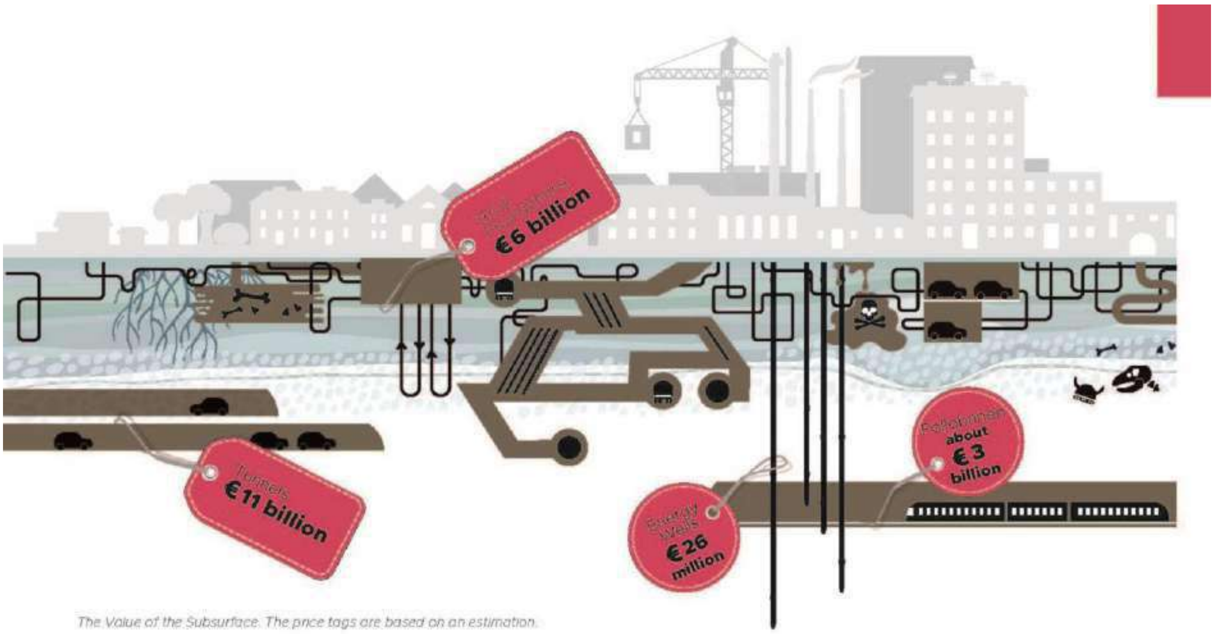

Figure 1: Oslo city has estimated the value of the subsurface, already existing and ongoing contractions. More underground installations are planned, constantly increasing the value.

2.2 Rotterdam – from contaminated ground to holistic urban planning

Rotterdam city, on the western coast of the Netherlands, is one of (few) cities that has achieved a lot regarding resilient and sustainable management of the subsurface in urban planning. In a way, one might say that they are forced to, having a city below sea level or at the riverside and ocean front. The challenges for Rotterdam became evident when re-development of the city began after the second world war (1950-60).

Formerly industrial areas or brownfield were turned into residential areas. That was when polluted ground became a main focus for the municipality and lay the grounds for ground investigations for contaminated soil, and collecting data regarding the subsurface in a public sector. “Soil Protection Act” in 1987 was a result of this work. Re-organization within the public sector lead to merging of urban planners, engineers and urban development into a collaborating team forcing a holistic approach regarding urban development (van Campenhout et al., 2016,). Geological information of the subsurface is implemented into the planning process at an early stage. Contaminated ground is mapped and data is available when decisions of development is executed. Rotterdam is an inspiration of good collaboration across disciplines and a holistic approach to common challenges for the best and most sustainable solutions for urban planning (Rotterdam Resilience Strategy, 2016).

Figure 2: Rotterdam City in 2035 – the other half of Rotterdam. Using the subsurface in a wise manner gives urban development a new dimension to explore. Illustration: Gemeente Rotterdam.

2.3 Glasgow – making the best out of old money-makers – up-cycling old mines into renewable energy

Glasgow is an old mining city, on the western coast of Scotland, UK, which had its victorious time in the late 1800. The mining activity has left the underground penetrated with abandoned mine shafts and cavities that has given challenges regarding the underground. In the recent years up-cycling (or creative reuse) of the city is in focus, from a city with economic and social decline to a turnover in growth and prosperity. To enable such up-cycling ground conditions is central, and it spans from contaminated brownfield turned into residential areas, across developing infrastructure, to abandoned and problematic mines turned into renewable geothermal energy (Whitbread et al., 2016).

To enable the up-cycling of Glasgow, geological knowledge and data about the underground is essential. Glasgow city council is in close collaboration with the British Geological Survey (BGS) to facilitate data for urban planning to reduce time spent, increase data-reuse and avoid future incidences (Bonsor, 2016; Whitbread, et al., 2016). Communication and a common language has been one of the most important building bricks to bridge the gap between disciplines and enable collaboration for a common solution. This involved re-organization within the municipality and exchanging working tasks and focus for BGS. A geological model of the underground is developed to form the basis for development projects, both infrastructure and buildings, where public and private actors and users can contribute to further development (Whitbread et al., 2016).

The main threshold that had to be dealt with was gathering and organizing data about the underground, especially borehole information. Previously, the ownership of the data was spread among private companies that executed the drilling. Throughout the up-cycling

Glasgow council has changed the contracts on their behalf, where all data collected in public projects are of public property and for BGS to manage the data, organized in their databases (Whitbread et al., 2016).

Figure 3: The underground of Glasgow city is full of old mine shafts. Not all are well mapped and accounted for. This drilling machine was mapping the quality of the subsurface when it occasionally found an abandoned mine shaft and fell in. Photo: British Geological Survey.

2.4 Odense – letting citizens take part and find solutions for reoccurring problems

The largest city on the island Fyn in southern Denmark, Odense has it challenges. In historic times, the water source for potable water came from the ground beneath the city and within the city borders. The depletion (abstraction) of groundwater lowered the groundwater level and dried up previous marsh and wetlands, creating new ground for urban development. As the city grew, and with increasing populations the threat of epidemics spread by drinking water, the water source was moved outside the city borders and into the nearby municipality (Laursen & Mielby, 2016).

With time, this change of water source caused the groundwater to rise and return to natural (old) water levels, returning developed land into marsh and wetlands. This change causes flooding of basements, streets and infrastructure. In a residential area that had reoccurring flooding the citizens came up with a sustainable solution that the municipality buys the damaged properties and turns the area into a storm water basin and recreational park (Figure 4; Laursen & Linderberg, 2017).

Figure 4: From problem to solution. Above: re-occurring flooding in residential areas in Odense city. Here from Ejersminde Street. The citizens themselves came with the proposition to turn the most challenged are into a storm water basin that also functions as a recreational area for the neighbourhood (Laursen & Linderberg, 2017). Photo: Ejgil Juul Nielsen.

2.5 Ljubljana – managing two possibilities in the best manner for maximum benefit

For Ljubljana city its most precious resource lies in the ground beneath, clean drinking water of good quality and in large amounts, enough to keep the entire city with potable water. The challenge is to keep the groundwater safe from harm and hazard, such as pollution and bad water management. Groundwater, as underneath Ljubljana, is a natural source of clean, well-protected and naturally purified water ready to drink (Janža et al., 2016 and Janža, 2017).

This jewel is also a resource for renewable energy; shallow geothermal energy for heating and cooling. Ljubljana, as several other cities, are today supplied by fossil fuel for heating and electricity. By using the groundwater for heating and cooling the CO_2 emission can be decreased enormously in short time (Janža, 2017).

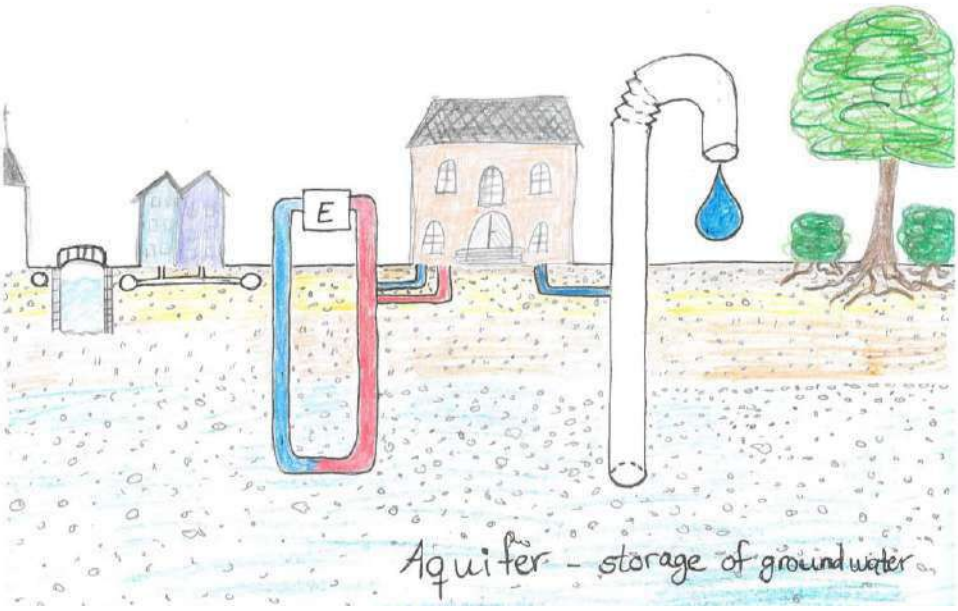

Figure 5: The most important natural resource lies in the ground beneath the city of Ljubljana: pure groundwater as potable water in rich amounts. The same resource can be used as renewable energy source for cooling and heating, reducing the carbon footprint for Ljubljana. E = energy.

2.6 Lisbon –natural disasters on the city planning agenda

Natural disaster is difficult to prevent or hinder, but it is possible to adapt and mitigate. Lisbon city has two major natural threats; re-occurring flooding from the river running through the city and earthquakes. Built along the river shore, the river has given opportunities to prosper in shipping, trade and had a constant supply on fresh water. But as the city grew the river was constrained. Climate change causes the flooding to occur more frequent and intense than previously, causing the river to go over its limits and cause damage to the city (Pinto et al., 2016). To adapt to climate change and the re-occurring flooding the Municipality of Lisbon has mapped the areas prone to flooding and implemented it into their urban planning, management and development plan for the city (Pinto et al., 2016).

Earthquakes is a known hazard for Lisbon, being located in an active area of plate movement, between the African and European plate. Earthquakes in the range of 2.8 to 5.6 in Richter's scale occur up to twice a year (https://www.earthquaketrack.com/p/portugal/lisbon/recent). City planning and development must adapt to such hazards, with respect to building construction, infrastructure and safety of the citizens. Implementing natural hazards into the urban planning makes Lisbon prepared for future events. Both flooding and earth quakes can trigger landslides, therefore Lisbon municipality has mapped areas prone to landslides and incorporated it into the city planning and development (Figure 6; Pinto et al., 2016).

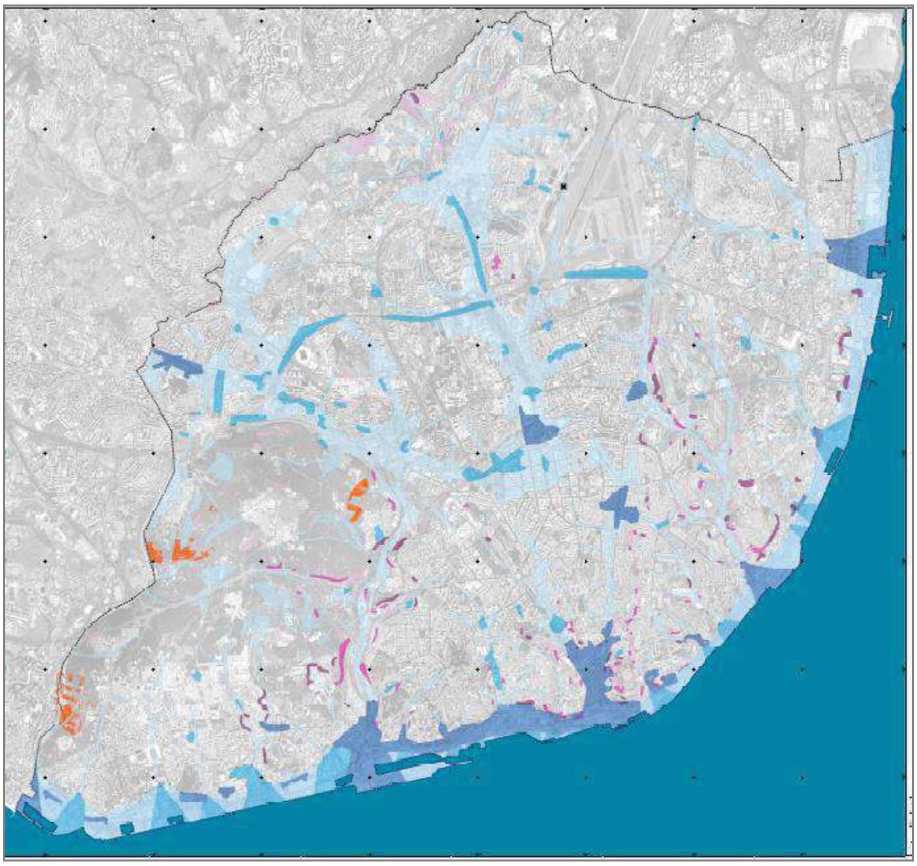

Figure 6: Natural and anthropogenic Hazards (blue – Flood Vulnerability classes; pink – Landslides Susceptibility classes; orange: fire vulnerability classes), Pinto et al., (2016).

3 Tools to incorporate the natural environment with the built environment into planning

Re-use of subsurface data will reduce risk and unforeseen costs as well as increase the resilience of urban development. There are many approaches and tools to implement subsurface data into planning tools. Geological Surveys are collecting subsurface data and organizing the data into databases that are targeted to deliver data to planning tools. Within the Sub-Urban network several approaches and tools were compared, to share experience and knowledge. A common opinion is that subsurface data must be included in the process for future urban development. Whatever tool or approach is chosen the benefits will be great. Here are two approaches presented:

3.1 GeoCIM – Geo City Information Model

3D modelling tools such as BIM (Building Information Model) is a well-known planning and design tool within the building sector. Such tools are also developed for city planning, such as CIM (City Information Model). They both lack the implementation of subsurface data, such as ground condition and geological information, therefore, a further development of these two that includes the subsurface is suggested (Figure 7; Schokker et al., 2017).

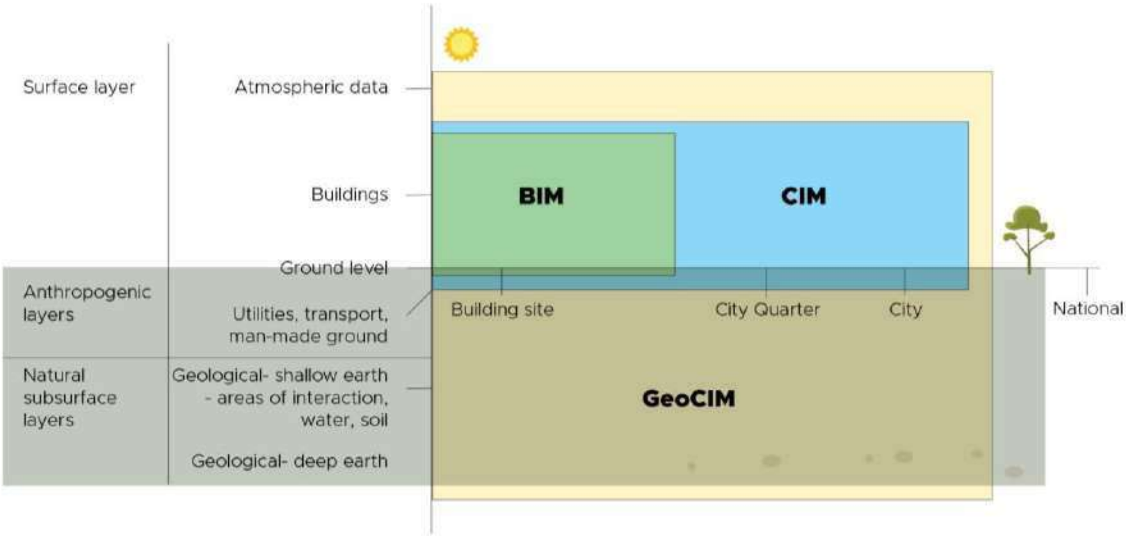

Figure 7: Vertical and horizontal scopes of BIM, CIM and GeoCIM (Geo City Information Model, Schokker et al., 2017).

Re-use of subsurface data will reduce risk and unforeseen costs as well as increase the resilience of the urban development. There are many approaches and tools to implement subsurface data into planning tools (Figure 8; Schokker et al., 2017).

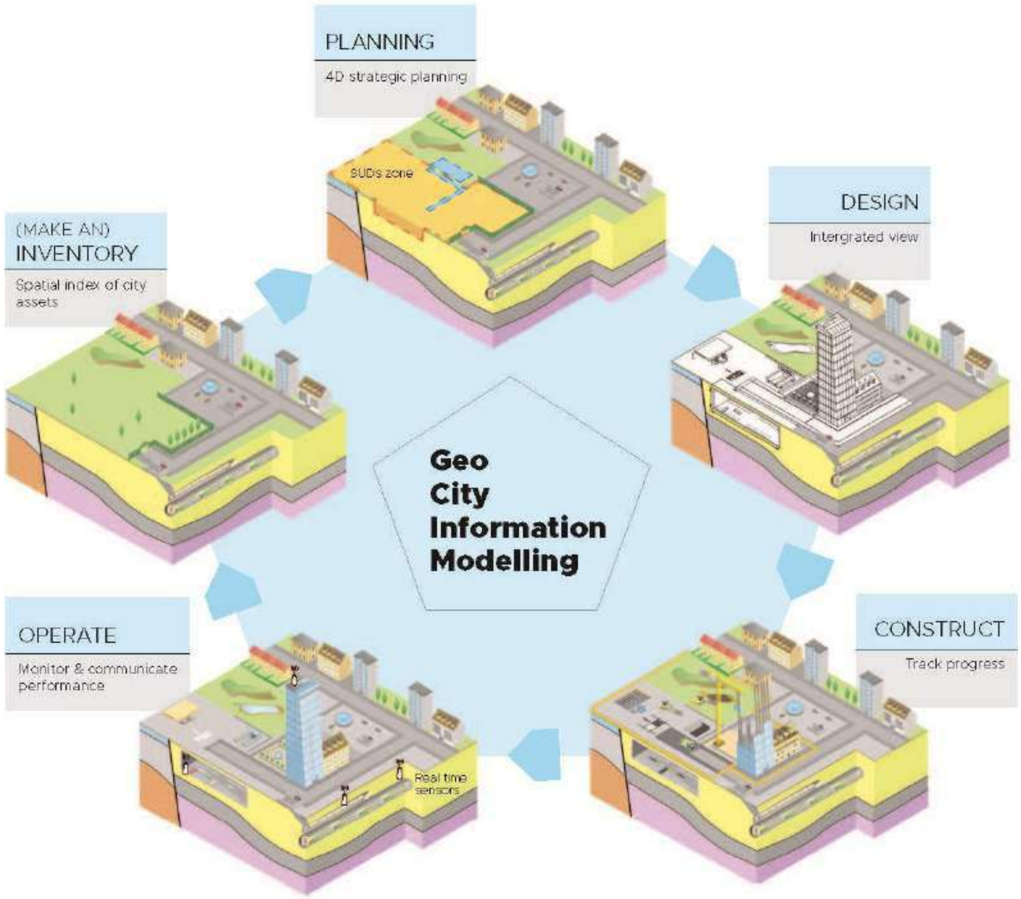

Figure 8: Geo City Information Model (GeoCIM) implementing the natural environment into the built environment by including geological data into construction and planning models. Illustration: British Geological Survey.

3.2 The Sub-Urban toolbox

Following the city case studies (van der Meulen, 2016) a toolbox is developed. It comprise a fit-for-purpose suite of recommended methodologies, good practice, guidance, and case studies to enable the free flow of key subsurface data and knowledge, and can be delivered to all those engaged in subsurface issues to enable improved urban planning and sustainable development. It is a free access source of knowledge, relevant to the needs of both researchers (e.g. Geological Survey Organizations) and urban policy- and decision-makers[1].

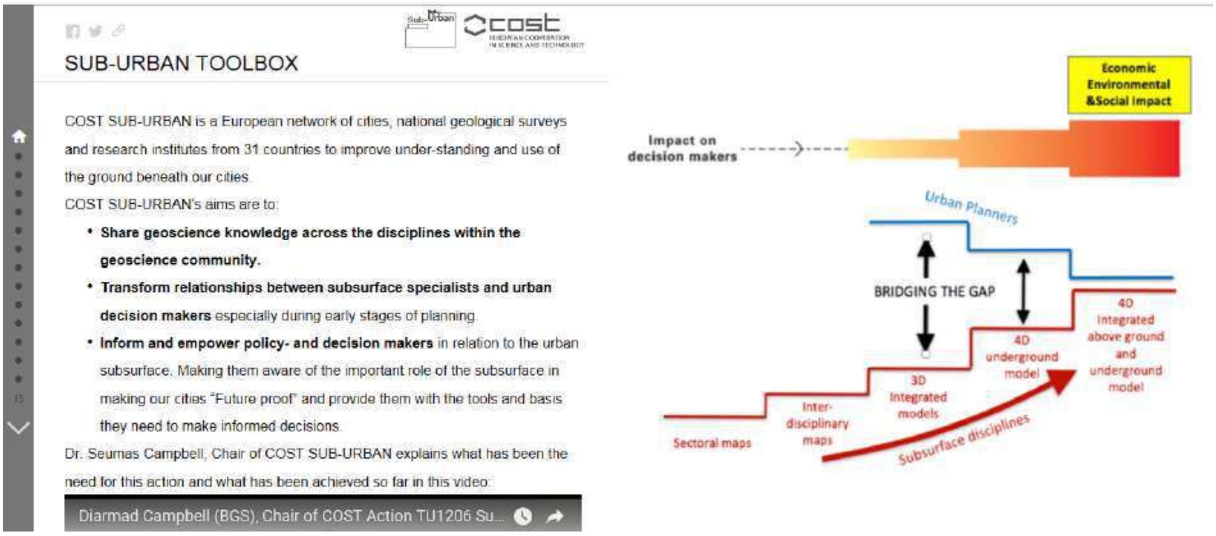

Figure 9: The Sub-Urban TOOLBOX is an open access web platform that gives check list of what to consider when planning in the subsurface, tips to where data is accessible and how to use the data.

To make it easy to navigate through the Toolbox we make use of a metaphor: a bike. In this metaphor our knowledge of urban planning is represented by the front wheel and the knowledge of the subsurface is represented by the back wheel. *Using* this knowledge, translating it into workflows is represented by the crank. Via the crank the bike is put into motion. And the decision-makers, addressing the city needs, sit on the saddle: they decide when the bike moves and in which direction. This bike concept divides the Toolbox into sections or topics. Within the Toolbox you can find 'highlights' like good practices and best efforts as well as gaps in our knowledge.

[1]Toolbox is accessible from :http://sub-urban.squarespace.com/toolbox-1/ or https://rotterdam.maps.arcgis.com/apps/MapJournal/index.html?appid=5f495157aae84a2780b5e7d87dcd66f2

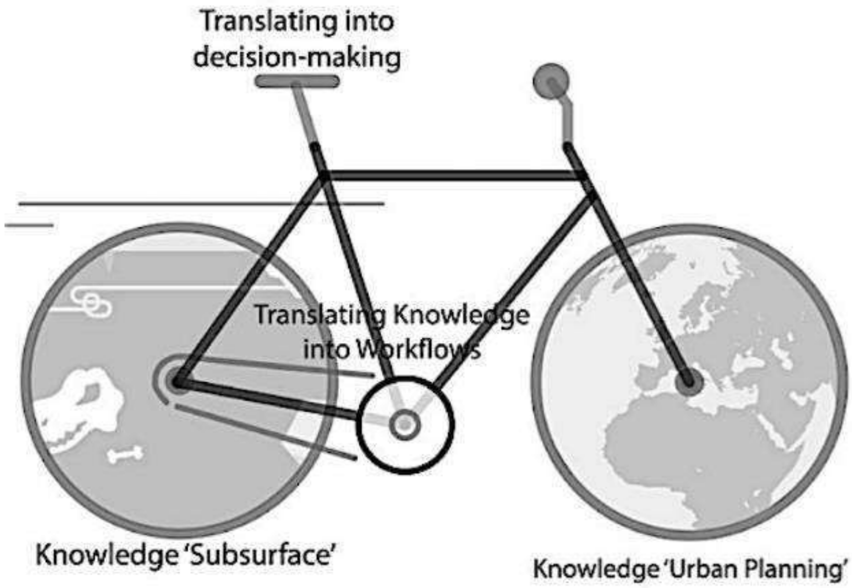

Figure 10: The bike metaphor for the Sub-Urban TOOLBOX.

4 Awareness of potential in using the subsurface in urban planning

The main challenges that became evident during the four years of knowledge sharing is that i) lack of or not specific enough laws and legislation, especially regarding data ownership and sharing of data, are hindering re-use and cost efficiency of data. ii) Communication across disciplines is challenging, and a common language for common understanding is a necessity (Campbell et al., 2017). Even if similar words are used, they often have different definition, meaning, within different fields. An example, the word "subsurface" has a different definition for a city planner than a subsurface expert. iii) For a planner and the planning process there is also the necessity of the right information at the right time and in the correct format / context. This is seldom in focus for the specialist who does not work with the planning process (Mielby et al., 2016).

One of the aims of this work is rising awareness of the subsurface, changing the concept that the subsurface is still in mind even if it is out of sight (Venvik et al., 2018):

Some **Pitfalls** to collective urban subsurface planning:

- Lack of dialogue between parties involved
- Lack of municipal and state subsurface policies and legislation
- Low awareness of subsurface assets and challenges
- Inadequate tools to make relevant information and data accessible

Some **Pathways** to collective urban subsurface planning include:

- Maintaining trust between parties
- Develop a simple common language (mutual understanding)
- Early coordination during planning and construction phases
- Understanding of responsibilities

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If you want information about the subsurface in you city contact your national Geological Survey, see www.sub-urban.eu for contact information

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Multi-dwelling home lifestyle and climate change

Xue, Jin; Næss, Petter; Steffansen, Rasmus; Stefansdottir, Harpa; Richardson, Tim, ÅS, Norway

ABSTRACT:

Cultural heritage sites in northern Norway are manifests of a lifestyle long-lost to industrialization and centralization. Often located between fjords and mountains, many of the sites, such as the fisherman villages in Lofoten and Sjøgata in Mosjøen, consist of wooden buildings that date back to the 18th and 19th century. The buildings are well-kept as they are still in use by the locals; they also serve as important identity markers for the people living in the areas as well as being beloved tourist attractions. The last couple of years climate change has begun to show its presence more than ever in the northern parts of Norway. Heavy rain and unstable winters lead more often to floods, avalanches, and landslides, and the cultural heritage sites that previously were resilient and withstanding are now vulnerable.

In the city of Mosjøen in Vefsn municipality urban planners are trying to develop a new zoning plan for the cultural heritage area Sjøgata. The zoning plan should also function as an adaptive strategy to climate changes so that the historical environment of Sjøgata can be kept for the future. The highest climate risks to Sjøgata are flooding, a rise in the sea level and avalanches, one of the consequences of this is that insurance companies refuse to offer home insurances due of the risk of damage.

The challenge for the urban planners is how to plan for landslides, avalanches and floods, and how to safeguard the historical buildings when this happens. As a part of the work with the zoning plan, the planning department in Vefsn has looked at the possibility to alter the landscape by raising the wooden buildings as well as the terrain up to the future expected sea level. The department also tried to find out if the zoning plan could allow new ways of anchoring and detaching buildings from the foundations so that the buildings could "float" both on water and avalanches without being too damaged.

The new zoning plan for Sjøgata is still is a work in progress. There are several issues due to climate changes that have to be solved in order to complete the plan and whether the strategy will work is yet to be seen.

It is certain that urban planners in northern Norway need more knowledge and research on adaptive strategies to handle climate changes so that the cultural heritage can serve as identity markers, tourist attractions, and homes for another 100 years.

New York City- Environmental Review & Planning for a Sustainable Future

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Synopsis:

New York City's environmental review and planning are key to creating a sustainable and resilient city. The environmental review process facilitates how our city can appropriately adapt proposed developments to the planet's changing climate. Planning with an environmental review emphasis should function by shaping future development to optimally serve this vast community with an adaptable, sustainable and secure city.

Introduction

New York City, with its five distinct boroughs/neighborhoods totaling approximately 304 square miles (489 km) is large urban mecca. From a planner's perspective, one can imagine that maintaining a vast geographical area with a diverse population (approximately 8.6 million as of 2017) comes with immense challenges. City agencies, including the Planning Department, Department of Environmental Protection and several branches within the Mayor's Office have a great deal of responsibility to usher projects and policies which focus on creating sustainable, resilient, enduring growth while reducing emissions, decreasing waste and inefficiency and preserving natural resources.

1. The Roll of Mayor's Office of Environmental Coordination (MOEC)

Within NYC government the Mayor's Office of Environmental Coordination (MOEC) was established under the New York City Charter (1989 revision). The agency's role is to assist all City agencies in carrying out and fulfilling their environmental review responsibilities. We are an advisory body who provides guidance and technical expertise on environmental procedures and progressing standards. In addition to serving as a liaison to federal, state, and city coordination we also maintain the entire digital catalog of city led environmental reviews.

MOEC and the New York City Planning Department have a partnership in our roles related to environmental review. Both agencies perform environmental reviews according to the City Environmental Quality Review (CEQR) guidance. CEQR is governed by a combination of state and city laws and regulations that specify the various components and procedures under which reviews are conducted.

The following section provides a brief history of the Federal, State and City legislation relative to environmental policy. The evolution of New York City's environmental review framework is evidenced by the series of legislative policies which unfold within larger and more varied municipal agencies.

2. Creation of Environmental Laws and Guidance

National Environmental Policy Act (NEPA)

The National Environmental Policy Act was established in 1970. The development of this policy can be attributed to increased public appreciation and concern for the environment that developed during the 1960's amid increased industrialization and pollution across the United States. The original intent of Congress in the creation of this policy was to "encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation; and to establish a Council on Environmental Quality." (NEPA,1970). A significant outcome of this policy established the requirement that all federal agencies prepare environmental assessments (EAs) and environmental impact statements (EISs). Shortly after implementation of the Act and in the decades to follow many countries around the world utilized the NEPA model to enact their own policies.

Beginning in June 2018 the Council of Environmental Quality (CEQ) issued a request to take comments on updating the NEPA Guidance. This is a unique opportunity to for cities, states and individual citizens to provide specific recommendations regarding new additions, deletions, or modifications to the text of our current NEPA regulations. Perhaps within the coming year we can anticipate an amended NEPA document which considers the importance of factoring in measures for sustainability with regard to climate change language and guidance.

New York State Environmental Quality Review Act (SEQR)

The New York State Environmental Quality Review Act (SEQR) is the New York statute which became law on August 1975. SEQR is the model which provides guidance to develop regulations to guide New York State and local government agencies in the implementation of environmental reviews. SEQR was intended to change government decision making by requiring agencies to balance the environmental impacts with social and economic factors when deciding to approve or undertake new development.

New York State Department of Environmental Conservation (DEC) recently adopted amendments to SEQRA regulations to streamline and incorporate additional transparency to this permitting process. These changes will take effect starting January 2019. Most relevant to resiliency and sustainability these amendments encourage sustainable development through green infrastructure, incentives for the private sector to install small to medium scale solar arrays, and continued commitment of government implementation of renewable energy sources (DEC, 2018).

New York City Environmental Quality Review (CEQR)

In 1973 the City established Executive Order No. 87 which directed that all major projects need to assess environmental impacts. By 1977 the City had formally developed its own

City Environmental Quality Review (CEQR) process and centralized primary agencies (City Planning) to lead the environmental review functions. In order to expedite review functions and ensure consistency with applicable laws, the City issued an Executive Order by the Mayor to institute a new office of oversight- the Mayor's Office of Environmental Coordination (MOEC).

New York City's Environmental Quality Review (CEQR) is our city's process for implementing and conducting an environmental review for proposed actions associated with new development. The CEQR process requires that agencies identify, analyze and disclose the potential environmental impacts of a proposed project before city approvals are considered. The 2014 CEQR Technical Manual is the guidance document which provides recommendations for specific protections or safety measures regarding development. This manual covers some 20 technical areas for analysis, as outlined in the following section.

MOEC staff are currently undertaking an extensive outreach with City agencies to address pertinent concerns shared by all city stakeholders in order to update the 2014 edition of the CEQR Technical Manual. These updates will most certainly have a central focus on incorporating resiliency strategies, and fine tuning climate related guidelines.

3.0 CEQR Process

The City level environmental review process requires the involvement of multiple New York City agencies and a high level of coordination. The average environmental review of an EAS or EIS will evaluate multiple technical analysis areas, approximately 20 technical areas. Among these CEQR analysis areas are: Land Use, Air Quality, Water and Sewer Infrastructure, Transportation, Noise, Public Health, Community Facilities, Socioeconomic Conditions, Hazardous Materials and several others. The thorough analysis of these environmental reviews requires the input and involvement of technical experts from different city or state agencies.

It should be noted that not all proposed development or proposed legislative measures are subject to CEQR analysis and City Planning Approvals.

There are several stages that unfold when a project begins CEQR environmental review. These are outlined below and graphically portrayed in the flow chart in **Figure 3.0.**

Step 1. A project is introduced, the proposed Actions requiring regulatory approval are identified and any involved City or State agencies are identified for coordination.

Step 2. The proposed Actions required are classified into a "Unlisted" or "Type I" CEQR category.

Step 3. An EAS is prepared. Answering specific project related questions within the EAS form will identify what technical areas are required for analysis.

Step 4. The completed EAS is reviewed by an expert city agency(s).

Step 5. A Determination of Significance is issued. This issuance will identify if the proposed actions result in No Significant Adverse Impacts or Significant Adverse Impacts are possible.

Step 6. If the project is determined to pose No Significant Adverse Impacts, then the Environmental Review process conducted by the City is complete. If the project is determined to pose potential Significant Adverse Impacts, then Project will require the submission of detailed analysis under the Environmental Impact Statement (EIS).

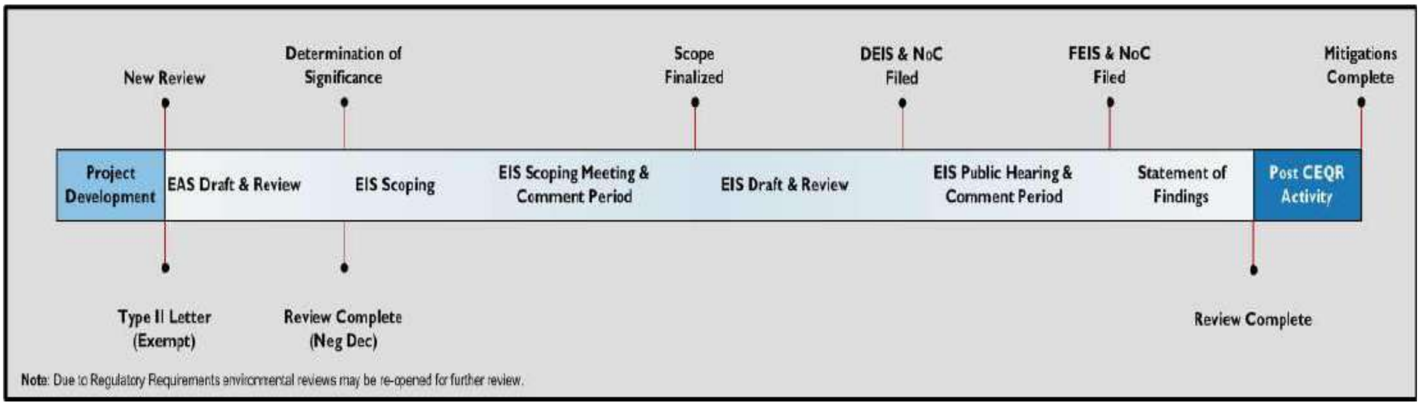
Step 7. With a project requiring more detailed levels of analysis under an EIS, a public involvement period is incorporated into the review, known as a Scoping or Public Hearing. The public are invited to submit comments on the project related to any sections of the environmental analysis.

Step 8. The revised EIS will reflect responses to the public comments and address any potential areas requiring further analysis. The EIS will continue to be reviewed by the expert technical agencies.

Step 9. Once the City agencies reviewing the EIS are satisfied with the completed analysis and any technical detailed studies have identified proposed mitigation for potential impacts resulting from the project the Application will be presented before the City Planning Commission and later to the City Council for a vote.

Step 10. Should the Planning Commission and City Council vote yes on the project then the Environmental Review process conducted by the City will be complete. Should a no vote be issued by either body, then the EIS will undergo further modifications and additional analysis.

Figure 3.0 **CEQR Process Flow Chart**



4. New York Commitments Toward Resiliency and a Sustainability Future

Climate Change

It is apparent for many coastal cities, New York included (with 580 miles of coastline), that our existing and future coastal development depends on the thoughtful, informed collaboration of multiple communities and even neighboring countries. Resolving methods for effectively securing coastal communities can be approached on a regional scale. The work of the United Nations Office for Disaster Risk Reduction developed a "Regional Action Plan for the Americas" to target priorities for action relative to developing public policy around disaster risk reduction (Waddington, 2018). Considering policy level applicable to all coastal areas spanning North and South America is setting an immense standard. However, with climate change acting as an existential threat to all cities and countries (factoring the steady sea level rise resulting from climate change), it seems an efficient method for addressing a contiguous area.

Responding to recent studies conducted under the World Meteorological Organization (WMO), the World Bank and the International Energy Agency which corroborate the relentless pace of climate change, the UN Secretary General António Guterres issued a global call to action to proceed with political decision making and financing to cut global emissions.

Sustainability

In 2017 New York State passed the Climate and Community Protection Act. At that time it was a very progressive state level climate and equity policy, which gained traction, after being passed by the state Assembly last spring. The bill set a mandate of 50 percent renewable energy by 2030 and 100 percent renewable energy in New York by 2050, with 40 percent of investment (whether through carbon pricing or other avenues) targeted for environmentally vulnerable low-income communities (McGhee & Reich, 2016). In response to our current White House administration announcing the forthcoming United States withdrawal from the Paris Climate Agreement, NYC's Mayor de Blasio signed an Executive Order committing the City the principles of the Paris Agreement.

On a local level, in 2006 New York City passed the Climate Protection Act. This Act set a mandate of 30 percent reduction in citywide emissions by 2030 and 80 percent reduction in citywide emissions by 2050. Applicable policies and programs specifically how to fulfill these emission reductions are outlined in former Mayor Michael Bloomberg's 2007 initiative "PlaNYC". The goal of this plan was to focus on better adapting to climate change, conserving city resources, and the reduction of the carbon footprint. Furthering the commitments within PlanNYC, our current Mayor Bill deBlasio introduced "OneNYC" in 2015 which sets forth goals of growth, equity, sustainability and resiliency. The OneNYC plan also provides "New York City's Roadmap to 80X50" which outlines specific steps toward achieving the ambitious GHG reduction target (MOS, 2018).

Resiliency

For city planning and associated environmental review, a common sense approach would involve preparing resiliency measures which factor in anticipated climate change risks. The New York City's Waterfront Revitalization Program (WRP), is a division within City Planning. Key to their role within planning and environmental review is their list of waterfront policies addressing the City's varied coastal conditions.

Primary goals of the WRP's policies include:

- development of waterfront planning and preservation while ensuring consistency with long term city and state waterfront goals,
- minimizing potential conflicts from proposed development while maximizing the benefits derived from economic development, environmental conservation and public use of the waterfront

Significant changes addressed in their 2017 Report "NYC Waterfront Revitalization Program Climate Change Adaptation Guidance", include sea level rise projections, flood damage reduction elements, adaptive measures for flood design and policies to promote climate resilient designs (NYC Planning, 2017).

As previously mentioned *One*NYC is the City's current strategic plan for inclusive growth and climate action. It is also the first resilience strategy released by any city in partnership with 100 Resilient Cities, pioneered by the Rockefeller Foundation. 100 Resilient Cities (100RC) is a nonprofit organization established in 2013, dedicated to incorporating resilience planning into multiple aspects of city growth.

100RC aims to: 1) Facilitate individual cities in becoming more resilient, establishment of a Chief Resiliency Officer.
2) Support of a global practice of collaboration among governments, NGOs, the private sector, and individual citizens.
3) Increased sustainability through shared resiliency strategies.

Resiliency planning includes communities examining their land-use and construction policies in order to avoid rebuilding in harm's way. Governments can incentivize adoption and enforcement of building codes which account for extreme weather scenarios and climate impacts. Additionally, the private sector can incorporate climate risk into insurance policies and incentivize communities for factoring in mitigation (De Souza, 2018). A focus on resiliency planning should ultimately reduce the need for emergency response to increased severe storm incidents and impending sea level rise. While incorporating for extreme conditions in resiliency planning, communities can reduce recovery costs as well as property and infrastructure damages.

In support of New York City's goal to reach an 80% reduction of GHG's by 2050, multiple levels of programmatic changes with respect to sustainability have been initiated.

The list below highlights several programs and steps that have been taken to meet our goal of becoming a more sustainable and resilient city.

• **Community Retrofit NYC**- a program for reducing emissions (GHG) in small buildings. Achieved through the elimination of steam heating systems and the conversion to heat pump systems (Gentric, 2018)

• **NYC Clean Fleet-** The goal of incorporating 2000 electric vehicles (EV) into the City's vehicle fleet. This includes partnering with local utility providers for the installation of over 100 EV chargers citywide.

• **Bills proposed** for banning straws and plastic bags, currently instituted by many countries to completely remove or tax the consumption of single use plastic products.

• **GreenNYC-** Program that provides steps for reducing energy use (both for home & work), eliminating unnecessary consumer waste (providing alternatives to single-use disposable products) and living a sustainable lifestyle (transportation choices, product selection- non-toxics, reduced packaging, and composting.

• **NYC** greatly encourages and supports City Employees to utilize water refilling stations in all City/Federal buildings and discourages the purchase of bottle water and drinks. Sustainable/reusable decanters are provided.

• **NYC CoolRoofs**- City initiative for installing energy-saving reflective rooftops.

- **Zero Waste-** Program geared toward reducing New York City's trash and refuse contributions to landfills. Target aims to have zero trash by 2030.
- **Resiliency Legislation –** Department of Buildings codes which address building moving or raising to secure the lowest above-grade floor property outside of flood zones.

• **NYC Green Infrastructure Program**- Program includes rooftops retrofits with vegetation or rainwater retention/catchment, reduction of storm-water runoff with installation of bioswales and rain garden planting.

• **City Divestment of Funds-** New York has proposed to divest from fossil fuel reserve owner companies- This represents upwards of $5 billion in investments. The City's commitment is among a vastly growing assembly of municipalities, states, countries and corporations to send a worldwide message that their obligations under the Paris Agreement can be fulfilled with the refusal to financially sustain the fossil fuel industry (Paddison, 2018). Approximate total in divested fossil fuels investments has reached 5 Trillion Dollars worldwide (Fossil Free, 2018).

5. Conclusion

Presently the sustainability and resiliency initiatives mentioned in this paper have been steps New York City and any city can take in order to reduce a community's vulnerability to climate change impacts. These initiatives also effectively utilize or conserve resources while reducing waste. With a robust administrative framework incorporating environmental review it's feasible to address the complex evolving nature of social and economic impacts resulting from climate change. The range of analysis incorporated into environmental review on a city, state and federal level is a significant component for guiding future development in creating sustainable and healthier communities.

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Track 2

SPOTLIGHT CITIES:
Planning for Coastal Cities, Remote Towns, and High North Cities

Making the most of underground spaces

Moderators: ADMIRAAL, Han (ITACUS/Enprodes); CORNARO, Antonia (ITACUS/ISOCARP Swiss ND/Amberg); REYNOLDS, Elizabeth (URBEN/Think Deep UK)

ABSTRACT:

Many cities have them, and the city of Bodø is not an exception: unused underground spaces in the form and shape of former civil defence or military bunkers. The question often is what to do with these relics of the past. The most obvious answer is to turn them into a museum, preserving the past as a poignant reminder of what we need to avoid in the future. With the advent of decarbonizing our cities, making our cities resilient and develop them sustainably, the question is whether these abandoned spaces can serve a better purpose. Are they just waste spaces or can they be proved to be assets waiting to be given a new lease of life? This session will be led by the authors of two new books on the use of the urban subsurface. Han Admiraal and Antonia Cornaro wrote the book ‘Underground spaces unveiled: planning and creating the cities of the future’ published in March 2018. Elizabeth Reynolds wrote the book ‘Underground urbanism’ which will be published in November 2018. In the introduction, we will look at popular uses ranging from underground agriculture to recreational uses. After introductions by the authors, we would like to turn the session into a workshop with the audience and the authors as well as representatives from the local municipality, the real estate department of the Ministry of Defense, the local aviation museum; and the airport authority will look at possibilities to repurpose these underground spaces. For additional inspiration, this session will be held at either the underground NATO base in Bodø or in one of the many cold-war shelters. The outcome will be a report to be presented to the local representatives at a later date. Also, the event will be the kick-off of a new ISOCARP group on underground urbanism. Because of the specific location where the workshop will be held, the maximum size in term of participants will be 30 people excluding the session moderators and local representatives.

Climate risks and urban drainage: A case of the National Capital Territory (NCT) of Delhi

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Cities are victims as well as a primary reason for climate change. They account for over 70% of global greenhouse gas emissions and shelter over 50% of the global population (IPCC 2015). The paper is an attempt to highlight the interplay of urbanisation, natural environment and climate variability for the National Capital Territory (NCT) of Delhi, particularly their implication on the city's mobility. With the help of aerial imagery and meteorological data, the study is grounded in detailed spatial-temporal empirical analysis conducted at macro and micro levels for the period of 1986 to 2016.

Empirical analysis at macro-level notes that during 1986-2016 Delhi lost 94 hectares of its vegetative cover, 6 hectares of water bodies and 14.3 hectares of flood plains for every 100 hectare increase of built up area. Simultaneously, surface run-off increased 3 times leading to increased flooding, travel time and road length under water. The correlation model built from this analysis forecasts city flooding to increase more than 80% by 2041 with 90% of city limits becoming a concrete jungle- thereby, increasing travel time by 43 minutes and clogged road length to 38 kilometres, from urban flooding. Micro-level analysis of the most vulnerable population, including 141 villages with over 2,800,000 inhabitants, indicates increased losses from flooding, burdening the state exchequer with over 20.1 million INR [~0.3 million USD] annually.

This interplay therefore has multi-dimensional implications on urban mobility and makes it imperative for a liveable urban future to conceive the city in a holistic framework of climate resilience, guided by policies of land use-land cover and transport planning.

Keywords: *Urban Development Pattern, Urban Flood, Travel Time, Inundation, Affected Population and Area*

1. INTRODUCTION

Climate change is a global phenomenon and variability of climate over decades is attributed, directly or indirectly, to human activity which alters the composition of the atmosphere, thereby contributing to natural climate variability observed over comparable time periods. Emerging trends of climate change indicate a global rise in human induced warming, higher than the natural warming of the earth which will continue to increase at a much more rapid rate. The Intergovernmental Panel on Climate Change 2014 report (IPCC Fifth Assessment Report. 2014) highlights that while global population grew from 4 billion to 7 billion, a 75 per cent increase since 1970, greenhouse gas emissions increased by 82 per cent, with an annual increase of 2.2 per cent in the last decade alone.

The Paris Climate Agreement 2015 supports the cause of climate change mitigation and shifts it from a global scale issue to one of development at the urban scale. This is not a new finding. In 2008, urban development became central to the international discourse on climate change, when global urban population increased by 50 per cent while total GHG emissions increased by 70 per cent. Four cases for this situation were identified: land use and land cover change, transportation, building construction, and pollution related to industry. These four categories of activities coincide with areas affected by the role of urban planners and urban planning in terms of planned development, adapting to climate change and mitigating future risks. Essentially, cities and climate change are intertwined and urban planning plays a vital role in this equation.

2007-08 also saw the publication of a tremendous amount of literature and research on cities and climate change. In India a plethora of research has been produced which studies the impacts of climate change, the spatial distribution of greenhouse gas emissions, and urban drainage in relation to changing intensities of precipitation. However, only a few try to think beyond these topics and assess climate change in terms of urban development patterns. The need to study climate change and the impact of urban development on climate change becomes more important today since cities cover less than 3 per cent of the earth's surface but contribute over 70 per cent of GHG emissions and account for 75 per cent of global energy consumption (UN-Habitat. 2011). Moreover, this trend of urban growth is forecast to continue as rural population decline.

This paper is an account of a study of climate change and its relationship with urban development and urban mobility in Delhi during the period of 1986 to 2016; with 1986-96 marking the decade of economic reforms and the post-Asiad games construction boom, while 2006-2016 marks ripples of construction boom for the Commonwealth games and the notification of the Master Plan for Delhi-2021. Empirical analysis is conducted for the four time periods- 1986, 1996, 2006 and 2016 using two prime secondary sources, which include meteorological data from the Indian Meteorological Department and raw aerial LandSat imageries from the online portal of the United States Geological Survey, Global Land Cover Facility and Bhuvan India. GIS modelling and analysis of aerial imageries in relation to statistical data indicate a trend of human induced climate variability for the city.

The paper is structured into three broad sections. In the first section, Delhi's urban development trend is described in terms of increase of built up areas and loss of heat sinks. In the second section, climate change is assessed in terms of natural climate variability and reflected through precipitation variables. The third section assesses the implications of urban development and climate change on mobility patterns of the city. The fourth section scales down the assessment to micro level and examines implications on the vulnerable population of the city. In particular, an empirical analysis based on primary surveys and supported by secondary meteorological data is conducted to assess physical, social and economic impacts of climate change on the most vulnerable population in the city, identified as residing in the villages located in the flood plains of Delhi. This includes implications on their mobility patterns.

The last section concludes on a note of dire need of climate resilient urban strategies to achieve a sustainable urban future of the city.

2. URBAN DEVELOPMENT PATTERN OF DELHI, 1986-2016

Delhi, capital city of India, is testimony of numerous changes and cumulative challenges. This section documents the changes which underscores the trend of urban development in the city. The change in land cover of Delhi (as indicated in Table 1) indicates that after 1986 the city spread around its core with infill developments. Moreover, developments from 1986-1996 amounted to 1.3 times the development of the preceding two decades. This may be attributed to the real estate growth that emerged after the 1980s Asiad games and economic liberalisation of the country's economy in 1990. Statistically, the city's developed area increased from 39.2 per cent of the overall city area in 1986 to 58.2 per cent in 2016.

Table1: Change in Land Cover of Delhi, 1986-2016

Land Cover	1986	1996	2006	2016	Decadal Change		
	Area (in sqkm)	Area (in sqkm)	Area (in sqkm)	Area (in sqkm)	1986-1996	1996-2006	2006-2016
Total Built Up	581.45	710.4	783.6	863.5	22.5	11.0	10.8
Forests	176.8	178.1	172.1	176.2	0.8	**-3.8**	2.6
Other Green areas	48.6	66.8	70.2	75.8	36.0	5.5	8.6
Water Bodies	41.9	34.4	29.6	25.4	**-21.7**	**-16.6**	**-16.9**
Agriculture Land	586.0	432.5	368.2	284.6	**-33.2**	**-17.7**	**-28.2**
Wasteland	48.3	60.8	59.3	57.6	25.9	**-2.8**	**-3.2**
TOTAL=	**1483**	**1483**	**1483**	**1483**			

Extracted by the author (2017) from USGS (1986, 1996, 2006 & 2016)

The increases in population and the built-up areas in the city resulted in the conversion of agricultural fields into non-agricultural use like residential, commercial and other non-permeable concrete 'jungles'. The city has witnessed a rise in its density as well. It is conjectured that for a population increase of 12.4 million during these three decades, there is a corresponding increase in developed area from 581.45 square kilometres in 1986 to 86,350 square kilometres in 2016. This is further accompanied by an increase of urban density of 2.6, an increase of developed area density by 1.8 and an increase in gross residential density by 2.14.

These developments have engulfed natural green areas and flood plains of the city, thus disturbing the city's microclimate and ecological balance. Both of these natural areas serve as heat sinks. Empirical analysis indicates that 57.5 per cent of the city's area acted as heat sinks in 1986 which declined to 37 per cent in 2016, with an annual rate of depletion equivalent to 1.4 per cent. Moreover, it is observed that heat sinks are depleting at a much faster rate (equivalent to 1.4 per cent) than the rate at which the built up area is increasing (equivalent to 1.3 per cent). Also, it is found that a 100 hectares increase of built up area corresponds to a loss of 94 hectares of vegetative heat sinks and 6 hectares loss of water based heat sinks.

3. CLIMATE CHANGE OF DELHI

The climate of NCT of Delhi is categorised into four seasons by the Indian Meteorological Department- winter, summer, monsoon and post monsoon. The winter season extends from December to February. Summer includes March, April and May while the monsoon season extends from June to September. The post-monsoon season includes October and November. The paper however assesses this change in climate for Delhi only through precipitation variables using meteorological data obtained from the Indian Meteorological Department, New Delhi and Irrigation and Flood Control Department, Government of NCT of Delhi.

3.1.1 Precipitation variability

The annual precipitation variability is assessed in terms of annual rainfall and annual number of rainy days for a time frame of 115 years, from 1901 to 2016. The trend of annual precipitation post-1901 (as indicated in Figure 1) shows that the average rainfall has increased by 210 millimetres and that the periods of drought have become longer than the periods of heavy rain.

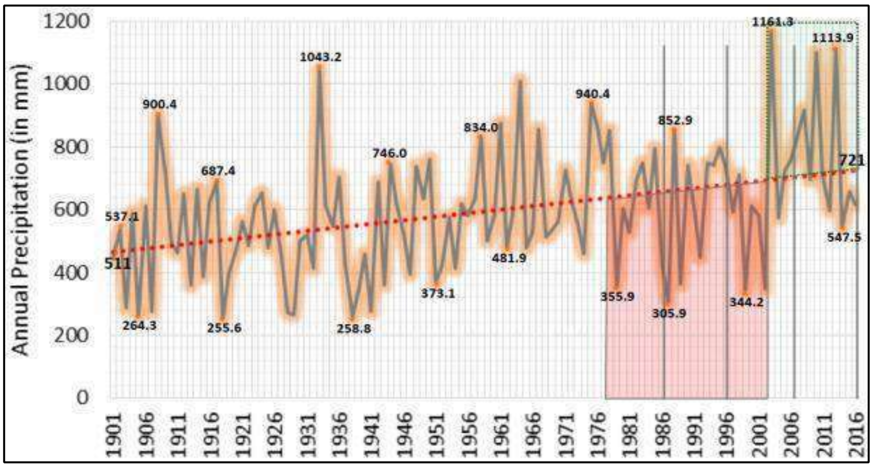

Figure 1: Change in Annual Precipitation for Delhi, 1901-2016
Source: IMD (2016)

Assessing the trend in the number of rainy days for Delhi (as indicated in Figure 2), in the same time period shows that the average number of annual rainy days has increased by 9 rainy days while the average precipitation per rainy day has increased by 2.5 per cent. Since the annual precipitation and number of rainy days are increasing, and given that the actual duration of precipitation has reduced, this resulted in a sharp rise in rainfall intensity from 13.2 mm/hour in 1986 to 22.9 mm/hour in 2016 (the latter leading to flooding of over 50 per cent of the city in three hours in 2016).

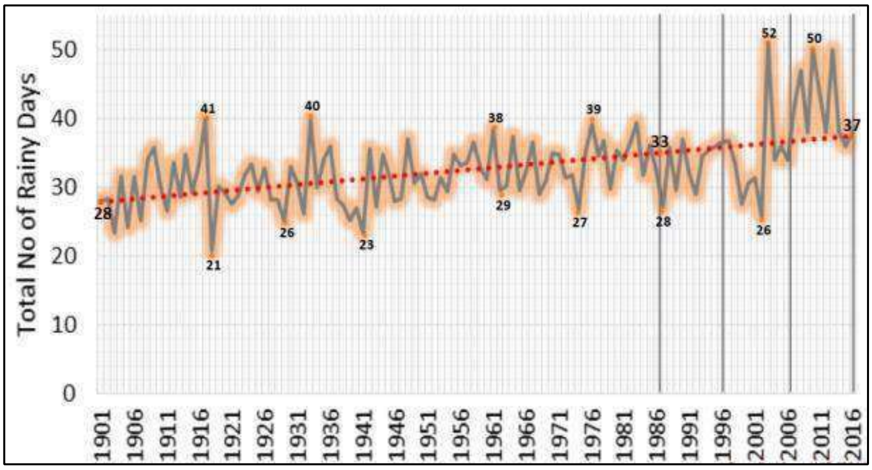

Figure 2: Change in Annual Number of Rainy Days for Delhi, 1901-2016
Source: IMD (2016)

The seasonal precipitation variability is assessed in terms of seasonal share of annual precipitation and rainy days for the timeframe 1901 to 2016. Analysis of the seasonal share of annual precipitation (as indicated in Figure 3) shows a trend of wetter summers and drier post monsoon periods. Rainfall and rainy days are increasing but the actual duration of precipitation is reducing leading to increase in rainfall intensity from 13.2 mm/hour in 1986 to 22.9 mm/hour in 2016. In 2016, 3 hours of rainfall at this intensity flooded over 50 per cent of the city, breaking down the city's mobility and livelihoods.

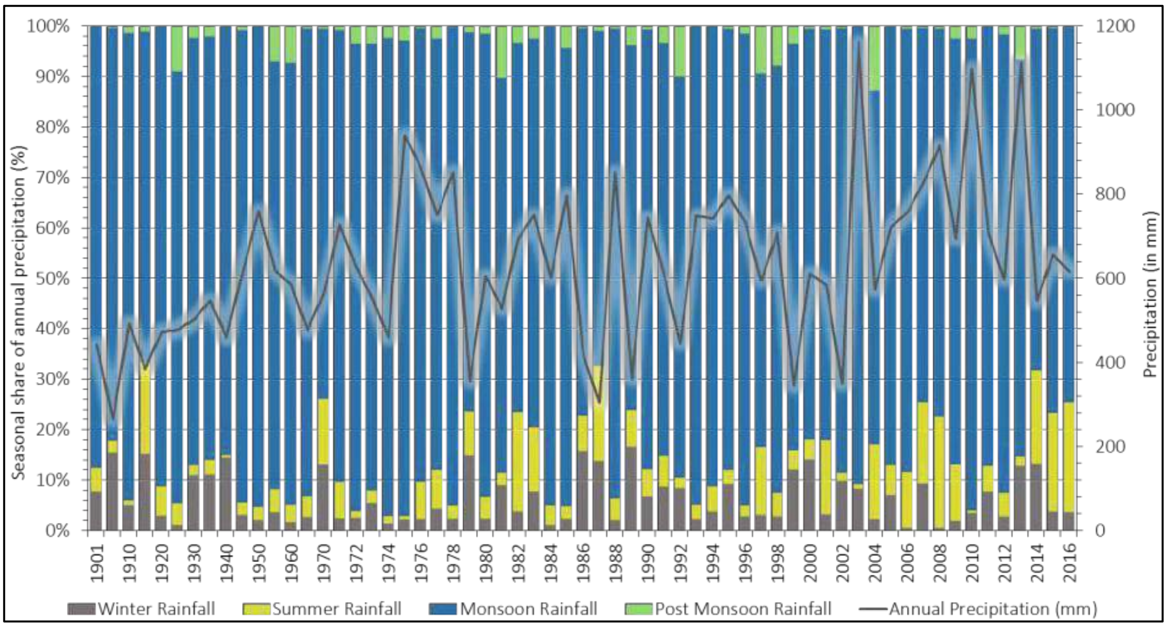

Figure 3: Seasonal share of annual precipitation for Delhi, 1901-2016
Source: IMD (2016)

4. Interplay of Climate Change and Urban Development with the Mobility Pattern of NCT of Delhi- 1986-2016

4.1 Contribution of the Transportation sector in total Green House Gas (GHG) emissions

The increase in GHG emissions for Delhi have been assessed at two levels. First, a spatial distribution of GHG emitters has been identified which included the built up area as well as wasteland. Second, the sectoral contribution of GHG emissions from the sectors of waste, transport, domestic and industries is estimated using the Tier II methodology formulated by the intergovernmental panel on Climate Change in 2007.

In the first case, imageries indicate an increase in the total area of greenhouse gas emitters, which has a direct correlation with the densities of the developed area. Their empirical analysis indicates that the city had 42.5 per cent of its area under greenhouse gas emitters in 1986 which increased to 56.8 per cent in 2016. That is at an annual rate of increase equivalent to 1.3 per cent, with the result that the city's emissions are increasing rapidly. The increase is related to increases in densities of the developed area.

In the second case, GHG emissions from the sectors of waste, domestic, industries and transportation was calculated using the Tier II methodology formulated by IPCC in 2007. The method uses emission factors for energy consumption in each sector. Based on this, emissions for NCT of Delhi have been estimated. This table shows that the city's GHG emissions have increased 4.5 times since 1986. Moreover, the increase has been over 12 times for the transportation sector, 3.5 times for the domestic sector, 3 times for the waste sector and 2.9 times for the industrial sector.

Empirically, for every 100 hectare increase in built-up area between 1986-2016 was leading to an increase of GHG emissions by 0.078 million metric tonnes of CO2 equivalent.

4.2 Urban Floods and implications on urban mobility

The city comprises 24,840 hectares of flood plains of which 68 per cent forms a part of the river Yamuna floodplains. The city has three drainage basins (as indicated in Table 2) based on the watershed that includes the North basin with a basin area of 26,694 hectare; the West basin with an area of 75,633 hectares; and the South and East basins spread over an area of 45,973 hectares.

Assessing the development pattern of Delhi, it is observed that the city has lost over 41 per cent of its flood plains and the loss has increased by 1.4 times since 1986 (as indicated in Figure. 4). The city's flood plains have reduced in width from 800 meters in 1986 to 300 meters in 2016 as a result of construction and developments located in flood plains.

Table 2: Loss of Flood Plains in Delhi, 1986-2016

Basin	Area of Basin (in sqkm)	Area of Flood Plains (in sqkm)	Loss of Flood Plains (in sqkm)				Loss of Flood Plains, 1986-2016 (in sqkm)
			1986	1996	2006	2016	
North Basin	266.94	20.02	3.96	4.91	5.17	5.83	1.86
West Basin	756.33	113.45	33.01	39.48	41.07	44.81	11.80
South and East Basin	459.73	114.93	56.91	72.37	83.03	84.97	28.06
TOTAL=	1824.1	248.4	93.9	116.8	129.3	135.6	41.7

Extracted by the author (2017) from USGS (1986, 1996, 2006 & 2016)

Summing up, the National Capital Territory (NCT) of Delhi witnessed a ~~paradoxical~~ dramatic ecological change over the past three decades. For every 100 hectare increase in its built up area it felt adverse repercussions of corresponding hard coverage of 94 hectares of green sinks and 6 hectare of water bodies.

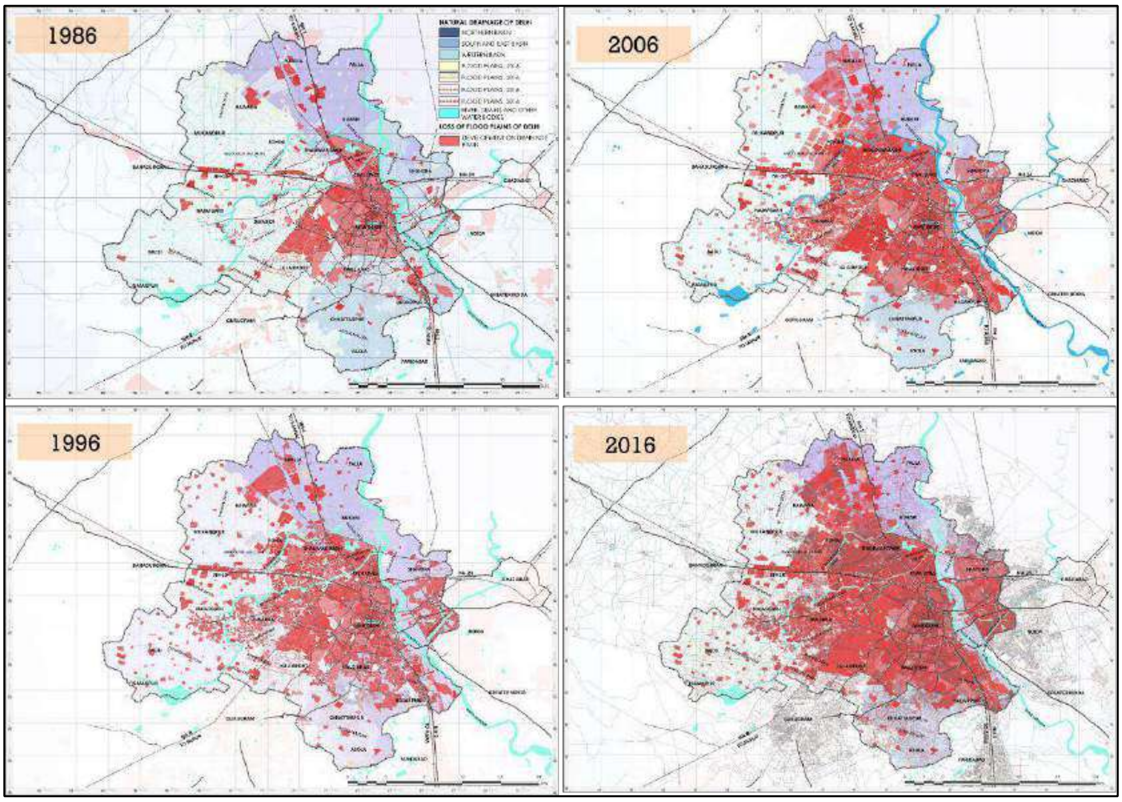

Figure 4: Loss of flood plains in Delhi, 1986-2016
Extracted by the author (2017) from USGS (1986, 1996, 2006 & 2016)

4.2.3 Impact of the built environment on surface run off

Increasing development of drainage basins and the resulting loss of flood plains, coupled with the increase in impermeable surfaces has led to an increase in surface run-off from the city. Due to an interplay of urban development and natural climate variability, the city's surface run-off has increased from 211 million litres per day (MLD) in 1986 to 622 in 2016, that is a 2.9 times increase over the last 30 years. Also, it is observed that with the loss of every 10 hectares of green cover, the surface run off increases by 0.014 MLD. Annually the surface run-off is increasing at 3.7 per cent while the loss of heat sinks is 1.4 per cent. That is, surface run-off is increasing at a much faster rate than the loss of permeable surfaces in the city. The entire chain of events becomes crucial in the light of strong interdependence between loss of heat sinks- both vegetative and drainage basins, increase of impermeable surface, urban expansion and changing precipitation pattern.

5. IMPLICATIONS ON URBAN MOBILITY OF DELHI

5.1 Macro-Level Implications

At the macro level or city level, the empirical study indicates critical linkages between the urban development pattern, climate variability and urban mobility. The two major linkages identified are – first, increasing greenhouse gas emissions with change in urban development which adds to climate change at a regional level, and second, the impact of urban floods on road networks of the city and consequently on the average travel time.

First, in terms of greenhouse gas emissions, recapitulating earlier facts, emissions for NCT of Delhi increased 4.5 times since 1986. However, the increase has been over 12 times in transportation sector alone, owing to rising vehicular traffic and increased congestion on roads. Second, increasing surface run-off and impermeable surface, along with increasing intensity of rainfall has led to increase in the area flooded by precipitation in Delhi (Figure 5).

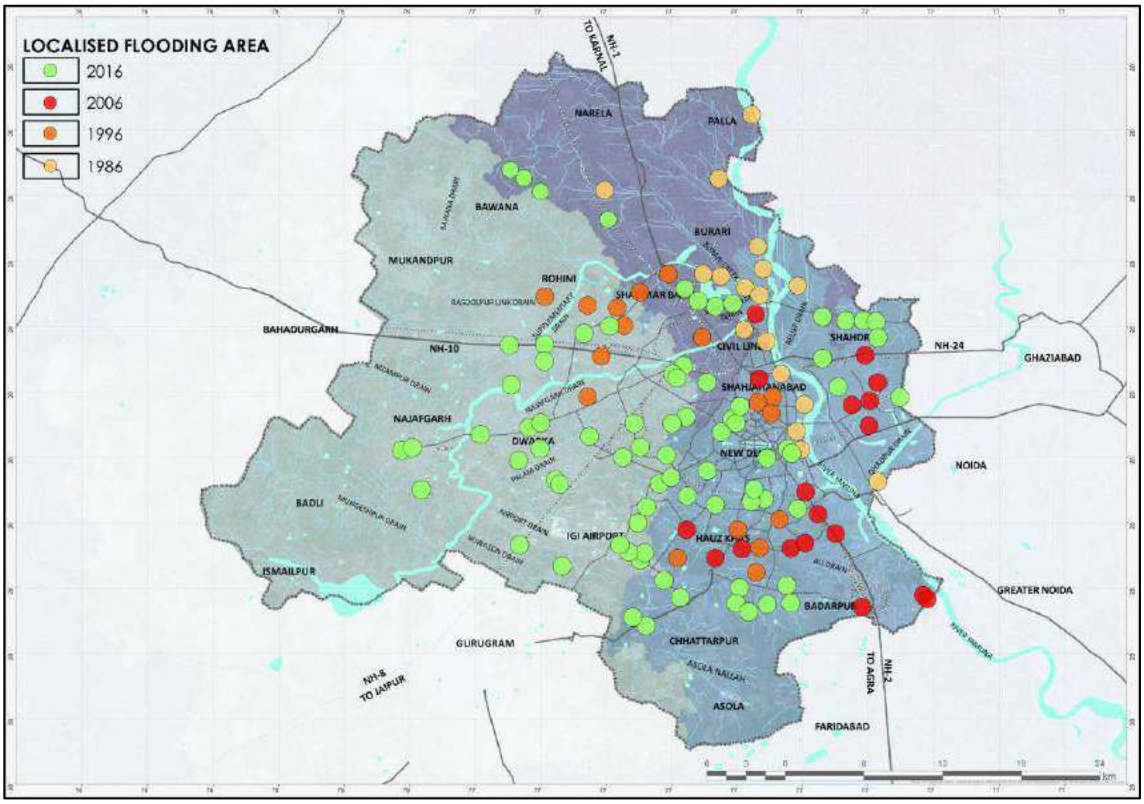

Figure 5: Change in waterlogged/ flooded area in Delhi, 1986-2016
Extracted by Author (2017) from USGS (1986, 1996, 2006 & 2016)

While the period witnessed an annual growth of surface run-off by 3.8 per cent, it led to increase in flooding by 2.5 per cent. Moreover, for every increase in surface run-off by 1 MLD [million litres per day], flooding increased by 85 hectares, the road length affected increased by 68 meters, while vector borne diseases increased by 7.8 per cent. The problem is aggravated by extraction and increasing reliance on groundwater to meet the water demand supply gap.

6. Impact of Climate Change and Urban Development on the Mobility Pattern of Vulnerable population of NCT of Delhi- 1986-2016

Having established the correlation between urban development and climate change at city and spatial levels, this section analyses the impact of climate change on vulnerable population. For this purpose, the flood plain of the river Yamuna is identified and the population at risk recorded. The village population is identified for detailed analysis and surveys among the cohort of climate risk population located in the flood plains, as it has the least adaptive capacity.

4.2.1 Profile of the Flood Plains of the River Yamuna in Delhi

The flood plains of the river Yamuna make up for over 68 per cent of the city's total flood plains. Over a period of time, the river has undergone a change in the course of its flow. Since 1986, studies have indicated that the flood plains have reduced in area and width by 800 metres on either side of the river in 1986 to less than 300 meters in 2016. The land cover on the flood plains of the Yamuna river have undergone major changes in the past three decades.

The land use on the flood plains of the Yamuna river have undergone major changes in the past three decades as well (as indicated in Figure 6). The trend indicates that of the total built up area, residential use has increased by over 200 per cent in the past 3 decades, followed by a 92 per cent increase in commercial and a simultaneous reduction in industrial use. To support the development, utilities and transport infrastructure have grown at the rate of 37 per cent and 14 per cent respectively. That is, the no man's land has become a favourable site for real estate despite the environmental senstivity of the region.

It is because of this increasing built up area alone, that the flood plains and its environmentally sensitive ecosystem have undergone a rapid depletion, accentuating the climate risk as well as frequency and intensity of floods in the river Yamuna.

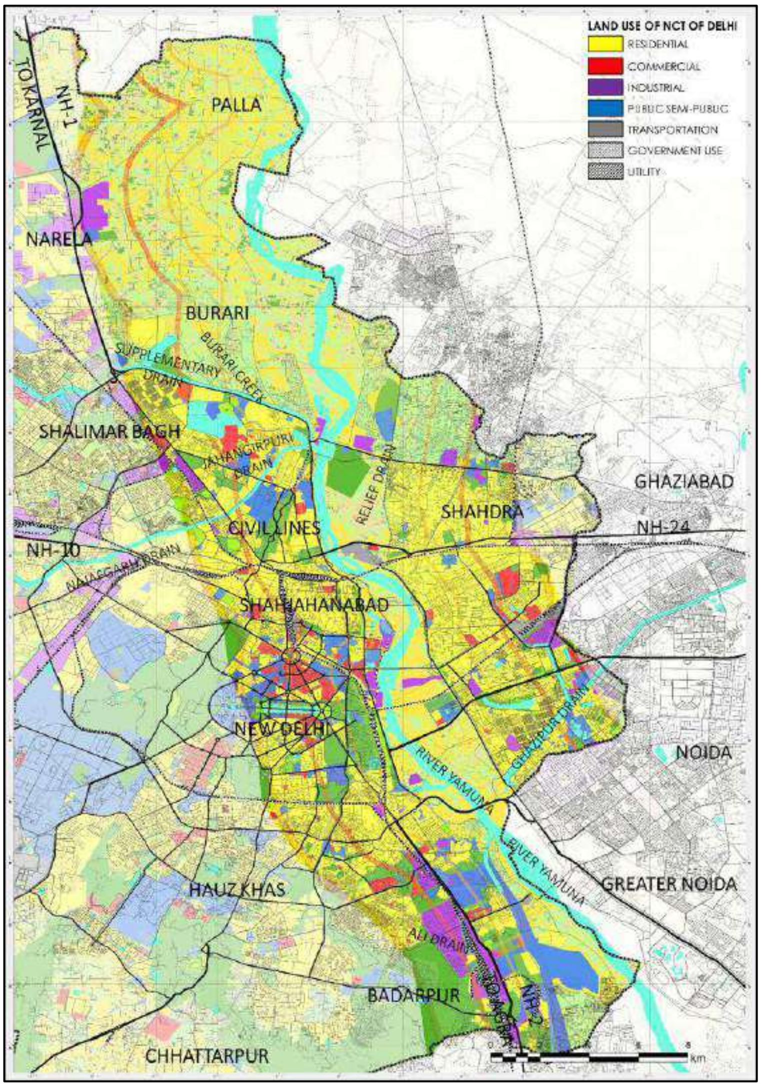

Figure 6: Land Use in flood plain of river Yamuna in Delhi, 1986-2016
Extracted by the author (2017)

5.2.2 Vulnerable Population

Climate resilient urban planning highlights the necessity for assessing the impact of climate on vulnerable population. With increasing developments on the flood plain of the Yamuna river, particularly residential development, the vulnerable population has increased by more than 2.4 times in the last 3 decades. Amongst the three categories of vulnerable population, maximum increase has been in the number and area occupied by unauthorised colonies while villages have reduced in number due to their conversion into census towns but increased in total population due to natural increase. Over time, planned colonies such as the Commonwealth games village have also come up. However, for the purpose of assessing climate risk on vulnerable population, villages are identified separately from the cohort owing to their limited adaptive capacity.

144 villages exist within the flood plains of Delhi that are prone to flooding. These villages are categorised annually by the Irrigation and Flood Control Department of Delhi, Government of National Capital Territory of Delhi into two categories – most vulnerable/totally exposed area villages and moderately vulnerable moderately exposed area villages. However, owing to constraints of time and human resource, only 3 villages (indicated in Figure 7) were selected for impact assessment, which include Badarpur Khadar, Usmanpur and Garhi Mandu in the upstream river Yamuna, north of the Wazirabad barrage.

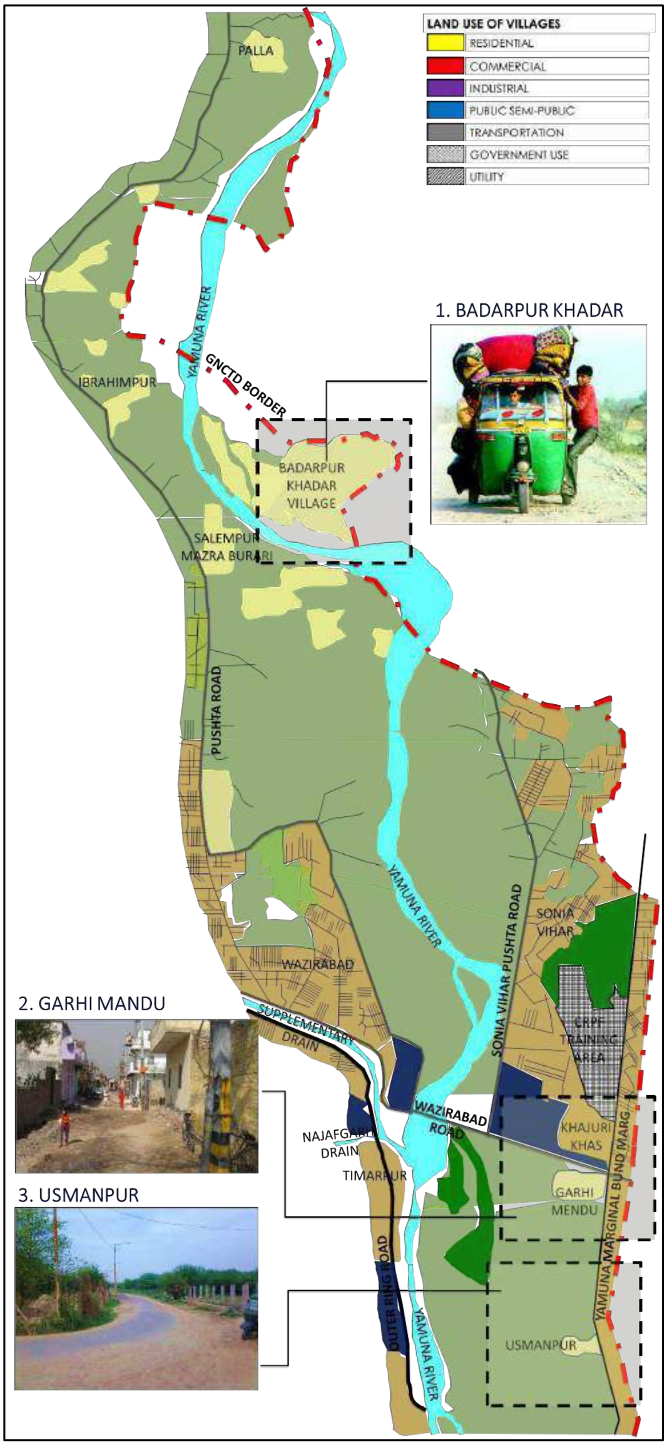

Figure 7: Location of Case villages in the upstream of river Yamuna flood plains, 2017
Compiled by the author (2017) from I&FC (2017)

The impacts were assessed in terms of physical loss, social impact and economic impact.

- **Physical impact -** The physical impact of floods is felt in terms of temporary loss of habitation by way of entry of flood waters into houses and loss of connectivity to the outside world, thus impacting access and connectivity of the settlement with the outside world. To cope with it, prior to flood warnings issuance villagers vacate to higher ground or are resettled to relief camps set up by the Delhi government.
- **Social impact** - Owing to the loss of connectivity and inundation by flood waters, access to education facilities is disrupted for an average of 10 to 12 days. Also, incidences of increasing vector borne diseases, like malaria, dengue, chikungunya and snake bites, have been recorded.

  Economic impact- Due to loss of connectivity to the outside world, a worker loses 10 to 12 working days and tends to lose over 25 per cent to 30 per cent of monthly income. It varies from Rs 250 (~4 USD) per day per capita to Rs 415 (~7 USD) per day per capita.

Summing up the survey findings at micro level, it is found that apart from temporary loss of habitat and connectivity to the outside world or suspension of school and increase in vector borne diseases and snake bites, the average economic impact incurred by the villagers is equivalent to 30 to 35 per cent of their monthly income, equivalent to 10 to 12 working days. Apart from the costs incurred by villagers, government spending on resettlement and relief camps is an annual burden on the state exchequer. The overall monetary loss due to floods in the Yamuna river flood plain is valued at 0.3 million USD per annum which includes 0.23 million USD as the cost incurred by government. Thus, the need to enhance resilience of vulnerable population becomes imperative.

6. Conclusion

The research presented here highlights the interdependence of urban development, climate change and the natural environment, as well as a multiplicity of implications arising from these interdependent phenomena. The need for planners and cities to deal with them in the planning system becomes critical, with cities being guzzlers of over 3/4 of overall resources and generators of about 3/4 of waste and pollution, while accommodating a little over half of the global population. Innovative thinking, planning principles and design within an appropriate framework to set strategies and priorities will be of the essence.

The study underscores the need for a climate resilient urban development for Delhi which means to start envisioning and planning the city according to its carrying capacity. The city's expanse and political as well as socio-economic importance has led to its relentless growth in area, population, vehicles as well as pollution and degradation of natural resources. For that reason, there is a need to put a break on the increasing trend of city development. This requires strong mobilisation of political support for fruitful planning strategies and policies. An example is the recent initiative of *Clean India Mission, famously known as Swachh Bharat Abhiyaan* by Prime Minister Narendra Modi. It has brought about a wave of behavioural change at every level of governance across India and given sanitation a political priority at the centre. Thus, political nexus and push, as well as bureaucratic support play a binding role in ensuring success of planners' efforts.

One of the priority proposals to be rolled out with central support is to initiate decongestion of the city, which can be supplemented by the upcoming Regional Rail Transit System connecting Delhi to surrounding towns of the National Capital Region. Delhi would continue to exist as an employment hub. However, a pressing current need is to start containing the development of the city. create heat sinks at an accelerated rate and redistribute population along more ecological principles. This could take the shape of land use-transport integration, redistribution of population densities and opening up public space, earmarking aquifer and recharging zones for no development among others.

Enhancing the climate resilience of population and infrastructure becomes indispensable to counteract the impacts which have arisen from years of past developments. Moreover, urban planning needs to widen its scope beyond the administrative boundaries of NCT of Delhi and start working at the level of Delhi Metropolitan region. This is particularly important for a climate resilient urban future. This would encompass making it a mandatory provision for all spatial plans to have a chapter on climate change and its implications on urban development. In particular, it should become a statutory requirement for the urban planning processes and plan documents to have a chapter with explicit mention of, and focus on climate change and its relation to urban development in Delhi. It is also proposed that any spatial plan shall have a chapter on climate change and policies for climate resilience, before it can be approved or notified in the official Gazette. The master plan document would have to elaborate climate strategies at city level and provide details at spatial level as well.

It is long overdue that planners start looking beyond the jurisdiction of the National Capital Territory of Delhi and start working and assessing climate and its relation to urban development for a region beyond the state boundary. That is, the urban planning jurisdiction should extend to the Delhi Metropolitan region. This recommendation is further supported by the fact that the predominant climate of the city is determined within 60 kilometres in radius of the city.

Apart from spatial development strategies including transit oriented development, redistribution of population and densities, protection and conservation of the city's drainage pattern, recharging the ground water aquifer and enhancing the green infrastructure, certain other spatial development and planning strategies should be compulsory as well.

Firstly, the master plan of Delhi has to have a comprehensive and clear non-disputable policy for relocation and rehabilitation of climate vulnerable population. Unambiguous provisions for the resettlement of population at risk of climate change have to be included in writing in all spatial plans. Resettlements within the same planning area have to be given priority. In case this is not possible due to space constraints, the resettlement location must not exceed 5 kilometres from the original stay.

Another strategy of paramount importance relates to enhancing the climate resilience for existing immovable infrastructure. There are three approaches to ensure that. First, roads could be aligned according to high flood risk level, or put out of use during the monsoon season. The second approach relates to the 'asset management approach', whereby planners, engineers and professionals from other disciplines would move from road design to planning and maintenance. That is, this approach is a departure from a reactive patch-and-mend approach to a preventive management approach. Lastly, it is necessary to opt for 'user behaviour management', whereby signage will guide users to alternative routes which are less or not affected by climate risk.

In this paper strategies for climate resilient urban development have been proposed for the National Capital Territory of Delhi. New guidelines for climate resilient urban development are also envisaged more generally for any megacity in India with similar attributes and evidence to that of Delhi. They include: land use and urban planning measures; planning for drainage including floods and solid waste management; management of water demand and conservation systems; building and enhancing resilient housing and transport systems; and strengthening of ecosystem services. These five categories of guidelines are directly related to spatial planning and development strategies, that need to be included and comprehensively detailed in spatial planning documents. Beyond that, another 5 categories of guidelines are proposed which are more related to institutional capacities and multiple sectors, affected by climate change and induced risks. They include: diversification and protection of livelihoods; encouraging institutional coordination mechanisms; establishment and strengthening of emergency and warning systems; improved technology and information systems; and enhancing education and capacity building of citizens.

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Effects of Urban land use change on Selected Public Utilities for Sustainable Development in Akure, Nigeria

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Abstract

Urban landuse change is one of the main driving forces of global environmental change. It is central to the sustainable development debate. The aim of this research is to examine the effects of urban landuse and its impact on selected public utility services in Akure with a view to improve strategies to protect these utilities for sustainable development. The research was conducted using remote sensing, Geographical information System and questionnaire to collect the required data for the purpose of fulfilling the objectives of this study. In this study of analyzing the urban landuse change, 2010 and 2018 IKONOS are used in a post classification comparison analysis to map the landuse changes and identify the conversion process in Akure. The landuse change statistics results obtained revealed that residential landuse has changed rapidly for the periods (2010-2018). The results also show increase in commercial landuses between the same periods. The results of the analysis reveal that the built-up area has been growing rapidly for the periods (2010-2018). Findings show that, housing provision (residential), business purpose (commercial) and educational (institution) are the major causes of land use change in the study areas. To reduce the effect of land use expansion in the study areas, policy measures were recommended which include regulating the growth and spread of development, regional development programs. In our opinion, the information provided by these technologies could help city planners and policy makers to attain and sustain future urban development.

Keywords: landuse, public utilities, sustainable development, remote sensing, GIS, satellite imageries

INTRODUCTION

Land use refers to the activity, economic purpose, intended use and or management strategy placed on the land-cover type(s) by human agents or land managers. Land cover refers to the characteristics and surface cover of the earth surface as represented by vegetation, water, bare earth, impervious surface and other physical features of the land (John *et al*. 2003). Land use change occurs when the use to which land is put in different from what it was in past. For instance, an open space or forested area could turn into a built –up area. Therefore, land use and landcover changes play an important role in local and regional environment conditionm of a particular territory and they are linked to global environmental change (Adeboyejo and Abolade, 2006). In order to understand 'why' land use changes as well as 'how' the changes occur. It may be necessary to know what is currently going on and the pattern of these activities in general form (Hudson, 1980).

The patterns of land use within different urban areas have different forms due to the factors that are shaping this pattern. Such factors include topographical features, legislation and legal decision from the government, social and religious, even customs (land holding system), government policy on public utilities and social services supply (Adeniyi, 1978).

Several researchers have employed various methods or techniques for landuse and landcover change. In his studies carried out by 2004 in Shaoxing City in China, Peng and Howarth (2004) used Satellite imageries for the year 1984, 1997 and 2000; one of the goals of the study was to produce a land use map of Shaoxing City and its surroundings. The results show that there are undoubtedly a lot of changes that occurred between 1984 and 1997 when compared with those of 2000, due to the sufficient time gap.

Similarly, Zhi-Yong *et al* (2005) used image processing and analysis in a GIS environment to assess spatial change in urban land use patterns and population distributions. Here, unsupervised classification was used to classify the images into land use classes. With Census data in a GIS, census polygon was constructed into various sets of units, and then comparison made with the classified image by proportion in surface.

Elnazir *et al* (2004) analysed the nature, rate and location of urban landuse changes, urban built-up land was extracted from each of the images, overlaid on each other to obtain an urban expansion image. These extractions were done on layers in the vector GIS environment and the result used to identify urban land change to obtain real time information. Musaogwu *et al* (2002) incorporated remote sensing and GIS to create overlays of two or more independently produced classified images· It can be used to detect changes, trend, location and amount of changes that have occurred. Zubair (2006) examined the use of GIS and Remote Sensing in mapping landuse and landcover in Ilorin, Nigeria between 1972 and 2001 to detect the changes that has taken place in this status between these periods.

The objectives of this study include to:

(a) identify the major land use types using remote sensing/ GIS in the study area.
(b) estimate the proportion of land use devoted to these different empirical evidence urban land use types in the study area.
(c) analyse the casual factors responsible for landuse change
(d) determine the planning implications of the urban land use change on these selected public utilities in the study area

THE STUDY AREA

The study area is Akure, the administrative capital of Ondo State. The city is located within Ondo State in the South Western part of Nigeria (see figure1). It lies approximately on latitude 7^0 15^1 North of the Equator and longitude 5^0 15^1 East of the Greenwich Meridian. Akure is a medium- sized urban centre and became the provincial headquarter of Ondo province in 1939. It also became the capital city of Ondo State and a Local Government headquarters in 1976 (see figures 2 and 3). The city's morphology has changed over time to assume its present status with its attendant land use problems, as experienced in similar medium sized urban centres in Nigeria. Akure is located approximately 700 kilometers South West of Abuja, the Federal Capital of Nigeria and about 350 kilometers to Lagos the former capital of Nigeria. The annual average temperatures range between 21.4 and 31.1^{o}C, and its mean annual relative humidity is about 77.1%. It is located within the tropical rain forest region of Nigeria where rainfall is high throughout the year. In 1963, Akure had a population of 71,106 which increased to 109,253 by 1976 (Olotu, 2005). The rapidity of its development within forty two years stemmed from the political status of the city which was initially a provincial headquarters later a state capital thus servicing as the seat of both local and state governments ever since; this accounted for the influx of people into the city for employment. In 1991, the population had risen to 239,124 and by 2006 the population was put at 340,021 (NPC, 2006).

Figure 1: Map of Nigeria showing Ondo State

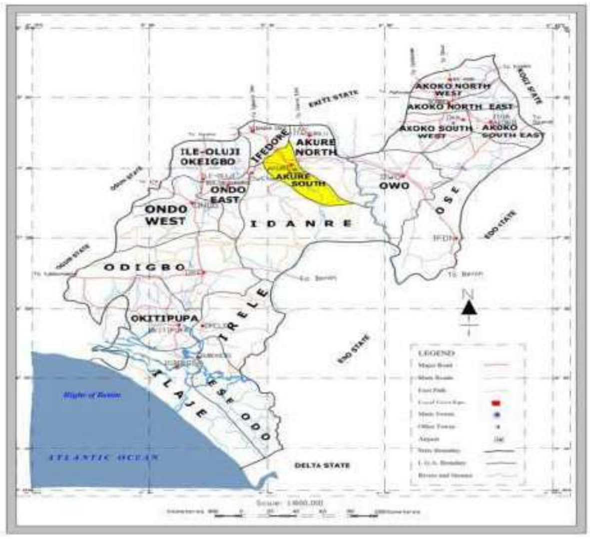

Figure 2: Map of Ondo State showing Akure South Local Government

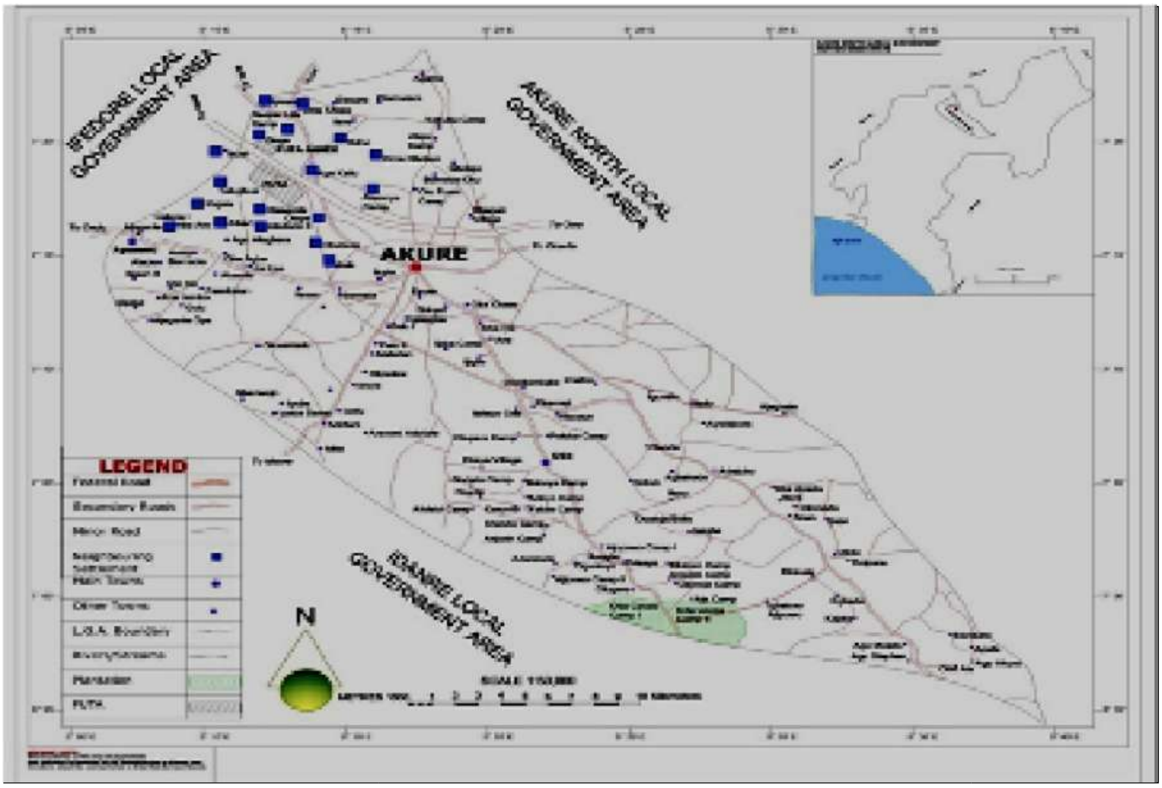

Fig. 3: Map Showing the Location of the Study Area

DATA ACQUISITION AND METHOD

This study was interested in the effect of urban land use change on selected public utilities in Akure. It also seeks to use the capabilities of Geographical Information System and remote sensing techniques to determine the rate of land use change on these utilities in the study area. To achieve this, IKONOS images of Akure were acquired for 2010 and 2018. The images are geometrically corrected and ground control point obtained through intensive ground surveys permitted the co-registration of all images to Universal Transverse Mercator (UTM). The Urban Satellite imageries were made to pass through process of image enhancement, geo referencing, resampling, image classification was performed on false colour composites into the following landuse: residential, commercial and institutional. Information collected during field surveys was combined with the digital topographic map which was developed for the study area was used to assess the accuracy of the classification.

The questionnaire method was used to generate attribute data to further enhance our information on the study. For the purpose of this study, the selected landuse areas are: residential (Obaafunbiowo and Igoba); commercial (Isikan market, shasha and Akure mall) and institutional (Federal university of Technology, Akure and its environs. The questionnaires were allotted based on the number of buildings in the selected landuse in each area.

Two hundred and forty questionnaires (240) were administered in all out which 200 were retrieved in analyzable form given a response rate of 83.3%. By this the exercise is considered successful. Table 1 shows the residential and the number of questionnaires administered per landuse area.

Table 1: Questionnaire Administration Analysis

Landuse Areas	Sampled areas	No. of Buildings in the areas	No. of Questionnaires Administered	Questionnaire Retrieved
Residential	Obaafunbiowo/Igoba	301	60	43
Commercial	Isikan market/shasha Market/Akure mall	298	60	45
Institution	Federal university of Technology and its environs	167	60	55
Sub-total		**766**	**240**	**200**

Source: Author's survey (2018)

The data collected using this medium was processed using Statistical Package for Social Scientists software (SPSS). Results obtained were presented in form of tables and figures. The areas covered by the questionnaire include demographic factors responsible for urban change in the study area. All questions were carefully analysed and considered in addition to spatial information from GIS analysis to arrive at our conclusion.

RESULTS AND DISCUSSION

Three major classifications were used in this study. These are the residential which comprises of the dwelling houses; commercial which include Isikan market, shasha market and Akure mall; and institutional landuse including Federal University of Technology and its environs. However, the total area of each of the landuse was calculated in 2010 and 2018. The total areal extent for each land use type is thus summarized in table 2. On comparing the figures 4 and 5 and table 2, it was observed that the residential landuse (Igoba) covered 7,573,720 square meters (0.03%) in 2010 and increased to 19853,027.32 square meters (78.23%) in 2018, while Obaafunbiowo in figures 6 and 7 decreased gradually from 1502,192.16 (0.25%) in 2010 to 2747,914.12 square meters (0.08) in 2018. The commercial landuse on the other hand in figures 8, 9, 10, 11, 12 and 13 due to massive in population affected the landuse change to various conversion of residential use to commercial. The commercial land use change of Isinkan decreased from 5937.30 (67.13%) in 2010 to 20776.61(0.08%) in 2018 while shasha and Akure mall increased drastically from 28969 square meters (0.10%) and 12100.17 square meters (0.05%) square meters in 2010 to 83299.80 (0.33%) and 31708.78 square meters (0.12%) in 2018 respectively. The institutional land use in figures 14 and 15 as result of massive encroachment, farming activities and various expansions going on, the landuse change decreased from 21161387.69 square meters (19.15%) to 2639.908 square meters (10.41%) in 2018.

Figure 4: Land area of Igoba Akure in 2010 covering 7,573720.03 square meters

Figure 5: Land area of Igoba Akure in 2018 covering 19,853,027 square meters

Figure 6: Land area of Obaafunbiowo Akure in 2010 covering 1,502,192.16 square meters

Figure 7: Land area of Obaafunbiowo Akure in 2010 covering 2,747,914.12 square meters

Figure 8: Commercial Land area of Isikan market Akure in 2010 covering 5,937.30 square meters

Figure 9: Commercial Land area of Isikan market Akure in 2018 covering 20,776.61 square meters

Figure 9: Commercial Land area of shasha market Akure in 2010 covering 28,969.61 square meters

Figure 11: Commercial Land area of shasha market Akure in 2018 covering 83,299.80 square meters

Figure 12: Commercial Land area of Akure mall in 2010 covering 12,100.17 square meters

Figure 13: Commercial Land area of Akure mall in 2018 covering 31,708.78 square meters

Figure 14: Institutional landuse of Akure in 2010 covering 2,161,387.69 square meters

Figure 15: Institutional landuse of Akure in 2018 covering 2,639,908.44 square meters

Table 2: Selected Land use change in (m^2/year) and (% year) of Akure in 2010 and 2018

Selected area	2010 in square meters	% in 2010	2018 in square meters	% in 2018
Futa	2,161,387.69	19.15	2,639,908.44	10.41
Isinkan	5,937.30	67.13	20,776.61	0.08
Shasha	28,969.61	0.10	83,299.80	0.33
Akure mall	12,100.17	0.05	31,708.78	0.12
Obaafunbiowo	1,502,192.16	13.32	2,747,914.12	10.83
Igoba	7,573,720.03	0.25	19,853,027.32	78.23
Total	11,284,288.96	100	25,376,635.07	100

IMPLICATIONS OF LANDUSE CHANGE IN THE STUDY AREA

A tremendous increase in population as a result of the improved status of Akure from a traditional town to a State capital led to changes in land use pattern, which initially dominated by residential and cultural landuse to a more complex and diversified type of landuse. Institutional, commercial and administrative and social landuses among others were added to the existing landuses. Akure has undergone and is still undergoing many changes in physical form and economic functions in terms of land uses in response to the population growth. There are so many inter-woven factors contributing to this population growth. The creation or establishment of industries created job opportunities which attracted migrants into the town. This has led to changes in residential as well as commercial land use. Furthermore, the creation of higher institution of learning such as The Federal University of Technology has also contributed to population growth which has both directly or indirectly influenced other landuse activities.

However, the impact of the population growth is also seen in the establishment of new markets and development of the old ones. In essence, the establishment of Shasha market and renovation of Isikan market and Akure mall are due to population growth and urban expansion. One can now be able to infer from the above that population growth in Akure leads to the increase in types and areal extent of urban land use.

Other variables that are responsible for land use changes in the study area include: the type of building; use of building; age of building; and building approval plan before construction among others (see Tables 3 7).

Table 3 shows that the bungalow type of building is the most occurring type of building with 36.7%, follow by block of flats also having 25.0%, storey buildings with 20.8%, and lastly followed by duplex with 12.9%, This is an indication that the other building types meant to accommodate large number of people are springing up and this will give rise to population of the study area and other urban problems such as overstretch of infrastructures will then be experienced.

Table 3: Building types

Response	Frequency	%
Bungalow	88	36.7
Storey Building	50	20.8
Duplex	31	12.9
Block of Flats	60	25.0
Others	11	4.6
Total	240	100.0

The result of the survey describes the previous uses of buildings in the study before they were converted into new uses as shown in figure 4. This result is a true reflection of what the area is ought to be in its real nature as planned. The survey conducted shows that residential covers about 50.0%, commercial 22.9%, institutional 16.7%, recreational 5.0% while industrial is 5.4% respectively. This shows the use at which the study is purposely meant for from inception. This is actually turning to a commercial land area from residential area.

Table 4: Former Use of Building

Response	Frequency	%
Residential	120	50.0
Commercial	55	22.9
Institutional	40	16.7
Recreational	12	5.0
Industrial	13	5.4
Total	240	100.0

Table 5 also shows the results of the present uses of building in the study area. The result shows that the most dominant use of land is the residential is 53.3%, with commercial 24.2%, institutional 16.3%, recreational 3.3% and industrial 2.9%. This survey reveals that the extent at which changes have occurred in the study area, this occurrences have not actually stop, so there is possibility that the area will attain another state of commercially developed area in the nearest future. This is an implication that one might not actually be able to ascertain the use of this area in the future to come if the government do not find measure to stop the ongoing change.

Table 5: Present Use of Building

Response	Frequency	%
Residential	128	53.3
Commercial	58	24.2
Institutional	39	16.3
Recreational	8	3.3
Industrial	7	2.9
Total	240	100.0

Table 6 gives an insight on how the buildings are converted from their previous use to their current use. From the survey carried out in Table 6, it is shown that most conversion are actualised by addition of uses to the previous use that is having mixed-use and this accounts for about 40.0%, followed by change in use from their original use which also account for 24.2%, also alteration of buildings also account for about 15.0%, partial demolition and renovation accounts for 10.4% while reconstruction and total demolition accounts for 6.3% and 4.1% respectively. The implications of all these indicate that buildings are being converted at an alarming rate.

Table 6: Present Use of Building

Response	Frequency	%
Mixed use	96	40.0
Change in use	58	24.2
Alteration in buildings	36	15.0
Partial demolition and renovation	25	10.4
Reconstruction	15	6.3
Total demolition	10	4.1
Total	240	100.0

Table 7 shows that over 50% of buildings in the study area did not secure building plan approval before construction. Up till the time of this study, there are no plans for most of the buildings in the study area. The situation reveals that property owners in the syudy area develop their properties without due regard to physical planning rules and regulations.

Table 7: Building plan approval before construction

Approval	Frequency	%
Yes	110	45.8
No	130	54.2
Total	240	100.0

CONCLUSIONS AND RECOMMENDATIONS

The study has revealed on the percentage basis the various landuse categories in the study area. It is clearly seen that residential and commercial are the most extensive landuse found in the study area. The reason for the high proportion of residential land use is the absence of other activities which is present in the large and medium towns, with this, one can easily infer that Akure falls to the categories of medium towns, since it has over 78.23% of its land area occupied by residential units. Furthermore, the study reveals that the total area covered by residential cum commercial is greater than the total area occupied by the remaining landuse activities combined together as shown in table 2. The result of the study shows that public institutions covered an area of 10.41% in 2018 and because of huge land requirement, they were located at the urban outskirts. Example include Federal University of Technology.

The landuse changes done in this study shows what exists in the urban scape of selected areas of Akure has therefore shown that the current landuse situation is such that can lead to ecological disaster. The study therefore advances some recommendations as a way of preventing these problems. First, the urban developer should be in conformity with planning regulations. People should be aware of such regulations to serve as a guide and rule for them in building o their houses both in terms of spacing and distance away from the roads. Second. Land conservation act should emphasis systematic growth of the city. Third, population growth through immigration should be controlled through the policy of regional development programme.

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Cool Waterfronts and Coastal Cities: How Qatar's Peninsula Develops a Resilient Future?

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Abstract

The coast is one of the most complex systems on earth as it is the result of the continuous interaction between people, land and water. These physical processes shape the geomorphology of the coast, which sustains specific ecosystems that provide crucial services to human societies to flourish. This paper aims at expanding the understanding on the functioning of the waterfronts, which are crucial factor to increase the awareness regarding the challenges of developing and governing coastal areas and waterfronts. Evidently, climate change represents the major human-induced source of natural risks. Understanding the risks associated to the coast is crucial to provide safe and resilient human environment. Planners must address the challenges of waterfronts and coastal areas' planning approaches. Coastal cities are facing the challenge not only by providing high quality services for its inhabitants but also to integrate specific coastal and waterfront uses that demand a large quantity of space and requires highly specialized services. Ports, dwellings, beaches, promenades, protectorates, industry, logistics, resorts, restaurants, are just few of the uses that characterized most coastal cities and waterfronts and need to be integrated into the urban fabric and smartly diminish the consequences of climate change. This paper provides an analytical narrative of Doha, the capital city of Qatar as a typical city-state in addition to significant coastal cities in Qatar like Al-Khor and Al-Wakra. The Gulf always played a major role in Qatar's economical, social, cultural and political life. Inhabitants of old Doha being fishermen and pearl divers perceived the Gulf not only as source of their prosperity but also considered as a sacred entity.

Selected Congress Track: 2-SPOTLIGHT CITIES: Planning for Coastal Cities, Remote Towns, and High North Cities.
Keywords: Coastal Cities – Waterfronts – Doha, Qatar – Coastal Management – Coastal Development – Climate Change Impact.

1. Introduction

Some cities have long-treasured waterfront promenades, many cities have recently built ones, and others have plans to create them as opportunities arise. Beyond connecting people with urban water bodies, waterfront promenades offer many social and ecological benefits. They are places for social gathering, for physical activity, for relief from the stresses of urban life, and where the unique transition from water to land eco-systems can be nurtured and celebrated (Macdonald, 2017).

> *"The waterfront isn't just something unto itself. It's connected to everything else."* Jane Jacobs.

The Gulf waterbody and the extended coastline are of a great social and cultural significance to the community of Qatar. With more than 600km of continuous waterfront, Qatar is blessed with a great potential which can be vital for its urban and economic future. This natural potential can be also perceived as a great plight if the impacts of climate change particularly the sea level rise are not considered. This paper illustrates a major shift in contemporary urban development in Qatar. The shift stems from a deeper understanding of the vulnerability of Qatar as a peninsula facing the consequences of climate change in an inevitable manner. Evidently, the first cycle of globalizing the waterfronts urbanity in Qatar and particularly Doha the capital city, was characterized with an emphasis on the image of the city on the expenses of being concerned and prepared for the consequences of climate change and global warming. Plenty of skyscrapers were built along the waterfront to generate a global city image for Doha. Additionally, a number of mega real-estate projects resorted to gulf reclamation to gain more land and create fantasy housing and recreational projects.

The paper sheds light on new planning approaches, coastal management strategies, global warming impact assessment, climate change readiness and urban development guidelines which characterize the new waterfronts development paradigm in Qatar. The related outcomes of Qatar Vision 2030 specifically the Integrated Coastal Zone management Plan for Qatar will be assessed to scrutinize its policy making, planning and implementation. More significantly, the paper traces the impact of the declaration of Qatar National Development framework and Qatar National Master plan, as calls for a better planning for the local waterfronts. The paper concludes with a holistic planning matrix which advises the development logic of coastal cities in Qatar to create a balanced relation between Gulf, city and society. It also suggests planning principles, policies, guidelines and regulations for future waterfronts and coastal areas' development in Qatar.

2. Qatari Cities and Water: A Unique Relation, the Past, the Present and the Future.

The relation between Qatari cities and water is historical and influential. The Urban history of Qatari cities was substantially affected by the proximity of the Gulf and the economic dependence on fishing and pearl diving. Studying the urban evolution of Qatar and other Gulf States would reveal two forms of settlements allocated in an adjacency with water. The first form is fishermen villages which were distributed along the waterline in the preferred sites for starting the fishing trips and its proximity to the community Souq. This form or pattern of waterfront development was not limited to Qatar but was repeated in all Gulf States as fishing and pearl diving were the main economic pillars for all pre-oil traditional settlements in the Gulf. The second pattern of waterfront development is the portal cities. These cities grow gradually and organically around a simple port which was used to facilitate trade activities within the Gulf and with neighboring countries particularly Iran, India and other surrounding countries.

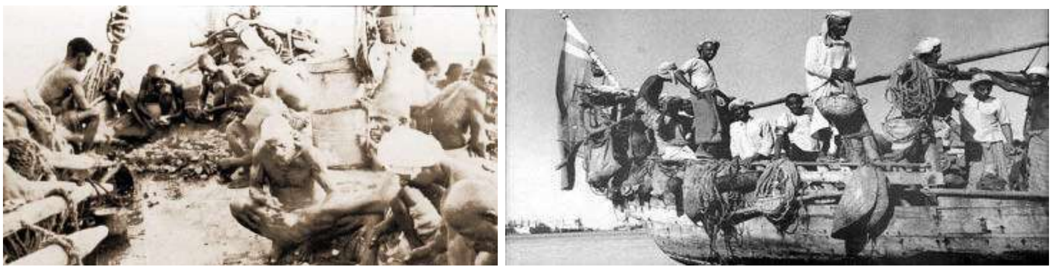

Figure 1: The economic base of the origin of Doha as a fishermen village

2.1. The Impact of the Gulf on Doha's Urban Evolution

The city of Doha is the capital of the State of Qatar and is located on the Persian Gulf. The primary industry in the city was pearl trading through the 1920s, and then collapsed due to the invention of pearl harvesting techniques in Japan. The population peaked at about 27,000 inhabitants in the 1920s (Alraouf, 2017) and consisted of traditional Islamic desert settlement patterns, as described by Hakim(1986).These patterns consisted of a vernacular road networks of cul-de-sacs, which enhanced the privacy of neighborhoods, known as ferej, and the market, located close to the port and constituting the central public realm. After national independence, Doha entered a phase in the 1970s and 80s when the discovery of oil fueled a physical growth of the city's infrastructure. While the old city centers were replaced by commercial buildings and apartment blocks for foreign labor, low-rise housing areas rapidly extended the urban periphery (Al Hathloul 1996). Studying the urbanity of Qatar and particularly Doha, would reveal the significance influence of proximity of the Gulf on the city growth pattern over the past decades. The city of Doha is the largest city and capital of the state of Qatar, and is located on the Persian Gulf. It has one of the fastest growing populations in the Arabic world (World Bank 2014). While the population of Doha was below 500 thousand just 20 years ago, it is now over 1.2 million and expected to continue rising at unprecedented rates. Even if we trace how Doha transformed from a traditional settlement to a cosmopolitan and global city, we can clearly identity the impact of the Gulf on the city morphology, roads development patter and growth directions. In other words, the urban growth dynamics of Doha were substantially relaying on the strong connection between city and water. The overall morphology of the city can also be seen as a reflection of the Gulf waterline geometry. Changes in the composition and configuration of urbanizing Doha were found due to the gradual growth respecting the genesis of the city's development; the Gulf.

Figure 2: The whole process of urban evolution in Doha, the Capital city of Qatar was based on the strong connection with water

2.2. Why Waterfronts are Significant to Qatar's Urban Future?

The Gulf and coastline assets are of great spiritual and cultural significance to the people of Qatar. As all the main cities in Qatar are basically coastal cities, planning for their sustainable future is crucial. All these coastal cities were and still represent the main centers of urbanization in the whole State. The growth of Qatari coastal cities population and the preference for living in coastal areas has resulted in their ever-increasing development. Coastal cities and waterfront areas are the most common destination, which brings in economic growth but implies additional urban development and increases the need for resources, infrastructure and services. Qatar went through different phases of dealing with waterfronts in the last decades. Most of the coastal cities were transformed from humble fishermen settlements to modern cities.

3. State of the Doha's Waterfronts in the Post-Oil Era

Historically a pearl-trading center, Doha has reinvented itself in just two decades into one of the world's busiest business, cultural and tourism centers. The Evolution of Doha's Waterfront if critically analyzed reveals profound conclusions about phases of development. The capital city Doha has witnessed a number of transformations after the discovery of oil. As per the waterfront, specific changes can be concluded as follows:

3.1. From a source of livelihood to a view.

One of the main transformations that can be observed in the post-oil era is the fact that the Gulf was not perceived any more as a source of livelihood. Fishing and pearl diving are no longer the back bone of the State's economic base. Hence, the Gulf's new value, particularly for hotels and real estate developers lies in its ability to provide stunning views for hotels' guests and residential towers dwellers.

*Figure 3: Doha's waterfront in the 1940s and **1960s**.*

Figure 4: **1990s**

3.2. The Port and the Market vs. the Glittery Towers

The post-oil era is also related to the domination of changing the image of the city so it can be easily related to global cities around the world. The waterfront which was historically distinguished with its vibrant port and lively market transformed into a setting for iconic development which constructs the new image of the city as a global urbanity. The result of such process resulted in the lining up of towers overlooking Doha Bay. Parallel to such aggressive development another form of urbanity can be observed. Considerable portions of the waterfront were designated to private entities primarily hotels, restaurants, resorts turning the enjoyment of the Gulf waterfront to private places. This privatization of the waterfront was accompanied with lack of interest in creating spaces for people and reestablishing the strong connection between the city, the community and the waterfront in Doha.

Figure 5: Doha's accelerating waterfront development in the last decade

4. Contextualizing the Waterfronts of Qatari Cities

In addition to Doha, the Capital city, Qatar's cities are all adjacent to water. The main reason can be understood once the urban history of each city is analyzed. All these cities are originally based on fishing or trade small ports. So every Qatari city overlooking the Gulf has its history but also acquired some architecture, urban, cultural and functional roles through the last few decades. Therefore, for planning the future development of Qatari cities' waterfronts, being informed about its history and current status is significant. The idea is using the personality, historical narrative, urban character and assets of every Qatari city to articulate its unique approach to waterfront development. For example if we compare between the other two cities following Doha in the ladder of Qatar's most important and populated cities, interesting conclusions would be revealed. In the case of Al Khor City/Municipality, the fishing port is the origin of the city. Al Khor city is located specifically on the East coast of Qatar, about fifty kilometers from Doha and come third in terms of population with its 200,000 inhabitants. The personality of the city now is weaved around a recreational role which needs to be elaborated and further explored. The future development of the city and particularly its waterfront should consider the city character, function and personality. Hence, invest more in developing the City and its waterfront as a holistic recreational development serving the community, the city and the whole country. The second important case is Al Wakrah City/Municipality. Al Wakrah, a city in Qatar is located south of Doha. The Eastern shore of Al Wakrah faces the Gulf. Originally fishing and pearling village, Al Wakrah has now evolved into a small city with a population of more than 300,000 inhabitants making it one of the largest cities in Qatar. The city has a strong history and evidences of the traditional architecture and urbanism of Qatar. It is also the location of the famous fort and traditional market. Hence, a focus on the historical heritage as a potential for developing the city's waterfront can be a key to its uniqueness within the Qatari context.

Figure 6: Partial attempts to develop parts of Al Wakrah waterfront as a manifestation of local heritage to attract tourism and serve the local community alike.

5. The Main Challenges of Waterfront Development in Qatar

For Qatar to develop its waterfronts and coastal cities in a sustainable manner, a number of challenges need to be confronted. As explained earlier, all the waterfronts and coastal cities in Qatar are part of the country's environmental assets and also contain the most significant urban and architectural heritage due to the fact that all traditional cities in Qatar were historically portal cities connecting Qatar with the rest of the world via trade and other economic activities. Here are the main challenges as prioritized to be confronted in any strategic planning aiming at developing waterfronts and coastal cities in Qatar.

5.1. Waterfronts as a Catalyst for Urban and Economic Development

To mitigate these problems it is necessary to consider coastal cities as dynamic complex systems which need energy, water, food and other resources in order to work and generate diverse activities, with the aim of offering a better socio-economic climate and quality of life. As a consequence, the integrated management and sustainable development of coastal cities is essential, with science, technology, architecture, socio-economics and planning, all contributing to provide support to decision makers. As stated in Qatar National Development Framework: “Although Qatar is a coastal nation, there is a significant under provision of recreational and leisure facilities in coastal locations for the community to enjoy". Qatar National Development Framework (QNDF).

5.2. Environmental Conservation.

The activities common to coastal cities and waterfronts areas require the development of well-planned and managed urban environments, not only for reasons of efficiency and economics, but also to avoid inflicting environmental degradation that causes the deterioration of natural resources, quality of life and human health. Preserving the environmental assets allocated along the extended Qatari coastline including mangrove trees. Qatar should learn from the negative consequences of water reclamation as it negatively affected marine ecosystems. Extensive coastal development in Dubai's artificial islands is a very illustrative example of such negative impact. Another important aspect in planning contemporary waterfronts is dealing with the future consequences of climate change.

Figure 7: The view over a few mangrove trees that grow on the shores of Qatar

5.3. Heritage Conservation.

The second main challenge in developing waterfronts and coastal cities in Qatar is heritage conservation. All the portal cities in Qatar from Doha to Al-Khor or Al-Shamal in the north or Al-Wakra in the south are sites for a valuable architectural and urban heritage. From the fabric of the traditional center of these cities to the unique vocabulary of architectural elements used in houses, mosques and majlises, conservation and preservation of such valuable and irreplaceable heritage should be a priority. Hence, the role of urban planning authorities in Qatar should be articulated around a more sensitive approach to waterfront development. An approach that will allow development and growth but more significantly acknowledge the importance of conserving the nation's heritage and preserve such valuable chapters of Qatar’s history.

5.4. Waterfronts in Qatar as Places for All

Many scholars in the field of urbanism, through their research, have highlighted the importance of the human dimension in urbanism (Jacobs, 1961; Gehl, 2013) and offered insights into systematically studying environmental behavior (Zeisel 2006) through international studies in public life (Whyte, 1980; Gehl, 2013). Studying public life offers immense insights to urban environment professionals by bringing users back into focus when they may be overlooked in design (Gehl, 2013). The expected outcomes could play an essential role in achieving the needs of the whole social spectrum that are considered as community members dwelling within Doha and other cities. People in Qatar could belong to any of the more than 150 nationalities that make Doha and other Qatari cities one of the world's most diverse places. Hence, waterfronts development in Qatar should speak to this diversified human mosaic and take their needs and aspiration into consideration.

6. The Role of the Urban Planning Department in Qatar: Towards an Integrated Coastal Zones Development

The Inevitability of Coastal Protection

Qatar coastline has come under increasing pressure as it continues to attract many new residents and visitors seeking the lifestyle and environment of coastal living. Planning for coastal communities must balance the need to provide jobs, housing, facilities and transport for a growing population while maintaining the coast's unique qualities. It was evident in Qatar National Development Framework (QNDF) that Qatar as a costal nation is not utilizing such a potential to the maximum level desired[1]. Qatar National Development Framework (QNDF) and the generated Qatar national Master plan acknowledged the lack of clear strategy to deal with the waterfront development and coastal growth. Hence, Interim Coastal Development Guidelines (ICDG) was developed with the determination to use it temporarily till the finalization of a comprehensive and integrated study dealing with Costal Zones Management. The main value of ICDG is to guide the assessment and approval of recreational, leisure, tourism and other forms of development and facilities proposed in coastal locations. Additionally, it directs public and private sector development to follow a clear set of development objectives, definitions and regulations to prevent the risk of environmental degradation in the Coastal Zones.

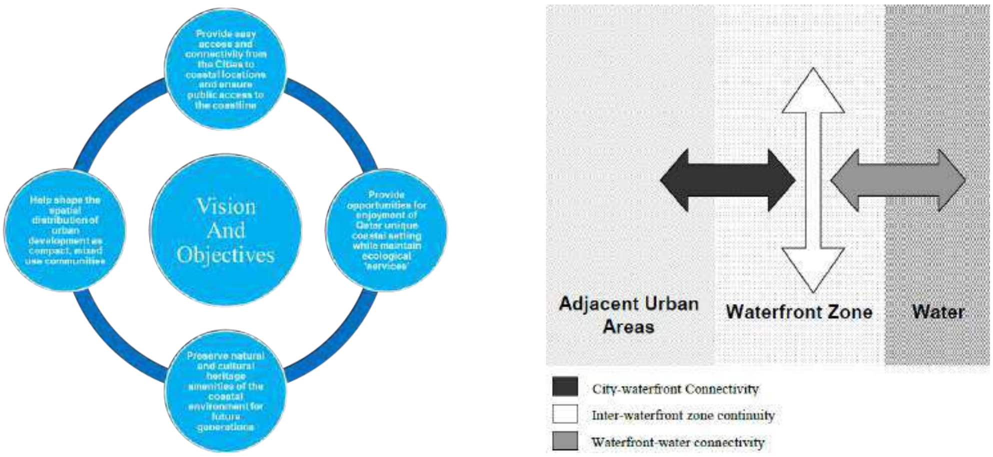

Figure 8: (Source: QNMP, ICZD)

Based on the coastal form of Qatar and the land use sensitivity analysis that has been undertaken and mapped, appropriate forms of land use and occupancy in the four major coastal zones have been identified. The Four Coastal Zone Types are Protected Areas and Aquifer Protection Zone, Developed Areas, Future Development Zone, and QP Jurisdiction Zone boundary and areas that have not been designated in the first the first three types. The third type or zone which is related to future development was also divided into three zones depending on the sensitivity of the development context. Hence, Classification of Future Development Zone was categorized as such The Future development zone with less environmental sensitivity, The Future development zone with medium environmental sensitivity and The Future development zone with high environmental sensitivity.

[1] QNDF has proposed the preparation of a comprehensive Integrated Coastal Zone Management Planning (ICZMP) to help manage and sustain the nation's valuable coastal assets.

Figure 9: The main promenade of Doha and the connected green public spaces.

Figure 10: The interaction between people and the waterfront along the city's active promenade.

7. Global Lessons: The Urban Value of Costal Development

The meaning of a city vibrant waterfront is centered on creating places for all people. Cities seek a waterfront that is a place of public enjoyment. They want a waterfront where there is ample visual and physical public access – all day, all year - to both the water and the land. Cities also want a waterfront that serves more than one purpose: they want it to be a place to work and to live, as well as a place to play. In other words, they want a place that contributes to the quality of life in all of its aspects – economic, social, and cultural". Remaking the Urban Waterfront, the Urban Land Institute (Seattle Department of Planning and Design, 2012)**.** In this section of the paper, a number of global case studies were analyzed in order to draw conclusions regarding the main features of positive and vibrant waterfronts. The selected case studies range from mega city like the Shanghai Bund Waterfront Redevelopment, the Northern Hong Kong Waterfront and Melbourne Waterfront Revitalization. The cases also include examples of small and medium scale interventions like the case of Aker Brygge Wharf, Oslo, Norway and the Cheonggyecheon River in Seoul, South Korea.

Figure 11: The best practice cases of the Shanghai Bund Waterfront Redevelopment and Melbourne Waterfront Revitalization respectively

The cases of Aker Brygge Wharf, Oslo and the Cheonggyecheon River, Seoul illustrated the value of small and medium scale interventions which aim to transform the city water potentials into a source of distinction and force to create new spatial experiences. In the two cases, the waterfronts were planned as social public spaces within the fabric of busy cities.

Particularly, the the Cheonggyecheon River development illustrated the importance of small act and big Impact approach. How the Cheonggyecheon River urban design restored the green heart of Seoul. The project is intended to create a green oasis in a concrete jungle. The large scale cases like The Northern Hong Kong and Waterfront Melbourne Waterfront Revitalization deal with the waterfront not only as a social and recreational edge to the city but rather as a center of holistic development which been infused through the whole waterfront and more significantly penetrated the depth of the city. These projects have been planned in light of a development framework which sees the waterfront as a catalyst for the whole city development. In the case of The Northern Hong Kong Waterfront, the refined urban design framework provides a coherent and legible structure of uses, building forms, open space and connectivity. It is built upon the waterfront promenade and four principal design corridors to create a sense of place.

Figure 12: Aker Brygge Wharf, Oslo, Norway

Figure 13: the Cheonggyecheon River Urban Design Restored the Green Heart of Seoul

Figure 14: The Northern Hong Kong Waterfront

8. Creating a Great waterfront: The Suggested Strategies
Planning Principles, Guidelines and Recommended Actions for Vibrant Waterfronts

This study involves an initial review of the literature on waterfront developments and urban sustainability to extract a comprehensive set of criteria that can be used to develop a vibrant, sustainable and successful waterfront (Macdonald, 2017; Andersson, 2018). Therefore, in this section, the lessons learned from the selected case studies in addition to the analysis of published literature on the new trends of planning waterfronts would construct the base for suggesting strategies, planning and design concepts which can guarantee the creation of create waterfronts. First of all, the importance of providing a diversity of attractions to create an all-time and all-season waterfront. Also, to provide a continuous waterfront promenade with an extensive greenery. The promenade as an extended spatial experience supported by green spaces would encourage social interactivity and sense of belonging to the waterfront. Such frequent usability can't be attained without allowing for public access and providing for environmentally friendly transport including green buses, bicycles, safe pedestrian routs and even effective water transportation. It was also documented that in all successful waterfronts, the main landmarks were integrated with the waterfront promenade to increase connectivity and vibrancy.

A social approach to urban waterfront regeneration is an important condition too as it will guarantee that the regeneration of the waterfront is actually speaking to all people without any form of rejection, discrimination or neglect. Such an inclusive approach would create bonds between people and place. The social approach to waterfront development would affect the decision making in the planning processes. The role of planners in public space planning is crucial but integrating the views of the community members is equally important. Hence, citizen participation in the planning and design process of any waterfront is not an option as waterfronts are one of the most social places and should by planned and designed by people and for people. Another crucial principle in planning waterfronts is to diversify uses and activities along the waterfront and within the coastal cities to include residential, commercial, cultural, institutional, and mixed uses connected with open and public spaces.

For a waterfront to succeed and attract people and enhance its city, a focus on quality and successful place making is highly recommended. Design-based waterfront developments should attain a number of qualities to accomplish positive planning process which would lead to vibrant and attractive waterfronts. More integrated spatial and planning patterns to guarantee the success of waterfronts can be crystalized as such:

8.1. Waterfront as a Sequence of Public Spaces
Begin by envisioning a network of well-connected, multi-use public spaces that fit with the community's shared goals. Waterfronts should be designed as a sequence of active and vibrant public spaces speaking to the whole city dwellers.

Figure 15: Waterfronts should be designed and planned as a number of connected positive public spaces

8.2. Public Goals are the Primary Objective
Waterfronts everywhere are too valuable to simply allow developers to dictate what happens there. . This is not to say that private development is unwelcome and should be discouraged – on the contrary, it is often necessary to the future of a healthy waterfront. But the best solutions for revamping waterfronts put public goals first, not private short-term financial objective. The viability of a waterfront development is also about how to balance public and private invest to be economically sustainable.

Figure 16: the needs of the different sectors and groups of the community are the primary objectives of a successful waterfront.

8.3. Build on Existing Assets & Context
After establishing the public spaces and public goals, begin the public visioning process with the existing assets and surrounding context. Therefore, it is wise to start small to make big changes. Placemaking is about doing more than planning. Many great plans get bogged down because they are too big, too expensive, and simply take too long to happen.

8.4. Create A Shared Community Vision
Unlike a master plan, a community visioning process does not lock a project into a prescribed solution. It is a citizen-driven initiative that outlines a set of goals--ideals to strive for--that set the stage for people to think boldly, make breakthroughs, and achieve new possibilities for their waterfront.

8.5. Create Multiple-Use Connected Destinations
Create a vibrant mixed-use community affordable and welcoming for all. The value of inserting popular destinations within the waterfront is to create a special place to draw people. The most effective way to propel a visioning process is to set a goal of creating a number of great destinations along a waterfront, an idea will guarantee extensive flow of people in different day times, seasons, weather and conditions. Such destinations along the waterfront should be connected to one another and incorporated into a vision for the waterfront as a whole. The connectivity between the selected and well planned destinations should be achieved via encouraging walkability and design the public realm which would encourage people to walk and reach the different destinations in safe and enjoyable manner. Link: Connect the city and the water. And provide multiple ways to get around and to reach the waterfront include transit, walking and cycling. Additional aspect in terms of suggesting uses for waterfront is to focus also on suggesting water uses. Activities like boating, sailing, fishing, swimming and other related activities add positively to the vibrancy and open up options for different users.

8.6. Open the site with accessible public spaces for all.
A vital dimension in developing waterfronts which would speck to the whole community is maximizing opportunities for public access. It is essential that the waterfront be accessible for everyone to the greatest extent possible. Therefore, facilitating access and enhancing linkage would enhance the overall quality of the development. Waterfronts should be seen as a manifestation of the democratization not privatization of public spaces.

8.7. Create a green, sustainable, innovative model community.
To balance environmental benefits with human needs, waterfront development should consider environmental assets and a healthy blend with it in order to produce a showcase of authentic sustainable development. While a wide variety of uses can flourish on a waterfront, many successful destinations embrace their natural surroundings by creating a close connection between human and natural needs.

8.8. Waterfront's Identity and Image.

Despite all functional aspects of a waterfront but it is also a platform to represent the identity of the city or the state. A waterfront also collectively would construct an image that can be literally printed in the minds of the dwellers or visitors alike. Therefore, the visual qualities of the waterfront is significant as it can be a representation and manifestation of identity and responsible for the city image.

9. Conclusions and Recommendations

Qatar should acknowledge that waterfronts, the unique places where land and water meet, are a finite resource, embodying the special history and character of each city. Qatar's approach towards developing its extended waterfronts should be holistic, comprehensive and sustainable. The suggested urban planning principles, patterns, guidelines and actions are tools to ensure that all coastal cities in Qatar exploit its relation with water in a way which would serve people, attract tourism and promote diversified economic routs. Doha and all Qatari cities should perceive the blessing of being developed along the waterfront as a great potential for a more sustainable and livable urbanism. Towards Looking at the urbanization of Doha and other Qatari cities, waterfronts can act as a medium to achieve City/Waterfront interaction. The urbanity of Qatar needs more effort towards connectivity and continuity. The connections, corridors and vibrant green streets towards the waterfront act as the city veins facilitating the coastal development to connect with the inner parts of the city. Hence, the successful waterfront acts as an interface to connect and link the city with its surrounding waterbody. It's possible that Qatar may end up getting a sparkling, successful new waterfront districts that draws in tourists from the world's four corners. In order to strengthen the waterfront's coherence and connection, this paper pays special attention to the design of waterfronts, ensuring that promenades are maintained as pedestrian and cyclists-friendly zones. But the suggested approach implies a different definition of target groups. A definition which gives priority for the local community and hence calls for a balanced urbanism, community participation and a public and private partnership. Developing waterfronts in Qatar can be seen as physical manifestation of the memory of place. Qatar architectural and urban heritage conservation within Qatari waterfronts commemorates history while creating a new legacy.

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A comparison of the utility of urban strategies for small towns: The Cases of Lobatse and Arandis

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Synopsis: This paper compares the urban strategies put forward by two small towns in decline. Each town, although somewhat remote is within 100km of a significantly larger town. The paper assesses the plans' resilience and sustainability response, scores utility and implementatibility and proposing an improvement for future strategy formulation processes.

1 Introduction

It seems obvious that that the purpose of planning is to put the plan into action. As the increasingly popular 6 Ps adage goes, Proper prior planning prevents poor performance. Completely unexpectedly, this adage alludes to something that urban planning has long failed at: performance. In a sense, planning too often misses the very reason for its existence. At some point planning must stop and implementation begin.

However, planners have consistently demonstrated a "curious lack of interest in developing methods to evaluate how successfully plans are implemented" and focusing instead on hypothetical assessments of the impacts of alternative proposed plans (Talen, 1996, p. 248). The nett effect is that planning has increasing become a 'tick box' exercise with no real ability to implement. This failure to implement has been a barrier to effective planning so long that it was coined "new plan syndrome" (Calkins, 1979), a term which describes the phenomenon where plans are updated and/or redone with no regard of the extent to which the previous plan (or plans) were executed; it is easier to simply ignore the what come before and to try to conjure a new plan.

But planning "is only defensible as an activity if it [is carried out in the belief] that it will deliver a future that is '*better*'[i] than that which would result without [it]" (Campbell and Marshall, 2008, p. 476 emphasis added). Planning is therefore inherently optimistic and a good plan is necessarily aspirational and transformational without being merely a pipedream: It must be implementable. But how do we know if a plan is even implementable within the specific context? In the small-town context, capacity and governance are the key considerations and as such are the lens through which each of the abovementioned focus areas are viewed.

Implementation evaluation can happen at least two distinct stages: Before implementation (i.e. the planning process) or during/after policy implementation (i.e. the plan implementation) (Talen, 1996). This paper intervenes at the level of the plan itself discussing ways to test a plan's 'implementability' even before the implantation phase—the argument being that only evaluating plan implementation ex post facto is somewhat redundant (although certainly not fruitless). Hence, this attempt to examine 'implementability' rather than the implementation. The premise is that if a plan's implementation is defined and measured in terms of performance (conformance), then the plan itself—specifically its implementability—has an important impact on successful implementation (Tian and Shen, 2011, p. 13).

Thus, the question of plan quality arises: What is a "good" plan? 'Is a plan with high implementation conformance a good one?' (Tian and Shen, 2011, p. 13) or should the substantive contents be examined. Believing that the substantive contents are critical, this paper attempts to address both content quality—with a focus on sustainability and resilience—and implementability. It considers four integration (cross-cutting) themes that impact a town's 'spatial functioning':

- Economic development
- Quality of urban environment
- Optimisation of land use
- Sustainable urban infrastructure

This paper is then a policy evaluation in that it applies evaluation principles and methods to examine the content of urban policy (plans) in a rudimentary attempt to understand the merit, worth, and utility the plan.

2 Approach

The approach is guided by the Centers (sic) for Disease Control and Prevention (CDC) Framework for Evaluation in Public Health (regular implementation reviews are commonplace in the health sector). The Framework outlines an ongoing process comprising six steps for policy evaluation throughout the policy lifecycle from problem identification to policy implementation (Figure 2).

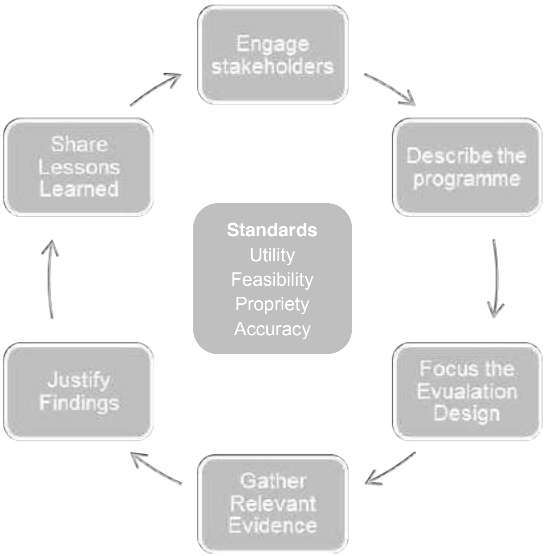

Figure 1: Six-step Policy Evaluation Process
(Adapted from: CDC, 2012a)

This paper constitutes an initial analysis and does not exhaustively adopt the Framework. It does however, follow most of the basic steps. Figure 2 shows the policy lifecycle highlighting the sections which is applicable to this paper.

Figure 2: Policy Development Phases and Types of Evaluation
(Adapted from: CDC, 2012a)

The remainder of the paper is structured as follows: The third section discusses theoretical perspective on the terminology, specifically sustainability, resilience and small towns. Section four determines the evaluation framework. The case study analyses are presented in section five, comprising an assessment of the representations of economic development, quality of urban environment, optimisation of land use, urban infrastructure from a sustainability and resilience perspective. The last part sums up the discussion and proposes next steps which would give the research more relevance.

3 Context and Terminology

The theme of rapid urbanisation is ever present in planning literature and popular culture today. (United Nations figures support this showing that much of about 2/3 of the world's population will be urban in 2050 (UNDESA, 2014). However, much of the discourse focuses on so-called megacities and too often forgotten in the narrative of urbanisation are the myriad of small towns despite the fact that more than 50% of the urban population live in urban areas with under 500,000 inhabitants (UNDESA, 2012). Indeed, even in a completely urbanised world is that there will be many small towns, fewer larger cities and only a few megacities (Batty, 2015 citing Cristelli *et al.*, 2012). So, cities will continue to be the dominant human settlement "regardless of whether the fact is considered positive or negative" (Vaništa Lazarević *et al.*, 2018, p. 1130).

In particular, Sub-Saharan Africa's urbanity is dominated by towns of fewer than 500,000 residents with 26% of such settlements inhabited by fewer than 50,000 people (Tacoli and Agergaard, 2017). Arandis and Lobatse are towns in this latter category with respective populations of about 8,500 and 27,000, respectively. Each is also located in a relatively arid climate zones and need to consider sustainable and resilient development.

The concepts of sustainability and resilience feature prominently in the Sustainable Development Goals (SDGs) particularly through SDG11*: Make cities and human settlements inclusive, safe, resilient and sustainable*. Both Namibia (Arandis) and Botswana (Lobatse) have committed to the integration and implementation of the SDGs.

Each town is located about 80 km from larger, more significant town, Gaborone and Swakopmund, respectively. This location, while somewhat remote is also sufficiently proximate for the pull factors of the larger cities to cause significant decline. Particularly in the developing world, the flow of people to large(r) urban centres has a double negative nett effect—it decreases the quality of service delivery in the receiving centres and decreases the viability of the sending settlement. In the case of these two towns, only Lobatse has suffered depopulation decreasing from about 29,000 in 2011 (LTC, 2018). Meanwhile, Arandis has struggled to attract investment despite a population growth rate of about 10% (RUL, 2018).

Thus, in the "no [place] is left behind" spirit of the SDGs', this paper investigates the regeneration efforts of these two small towns.

3.1 Small town

While 'small town' has no specific definition per se, the most fundamental definitions are based on population size with the United Nations smallest population category being urban agglomerations with "less than 50,000" (UNDESA, 2012). However, population alone is problematic since urban hierarchies vary across the world (Bell and Jayne, 2009). A town's "'cityness', [physical] smallness, 'third-tierness', 'localness'" would be a more justifiable basis for its 'small town' status (Fahmi *et al.*, 2014, p. 2). Thus, the relative importance of a city within its own (country's or region's) urban hierarchy should be of greater relevance rather than its absolute population.

Segueing from this is the economic importance of a settlement. Small towns (however defined) tend to have small, unvaried economies. Economic diversification and development strategies typically fail from an absence of economies of scale. Still, these towns often play an important role serving as service centres which both stimulate and support rural and hinterland economies. In particular cases, small towns are sometimes thought to blur the undefined line between urban and rural since they often include significant agricultural activities (Fahmi *et al.*, 2014).

Accordingly, this paper considers a small town as a tertiary city (in its own countries context) with less than 50,000 inhabitants with a relatively one-dimensional economy. Small towns can be grouped in two categories: those within (relative proximity to) a larger (mega) urban region and those within rural regions (Prabatmodjo, 1993). This this paper deals the former.

3.2 Sustainability

The term "sustainability" implies indefinite continuance and as such is a logical goal of human settlements. *Our Common Future* (also known as the Brundtland report) defines sustainability as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). Some criticise this 'classic' definition for "[resting] heavily on the dubious assumptions of limits to growth" (Bruegmann, 2008, p. 148) since it supposes that the resources used in the future will be those used today. However, it may well be this very prudence that makes the definition so apt. At the same time, this simplistic eschatological conception of sustainability belies the scientific reality[ii] that "'sustainable' cannot mean 'forever'". Moreover, it is immeasurable and reliant on an impossible capacity to bequeath utility on future generations (Daly, 2002, p. 40).

The utility-based[iii] *Our Common Future* definition must therefore be augmented by a more immediate impetus. But, utility as a basis encourages frugal consumption—use less—while throughput is the impetus for efficiency—use wisely. "'Frugality first'…, induces efficiency as a secondary consequence [while] 'efficiency first' does not induce frugality—it makes frugality less necessary" (Daly, 2006, p. 11). Both frugality and efficiency are valid, necessary and inextricable. Thus, this paper looks at sustainability through both the frugality and efficiency lenses and expects strategies to demonstrate an appreciation for cyclical resource flows.

However, sustainable urban development entails more than just environmental concerns and must also focus on economic viability, physical liveability and social equity. The fifth dimension is political sustainability—which will be called governance here (Pieterse, 2011). It holds the sustainability puzzle together and without a focus on governance sustainability, realising urban sustainability becomes that much harder.

3.3 Resilience

Resilience is a related but distinct concept which, has gained traction in urban discourse since the 2008 (economic) crisis, is sometimes used (wrongly) in place of sustainability (Vaništa Lazarević *et al.*, 2018). As climate change increases the frequency and intensity of natural disaster, resilience becomes a more important goal for cities. Resilience asks how well a place can “absorb the presence of an organism or activity” using the health concepts of “immunity and recovery” (Neuman, 2005, p. 18). It has both preventative and reparative dimensions.

Resilience is the capacity to recover quickly from difficulties. The Rockefeller Foundation’s 100 Resilient Cities movement defines urban resilience as “the capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks they experience” (Rockefeller Foundation-RF, no date). Most definitions capture this sense of an urban areas ability to withstand both immediate and forecast multi-hazard threats. They tend—more so than the definitions of sustainability—to highlight the individual citizen’s role in constructing and maintaining urban resilience. Resilience, in contradistinction to sustainability, seem to have a more obvious focus on both short- and long-term futures of urban systems (Vaništa Lazarević *et al.*, 2018).

4 Evaluation Framework

Before articulating the evaluation framework, it is important to reiterate the purpose of the evaluation (CDC, 2012a). The aim of this evaluation is two-fold: To establish whether the plan aligns with the targets of SDG 11 and determine the extent to which each town’s strategy embodies sustainability and resilience principles. Effectively, it seeks to see whether the plan is implementation-worthy. Secondly, it seeks to determine whether the policy is implementable—that is whether there is enough guidance so those responsible for it will be able to put it into action.

To this end, specific evaluation questions were identified. Ideally this is done in the policy drafting phase to ensure quality outcome (CDC, 2012b). The following are some policy content evaluation questions used in this evaluation framework (CDC, 2012c):

- Does the policy clearly state the goals or objectives?
- Are the components of the policy consistent with those of model policies?
- Which major stakeholders played a role in the policy’s development?

The evaluation has two stages. The Utility Assessment tests the plans inclusion of principles of sustainability and levels. It further assesses the expected outworking of these by comparing the number of projects planned in each SDG category. The Feasibility Assessment considers the implementability of the plan asking questions about implementation guidance.

4.1 Utility Assessment: Resilience and Sustainability

SDG Goal 11 is developed into ten targets. For this paper’s analysis, these are customised to a small-town level and their assigned to one (or more) of the four focuses of this paper—viz. economic development, quality of urban environment, optimisation of land use and sustainable infrastructure Table 1.

Table 1: Customisation of the SDGs Targets to Small Town Setting with the associated Focuses indicated

No.	10 Targets to Achieve resilient and sustainable cities	Principles within a small-town setting	Applicable focuses
1.	By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums	**Housing**: Density that allows increased usage of infrastructure, makes public spaces viable and limits new infrastructure requirements	Economic Development Quality of Urban Environments Optimisation of Land Use
2.	By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons	**Transport**: Support for non-motorised transport (NMT). Linked to land use with a focus on vulnerable people groups	Economic Development Quality of Urban Environments Sustainable Urban Infrastructure
3.	By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries	**Participatory Planning**: Adoption of structures that promote citizen inclusion in urban planning and management	Quality of Urban Environments Governance
4.	Strengthen efforts to protect and safeguard the world's cultural and natural heritage	**Heritage**: Promotion and protection of cultural and natural heritage in town's spaces	Quality of Urban Environments Governance
5.	By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations	**Disaster Mitigation**: Development disaster management protocols and mitigate risks through nature-based design and preparedness	Economic Development Quality of Urban Environments Optimisation of Land Use Governance
6.	By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management	**Quality Environment**: Focus on cyclic economy and incorporate environmentally regenerative design	Quality of Urban Environments Sustainable Urban Infrastructure
7.	By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities	**Public Open Space**: Design varied open spaces *networks* that are safe for and accessible to vulnerable people groups	Quality of Urban Environments Optimisation of Land Use Sustainable Urban Infrastructure
8.	Support positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and	**Rural-Urban Rapport**: Support rural activity with associated urban functions	Economic Development

	regional development planning		
9.	By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015-2030, holistic disaster risk management at all levels	**Urban Governance**: Openness to greater citizen participation by embracing digital platforms, flexible, transparent and consultative decision making	Optimisation of Land Use Sustainable Urban Infrastructure Governance
10.	Support least developed countries, including through financial and technical assistance, in building sustainable and resilient buildings utilizing local materials	**Genius Locii**: Booting local economy by using local / traditional designs, techniques and materials	Economic Development Sustainable Urban Infrastructure Governance

4.2 Feasibility Assessment: Implementability

The feasibility assessment is a series of questions focused on the process, content and guidance offered by each strategy. Since this paper advocates reflection, this assessment includes questions about the previous plan(s). It also attempts to assess the plans flexibility since strict adherence to (the specifics of) the plan is not always useful in a dynamic environment (Tian and Shen, 2011). Adherence to the spirit of the plan (if not the letter of it) is important. It questions the extent to which planners can adjust the plan. This assessment of the implementer's agency further demonstrates the need to assess implementability in the first place.

5 Analysis

The case study compares two towns: Arandis is a small mining town in the Erongo Region of western Namibia and Lobatse, a small—although significantly larger than Arandis—town in the South-East District of southern Botswana.

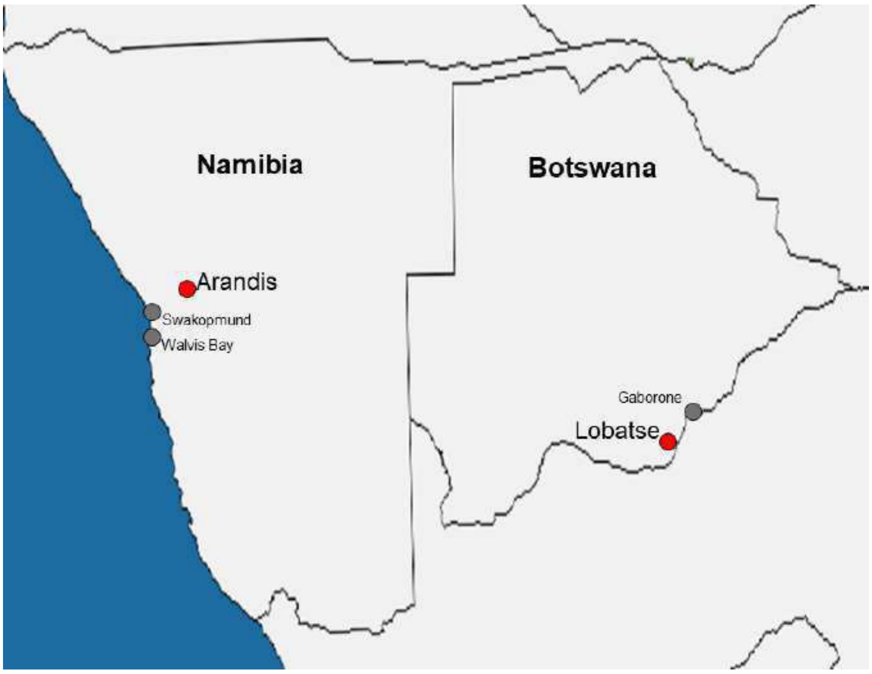

Figure 3: Location of Arandis and Lobatse

The principal reason for the choice of these two towns is the author's familiarity with them. However, the comparison may still be warranted as each is a small town in decline which has put forward strategies to stimulate regeneration. Both are somewhat remote being within 80km of significantly larger urban agglomerations so are susceptible to urban degeneration. Both towns have arid climates and are vulnerable to climate change hence the paper's focus on resilience and sustainability. Additionally, as small towns in proximity to larger urban centres, each town reports capacity constraints particularly with respect to urban management and planning and often seek consultant's assistance with strategy development. Hence this paper also seeks to assess whether the inputs of said consultants are conveyed in an implementable manner. The towns have similarities and some noteworthy differences (although these have not been calibrated for) (Table 2).

Table 2: Key similarities and differences between Arandis and Lobatse

		Arandis	**Lobatse**
Similarities	Proximity to larger settlement	60km from the Walvis Bay-Swakopmund urban agglomeration. These touristic and logistics towns are the country's second and third largest respectively.	75km from Gaborone, the country's largest city and economic and political capital.
	Climate	Hot and arid	Hot and arid
	Political / Administrative Classification	Phase 2 municipality (receives direct financial support from national government)	Receives funding from national government
	Regional impact	Mining activity impacts the town which is very susceptible to resource price fluctuations	Border proximity along SA-Namibia corridor. Some cattle rearing and other agriculture in the area around the town.
Diff	Population	8,500	27,000
	History and	A young town proclaimed in 1994 after	The area of Lobatse has been settled

national relevance	formation as a mining settlement in 1978 for Rössing Uranium Limited employees. It ranks about 25th in Namibia in terms of population.	since the 18th century. Considered around independence as a candidate to be the nation's new capital, Lobatse is seat of the judicial system ranks about 13th in population size in Botswana.
Economy	Single industry: Mining	- Main industry: Beef. - Country's largest concentration of agro-based industries - Limited manufacturing
Climate	Desert with mean annual rainfall of about 45mm and mean annual temperature of 19°C.	Semi-arid with about 550mm mean annual rainfall and mean annual temperature of 20°C.

5.1 Utility Assessment

The following analysis tests if and how the principles of sustainability and resilience are embedded into urban strategies. It seeks occurrences of the terms focusing on parts of the plan where the objectives, vision, aims and conceptual approaches are expounded among others. Terms related to sustainability included *green*, *renewable*, *recycle*, *cyclic*, *reduce*, *efficiency* and variations thereof. Terms related to resilience included *resilient*, *prepared*, *adaptive*, *flexible*. It is followed by an assessment the extent to which the projects in the strategies reflect the SDGs.

Table 3: Instances of Terms Related to Sustainability in the Arandis and Lobatse Urban Strategies

		Sustainable	Green	Renewable	Recycle	Reduce	Efficiency
LOBATSE		Principles; projects; development; regeneration	—	—	—	—	—
	Governance	—	Building guidelines	—	—	—	Facilities management; implementing institutions
	Economic Development	Economic growth; employment	Community garden	—	—	Development costs	—
	Quality Urban Environments	Nature's cyclic systems; river abstraction; Societies; living environments (access to opportunities); neighbourhoods	Historic character Landscaping Open/public space Streets	Urban renewal	Nature's cyclic systems	—	—
	Land Use	Expansion (physical extension); infill & densification	—	—	—	Fragmentation (increase urban integration); expansion (favour infill)	Mixed land use Land development; layout structures
	Infrastructure	Infrastructure (bulk, natural, dwelling unit density); Transport; NMT permeability Technology	Natural infrastructure	Energy	Collection Points	Travel demand & infrastructure	Transport Movement Permeability (NMT access) Infrastructure use
ARANDIS		Development	—	—	—	—	—
	Governance	Self-sustaining Partnerships Local authority	—	—	—	—	—
	Economic Development	Returns on investment Growth (economic) Job opportunities Employment Financial	—	—	Tourism Mines Material (Glass, fabric) Production from wastes	Extreme poverty Malnutrition	—
	Quality Urban Environments	Livelihoods model	—	—	—	Social ills	—
	Land Use	Buildings	—	—	—	Maintenance backlogs	—
	Infrastructure		—	—	Building roads	—	—

Table 4: Instances of Terms Related to Resilience in the Arandis and Lobatse Urban Strategies

		Resilient	Prepared	Adaptive	Flexible
LOBATSE		Principles; projects; development; regeneration	—	—	—
	Governance	—	Governance	Plans - Diverse stakeholder contributions	Land administration - Land subdivision - Site layout - Plot configuration
	Economic Development	Thinking - City development - Economic strategy	Tourism	—	—
	Quality Urban Environments	Landscaping - Automation of watering - Drought tolerant	—	—	Public/Open spaces
	Land Use	Land use	—	Land uses	Layout; land use / function; permeability
	Infrastructure	Building design	—	—	Grid; building design
ARANDIS		—	—	—	—
	Governance	—	—	Planning	Institutions
	Economic Development	—	—	—	—
	Quality Urban Environments	—	—	—	—
	Land Use	—	—	—	—
	Infrastructure	Infrastructure management		—	—

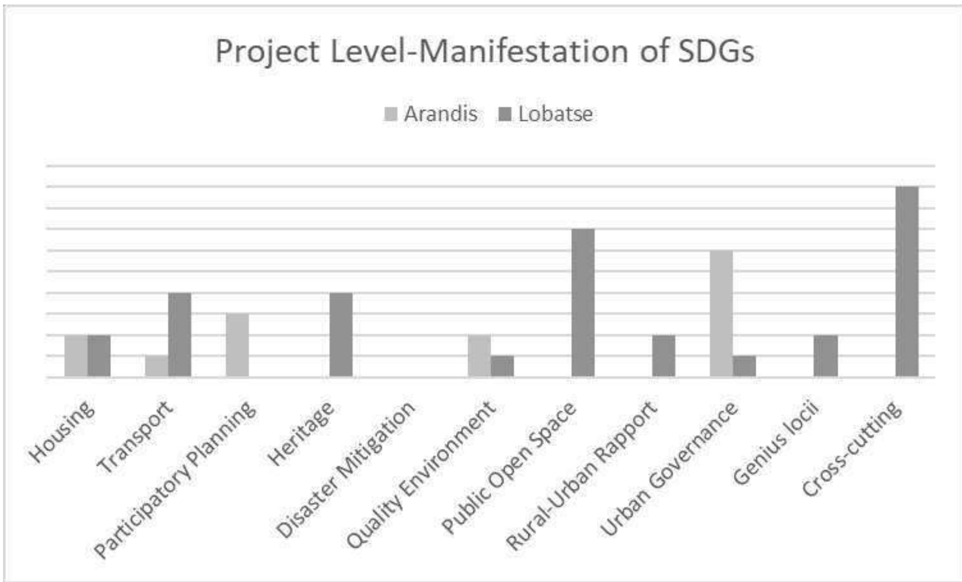

Figure 4: The extent of alignment of each strategy's projects with the SDGs

5.2 Feasibility Assessment

Table 5: Feasibility Assessment

		Arandis		**Lobatse**	
		Comment	Score	Comment	Score
Contents	**Does the policy clearly state the goals or objectives?**	**Yes**. One of the main objectives of the council is to gain economic independence from the mining activities—i.e. economic resilience. The strategy then outlines thirteen strategic objectives defined within four Strategic Themes, namely cultural capital, community service excellence, stakeholder relations and financial sustainability.	1.0	**Yes**. It seeks to provide the implementers and investors with a quality plan for participatory regeneration of the town focusing on specific precincts. It further provides an implementation framework for Lobatse regeneration efforts.	1.0
	Does the plan highlight its alignment to higher policies?	**Yes**. The strategy reports alignment to Namibia's Vision 2030 and National Development Plan (NDP) 4 (since superseded by NDP5). It further aims to develop a marketing and tourism strategy aligned to the Erongo Regional Tourism Plan. It fails to indicate alignment to the Erongo Region's Strategic Plan and its principal themes of socio-economic development, operational efficiency, good governance despite alignment thereto.	0.75	**Yes**. The plan forms part of the overarching Lobatse Development Plan (2000 - 2024). While any other alignment can be inferred (through its association with the Lobatse Development Plan (2000 - 2024), it fails to specifically indicate alignment such plans.	0.75

Process / Ownership	**Which major stakeholders played a role in the policy's development?**	The strategy was prepared by Council with the support of consultants. However, inputs from other stakeholders were limited.	0.75	The plan was developed by private consultants with regular inputs from Lobatse Town Council and the Department of Town & Country Planning within the Ministry of Land Management, Water and Sanitation Services.	0.5
	Is there any analysis of the previous plans and/or the implementation of such plans?	**No**. The strategy only mentions other sector strategies e.g. LED Strategy (2009) which were current at the time of drafting and which should also be consulted when reading the strategy. Curiously it barely references most these again. Neither does it indicate that it is the first such document.	0.25	**No**. It mentions an older development plan, Lobatse Urban Development Plan (2003 - 2009), but makes no attempt to assess the implementation of this nor any other plan.	0
	Are the implications of such plans (and the assessment of their implementation) for the current plan indicated?	**N/A** (The above was not done well.)	0	**N/A** (The above was not done well.)	0
Implementation guidance	**How flexible is the plan?**	The strategy is flexible in as much as it does not have budget for all its projects. However, it fails to indicate alternative scenarios to help implementers rationalise.	0.5	At times, the plan presents some alternative scenarios and their implications which give implementers good information should they chose / need to deviate.	0.75
	Are the requirements (pre-requisites) for implementation clearly stated in the policy?	Not always. At the project level, the strategy indicates some requirements as "Assumptions and risks". Throughout, it mentions some requirements currently lacking but stops short of clearly identifying general implementation pre-requisites.	0.5	Prerequisites are not specifically presented but the plan indicates that infrastructure upgrades will be required (to stimulate private development) and suggests that special funding be put in place to that end.	0.25
	Are the requirements feasible given available resources? If not, does the policy present a rectification / amelioration action?	The requirements listed are often "availability of funds" and hence it's is difficult to definitively indicate feasibility. As a Phase II town, the Council is dependent on national government.	0.5	The requirements although not specifically listed will likely include funding. Having received budget cuts in recent years from national government, difficult to definitively indicate feasibility. However, the plan calls for some specialist design and capacity may not exist locally.	0.5
	Does the Strategy culminate in projects – that is specific	The strategy presents forty-three strategic initiatives/projects for implementation of over its five-year period. The projects are time-bound with high-level financial requirements indicated	0.75	The presents several projects for each precinct. The projects are not time-bound nor is any attempt to give high-level indicative costs made. Although	0.5

interventions which are **a. Time bound** **b. Budgeted** **c. Prioritised** **d. Geolocated (as required)?**	and where relevant, located. There are not prioritised.		not all prioritised, the plan does give some strategic interventions which should be prioritised for regeneration.	
Does the policy assign responsibility to appropriate implementing and/or monitoring actors?	**Yes**. Each of the strategic initiatives/projects has an associated responsible entity. However, it is explicitly clear who is responsible for **monitoring** implementation progress.	0.75	**Yes**. Each of the strategic precinct has specific intervention high-level actions for the realisation of its projects. Each action has an associated responsible entity. However, the plan only gives a generic overview of monitoring and evaluation indicating that independent evaluators should assess three key evaluation processes (i) at the beginning of the project to establish existing situation; (ii) during implementation and (iii) at the end of the project by external.	0.5
Does the policy articulate the mechanism for monitoring implementation ?	The ATC Strategic Scorecard reflects that the organisation needs to implement, manage and report quarterly on twenty-six (26) Performance Indicators / Measure within the thirteen strategic objectives. It further gives the reporting baseline so that those monitoring have a sense can get a trend immediately.	0.75	**No**.	0
Does the policy identify indicators for assessing program success?	Yes. At the project level, the strategy's scorecard has targets and completion dates for projects.	1.0	**No**.	0
Is there any mention of costing? Where the funds will come from? How to seek funding? And what are the financial operational and maintenance implications?	Yes. Reflected in the ATC Scorecard, is a resource requirement estimate per strategic initiative/project budget across the strategy's horizon. It doesn't propose funding sources or financing mechanisms.	0.5	The plan makes no attempt to cost interventions. It does however highlight the need for a budgeting process to mobilise funding from both private sector and government finances to implement the regeneration plan. Further, it proposes a special fund for all infrastructure and catalytic projects as well as the annual budgets that deal with operational issues. It suggests that a "certain amount be allocated annually (development	0.5

			and re-current) over the next 10 years for the implementation of the Lobatse Regeneration Plan. This budget should include funds for sectoral strategies and detailed design that is essential spur implementation.”	
SCORE (x/11)	**ARANDIS TOTAL**	**8.0 (62%)**	**LOBATSE TOTAL**	**5.25 (40%)**

6 Discussion

This two-step utility analysis of the development urban strategies of Arandis and Lobatse indicate that sustainability is a well-understood concept which features prominently even in small town plans. Resilience, on the other hand is a relatively new concept and is still being adopted into the lexicon and is yet to be embedded broadly into the strategies.

The analysis showed that the most frequently used terms are the sustainability and resilience (and variations) which appear in both strategies. Sustainability features across each of the four integration areas (economic development, quality of urban environments, land use and urban infrastructure) and governance. Associated terms appear less frequently. The Arandis strategy scores poorly with less than 50% the frequency of instances of sustainability (as associated terms) as in the Lobatse strategy.

Resilience and its associated terms, are mentioned significantly fewer times in both strategies. In the Arandis strategy, there were only three instances—across governance and urban infrastructure—while the Lobatse strategy associated resilience with all five integration areas.

The second step in the analysis assessed the conversion of the concepts as expressed in the SDGs into concrete projects. Here exposed the gap between the concepts and their application. In the case of Arandis fewer than 50% of projects clearly express the principles. It must be noted, however that the strategy has several governance-focused projects which align with the sustainability and resilience principles of the SDGs. Lobatse’s strategy fairs significantly better with in the 72% of projects clearly expressing the principles. However, the plan has only one governance-focused project. It is noted with concern that neither town’s strategy makes any mention whatsoever of disaster mitigation and preparedness.

The feasibility analysis indicates that both strategies are well constructed indicating their purpose clearly and aligning themselves to plans on higher levels. However, their scores are mediocre with regards process/ownership. Moreover, each plan perpetuates “new plan syndrome” with no evidence of having consulted, much less assessed the implementation of previous plans.

Overall, the Arandis plan emerges as the more implementable plan. It contains in part all the elements that offer guidance to implementers including an indication of financial requirements, timeframes, pre-requisites and project-specific monitoring and evaluation.

7 Concluding and further remarks

This paper has shown that in the case of small towns, sustainability and resilience are concepts that are not fully embedded in urban strategy. Resilience in particular, has yet to gain traction. It further showed that there is at times a disconnect between the discourse in the strategy and how it manifests as projects. This is especially true for supranational goals and targets which find little expression in the town's projects.

Still, Lobatse's plan emerges as superior with regards to its embedding sustainability and resilience, particularly sustainability. However, from an implementation perspective, Arandis' strategy seems more likely to be implementable. It quantifies time and money and offers measures to monitor progress.

It becomes difficult then to determine which is a good plan—the one that reads well or the one that can be implemented well? In the context of under capacitated municipal officials, it is interesting to note that Arandis' strategy was developed in closer association with the Council which may be a lesson to improve future plan's implementability. The more aspirational/transformational plan was developed by consultants with limited Council involvement. Perhaps a closer association is required to bring aspiration and implementable to a convergence.

This paper was primarily a desktop exercise with minimal engagement with either town's official. The next step is to test the assessment with the implementers (i.e. council officials) to determine whether they feel it is useful as a sort of rubric to assess the work of future consultants (or indeed their own). A following step will be to review in the medium- to long-term whether the implementability index line up with implementation in reality?

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[i] But, for whom must the future be better? That there are scales of better. But in all cases, "better" should represent good value and benefit particularly for the poor. In other words, better refers to a Just City.

[ii] According to the Second Law of Thermodynamics, the entropy of the universe tends to a maximum. In other words, the universe must end and thus nothing can be sustained indefinitely.

[iii] Utility reminds us that societal actions – regardless of intention – can reverberate through time. We are experiencing this today with global warming.

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Territory and urban planning: perceptive studies over the south border of the city of Buenos Aires, Argentina

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1. Introduction

The city of Buenos Aires and its agglomeration concentrates thirty percent of the Argentine population. (INDEC, 2010) Historically, the political governments focused all the equipment, investment, progress on the north of the city, the place where all the financial, core services, and the main country harbor is. The south part of the town and all the cities around it has been, where lies the most urgent vital unfulfilled needs of the population. The river Matanza-Riachuelo that cross over the urban agglomeration of Buenos Aires, has been significantly a place of urban segregation for being located in the south area of the main town. Since the post-colonial times, the river has been officially a place that separates the jurisdiction of the city of Buenos Aires with some of the towns that were built around the urban agglomeration.

Since its place has never been treated as a whole and has always been treated as a boundary, there is always been a focus for factories to dispose its waste and an attractive place for a large portion of the underclasses to settled down there, occupying illegally the previous terrains that were once from the railway, now abandoned. In addition, the population that inhabits the south side of this limit has few accesses to enter the Capital, with very few points of contact between both margins. This situation frequently generates collapses in public or private vehicular traffic, due to the need to access the area with the greatest range of services found in the capital area. Beyond all the problems listed, the high levels of contamination that the river has make it one of the most critical in the world. (Alonso, 2018) Thus, the inhabitants of the aforementioned settlements fight for their rights of use and appropriation of space, while the State demands intervention in the urban coast, constituting one of the most promising discussions in this urban sector. (Gruschetsky, 2011)

Knowing all of the effects of urban troubles in places of boundaries, it is undebatable that a more species concern of what happens at the local level of population should be done. Urban management until recently does not know how to handle territorially this kinds of places and even by using countless tools for intervention on these they fail to correctly trigger the main concerns. The issue regarding this failure is that they keep on developing the same strategies by the same diagnostic studies and without knowing that such tools are dated or not precise the troubles around those areas will be worsened by time. (Brenner, Marcuse, Mayer, 2017:99)

The study presented here focuses on the perception of those who lives in this boundary through interviews and collective experiences and is a part of a more developed project in the University of Buenos Aires study called URBAN LANDSCAPE AND SUSTAINABLE INTERDESIGN: Guidelines and strategies for landscape interventions in border areas of the city.

The main objective of this work is to propose a methodology of diagnosis on urban territories in a low degree of scale, by the pedestrian view of the city, using the commonly labeled concept of participatory mapping (Diez Tetamanti, 2016) and developing a distinguished theoretical approach to landscape studies on urban areas: The landscape units (Choi, Corbalán, De Sousa, Di Corrado, Larumbe Araujo, 2018). This methodology was developed in order to study places within cities that are surrounded by edges (Lynch, 1960) and/or boundaries (Arriaga Rodriguez, 2012), such as the limits between neighborhoods or cities. We have found that this methodology in development is way more precise and effective for the study of particular scales and cases in the territory rather than the convenied simplistic morphologic ways of studying the territory which is yet an overused trend on urban management policies.

The following paper will show the detailed development and the results of the undergoing work around the stated methodology. To do so, the first part of it will be focused on the theoretical approaches surrounding the main component of it which is the concept of Landscape Units. A representative concept currently developed by the research team that structures the main potential axis for this new methodology. It is by studying and itemizing them in the territory that the process of identifying the particular troublesome areas is more pertinent.

The second part of it will be focused on the methodology of how these Landscape units were detected on the particular case of study and how they were represented. As well, how these are applied into the territory by the inhabitants of it by the use of surveys, audiovisual methods and so on. In the last part, there will be the results of the applied methodology with some successful mapped places in a proposal to counteract the raised hypothesis of the research work.

2. Theoretical Approach

To define some of the further points, it is important to remark our views on the idea of scale. We share the view of the concept of scale as scalar configurations, as Erik Swyngedouw defines: “I conceive scalar configurations as the outcome of socio-spatial processes that regulate and organise social power relations. As a geographical construction, scales become arenas around which socio-spatial power choreographies are enacted and performed” (Swyngedouw, 1997). It is important to note, though, that most of this theoretical support is mostly based on urban landscape areas rather than rural ones.

We rescued the idea of edges from Kevins Lynch and considering the described scale that we studied as a low degree socio territorial scale where these edges are most easy to identify: “Edges are the linear elements not used or considered as paths by the observer. They are boundaries between two phases, linear breaks in continuity: shores, railroad cuts, edges of development, walls. (...) These edge elements, although probably not as dominant as paths, are for many people important organizing features, particularly in the role of holding together generalized areas, as in the outline of a city by water or wall” (Lynch, 1960: 46). Lynch's took for granted the idea of scale which is one huge criticism that the spatial territorial studies gave on him but considering the precision of studying the territories, this idea of edge seems relevant considering this scale of study.

In addition, we differentiate the idea of edges with the one of boundary, sharing the concept that defines Arriaga Rodriguez on “frontier or boundary” as “absolute place” and as a “socially built place” (Arriaga Rodriguez, 2016) being the last one of the elements that will support the idea of Landscape Units. This idea of boundary as an absolute place is how we usually undermine those places that are separated interjurisdictional by the imposing forces of the core elemental powers. “its physical existence is independent from the social phenomenons that happens, since it only answers by its own natural law. The geographic place is transformed by the human action, only by its appearance but not from its essence. (...) the “absolute place” is a mere holder of objects, humans and social activities and the social activities are precisely the main used element to differentiate, classify the geographic space.” As Arraiga Rodriguez says, the commonly imposed boundaries of this “absolute place” is one of the potential issues surrounding segmentation, fragmentation and tension between the social activities that surrounds them.

As the discipline that we are currently working on is mostly based on the main links between the landscape studies, cultural geography and urban areas most of the conceptual basis will be related to these subjects, even though it is deeply influenced by a lot of interdisciplinary areas which is the main key to understand how cities work as a whole (Graham and Marvin, 2001: 33). By that, the central conceptual focus on this work, the Landscape Units, is a very debatable tool currently on development but with some really effective appliance onto territorial crops. Then in this sense, we will follow up to define four of the main core concepts surrounding this idea:

First, the Lynch´s idea about the imaginability of the City “That quality in a physical object which gives it a high probability of evoking a strong image in any given observer. It is that shape, color, or arrangement which facilitates the making of vividly identified, powerfully structured, highly useful mental images of the environment”. (Lynch, 1960: 9) These useful mental images that Lynch evoke in such quote refers to the association of the vividly spaces that people has in their territories. It is a proper tool to define common aspects of the cities that are heavily influenced by the subjectivity of those who remarks the landscape of the cities that they live within.

Second, the idea of cultural landscape which is a theoretical construction that decant over the landscape that we perceive are read by the symbols, meanings and customs each society built over the territory. (Corbalán, Kestelman, Tella, 2018) Such landscapes are not unchangeable, they are constantly converting and it is mostly the local population that modifies, represents and permanently generates new territories that signifies individualized landscape units with their own features. We perceive, understand and build the landscape through the filter of culture.

Then, the relevance on studying landscape by the perspective of urban infrastructures. Specially, Infrastructure Networks. which are the bundle of materially networked, mediating infrastructures. These landscape units aren't statical and they are heavily influenced by the urban intervention of political actions, as well as the own actions of the community. Yet the infrastructure that supplies the commonly shaped community that live within (transportation, water, etc) affects the dynamics of the flows and settlement of the population. (Graham and Marvin, 2001: 10)

Finally, boundaries as “socially built place” such as Juan Carlos Arriaga Rodriguez defines it and inspired by the thesis of David Harvey (Harvey, 1977: 3-6): “This conception of boundary it is an space that could be explained by the production of those who organizes it, by the dominate action and the power that has place and by the representations of which the subjects that lives and also the groups that has the political and economic power to transform it. Boundaries are the fragment of a bigger space -the territory- that has been structured by social relations of dominant production.” (Arriaga Rodriguez, 2012) This is a pretty important concept to understand the boundaries that are drawn by the detection of landscape units. Territorial crops by social dynamics have boundaries even without being as strong as the already defined “absolute place”. Social interactions are constantly building new ways to reproduce themselves in their territory, yet there is a range of such even if they aren't statical. Our proposition by drawing the limits of these landscape units has to do with the common territorial perception that people have in them even if one or two has a wider spread of their territorial belonging.

The Landscape Units are places from the territory characterized by the combination of different elements from diverse sources such as nature, cultural, perspective, symbolic and that recognizes its territorialities that differ them from the other places around essentially beyond the interjurisdictional boundaries and edges (Choi, Corbalán, De Sousa, Di Corrado, Larumbe Araujo, 2018).

3. Methodology and Appliance

Applying such idea into the territory takes the detection and the representation of these Landscape Units which are usually labeled and recognized by four main components that we suggest: the urban structure, the citizen participation, the perceptual or participatory mapping and the environmental images.

For the analysis of the urban structure, we use three definitions of such and we make a comparison between them. Firstly, the arrangement of land use in urban areas by official zoning planning and then, the real usage of the land. Since most of the featured work are in cities with very low regulation it is pretty necessary to do a heavy focused research onto the second point. Such research is usually made by observation or interviews on the field work but it was also made by analysing their conditions on satelital programs. The way of representation of such analysis is basically comparing those two kind of urban structures to identify those places where the informality is way more rounded, and whether that comprises a big territorial dimension it can be identified by itself as a Landscape Unit as well as for those places that are essentially respectful with the official arrangement of land use. As for the last definition, we also study the historical rehearsal of the territory. Understanding how things were settled we tie up the four core concepts that defines the landscape units. This is crucial for building them since most of them are a result from the whereabouts of how the settlement was initially made, how the first population used the land and finally how the main cores of power managed it afterwards. From this point we could detect the potential landscape units and draw a intenting map as an ad-hoc hypothesis of how they could be shaped.

The second step is to apply such potential landscape units into territory by gathering enough participation of the people from the different detected units. Such work focuses on interviewing them by asking sensitive aspects of what they feel regarding the environment that they usually live in their routine. Some of course aren't regular visitors of the places but our focus are mostly those who their reproductive practices are within these places. Once finished we followed up on translating those perceptions and comparing them with the Ad-Hoc landscape units that we made “abstractally” before. Then, we calibrate the subtle differences between these new landscape units maps with the Ad-hoc ones, essentially the spread of the boundaries, or if there is any huge contradiction we would return to the first step to analyse those particularities and so on until we have a more precise map.

The third and final step is participatory mapping and environmental images respectively. The main reason to understand simultaneously both ideas is that they are very similar in execution. Basically it consists on interviewing specific persons from this landscape units with a more severe detailed and try to construct alongside them maps using the references of the imageneabilities ones from Kevin Lynch (Lynch, 1960: 20). After that, we proceed to do something similar by other means of representation such as short films, collages, etc. Indeed we can convey the hard processed information into a more accessible one. It is a way to express the feelings that are associated with these landscape units by representation to other persons. Whether it is effective or not, in terms of social communication, it is yet a nice resource to pull of territorial mapping by other ways aside of the morphologic and geographical one.

By following these steps, we are still developing this alternative methodology tool on urban studies. Even though there is quite a lot that is taken for granted, the idea of this resource is to be used as a complement to other territorial studies. The next step to polish it would be to cross other social statistics to this sensitive representation. It could open a lot of opportunities to think why this landscape units were settled historically and infrastructurally in the first place.

4. The case of study: Nueva Pompeya (City of Buenos Aires) and Valentin Alsina (Lanus) and the appliance of the developed methodology.

Figure 1: Map of Buenos Aires and its agglomerations. Highlighted in black is the Riachuelos River and the two main municipalities where the cases of study are located. Source: Geographic National Institute

The localization of this troublesome area is in the south part of the Buenos Aires City and in the north of the southest part of the Metropolitan area, they are different jurisdictions and on the type of government as well as for the distributed budget by their local centralized management. In the Autonomous City of Buenos Aires, Nueva Pompeya is just a neighborhood within an extensive area of administration while at the other side, Valentin Alsina is a city within a set of cities. Hence, both jurisdictions in every aspect are completely different. Interestingly enough, since the beginning of the settlement of the old harbour in the basin of the Riachuelos River (which is the river that divides both jurisdictions and also the city of Buenos Aires with the rest of the territory) it has been always a place of boundary, as an “absolute place”.

Yet, the main reason of choosing this case of study in particular were two aspects: firstly as a place of boundary by itself and how the river is overlooked by being a place that divides the population. This river, the Riachuelos river has a huge historical fluctuation of treatment by local authorities but in particular by this tense area since it is today the most conflictive part of most of the basin. Secondly, the heterogenization of the qualities of both sides of the river. How this place is looked and associated as pretty different despite being in the same metropolitan area (which it isn't actually truth) and how the connection through the river is just subtle and unison.

This urban river has a huge attach with the development of the country as a whole and in particular with the first growth of the metropolitan Area. Also, it was used back in the first twenty years in the beginning of the twentieth century as a channel of harbor. Simultaneously it was also the place where part of the first railway areas were settled and so the first industries of the country. Altogether the border of the basin in both banks was already, in the beginning of the republic, a place that separated the main capital city with the rest of the country (Gorelik, Silvestri, 1991). Graciela Silvestri, an historian from Argentina, divided the Riachuelo in three different sectors by its actual condition and its historical rehearsal: the first one as the La Boca neighborhood that despite being also a marginalized place there is a huge identity attached to it related to the Tango and the historical harbour; the sector of Villa Lugano and Lomas de Zamora where the project of canalization of the Riachuelo was successfully made and the sector that comprehends the two localities of our case of study, which is a place of historical unfulfiness: “this sector is instead unknown to the inhabitants of the formal city. it constituted an unity of action from a technical point of view for the channeling companies that tried its modification (of the Riachuelo). The inefficiency of these interventions are evident in the territory: the riverbanks continue without being transformed, the abandonment of both shores is in line with works that were never completed.It was a thriving sector at the time of installation of the factories in the country, especially the metallurgical. The building nowadays are ruins from those undertakings. The misery that at the beginning of the century is condensed in the puddles of the dump, multiplies today in informal settlements.” (Silvestri, 2004; 30) It is, however one of the main focus of fluxes of all the metropolitan area of Buenos Aires since it has one of the three bridges of all the river that connect the main city with the south region. By virtue of that, it is clearly remarkable the variety of services of public transportation, the overwhelming automobile traffic and the railroad connections.

After this background it is clearly that the choice of this landmark is mostly based on the urgence of building up an identity that it is mostly obscured by the adjacent landscape identities of this sector. Such imprint will be cleared when applied the methodology already explained before.

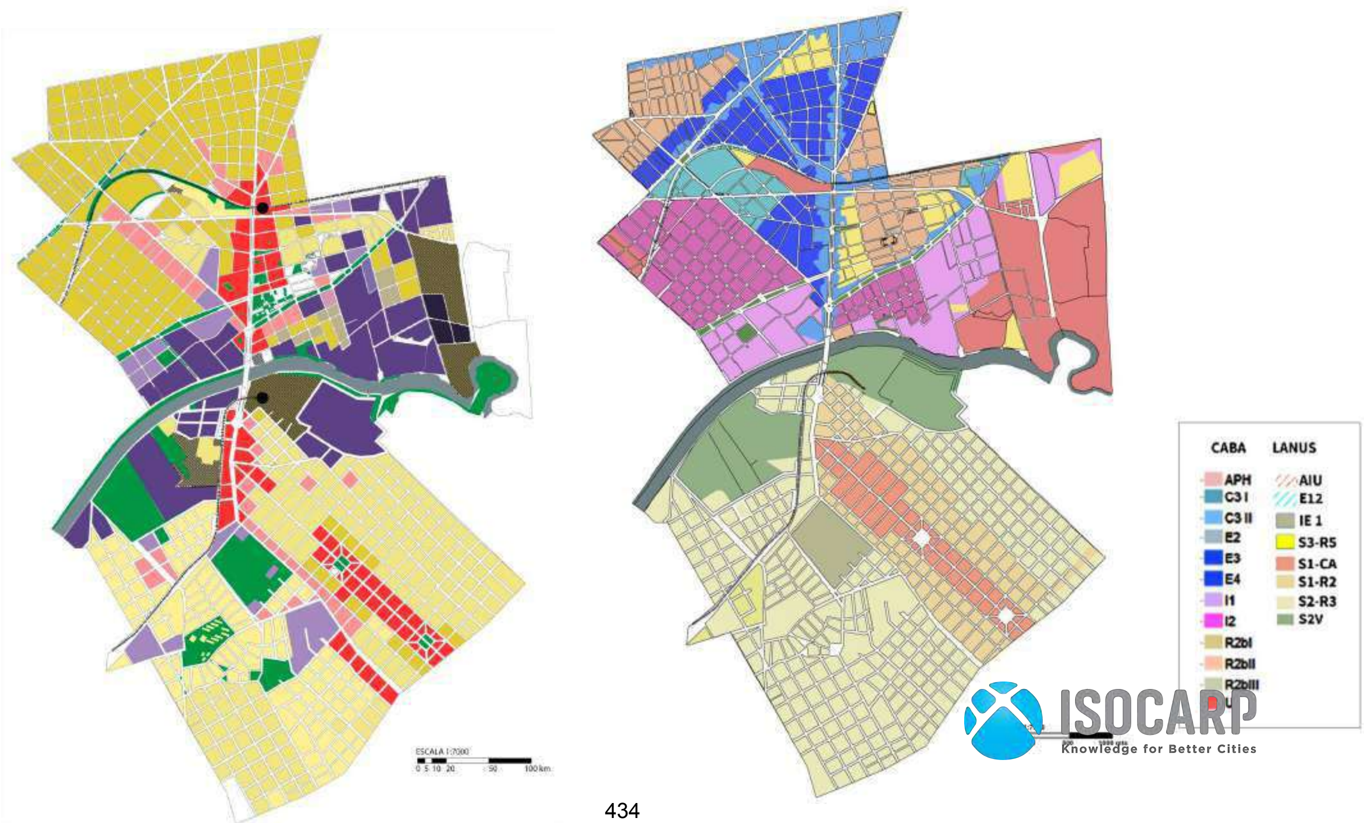

Figure 2 and 3: Cropped territorial fragments of the south axis Nueva Pompeya (City of Buenos Aires) and Valentin Alsina (Buenos Aires Agglomeration) showing the zoning areas (at the right) against the real usage of the land (at the left). It is interesting to see how there is a chromatic diversity from one to another. That means how the usage of the land are mostly illegal on the edge of both places.

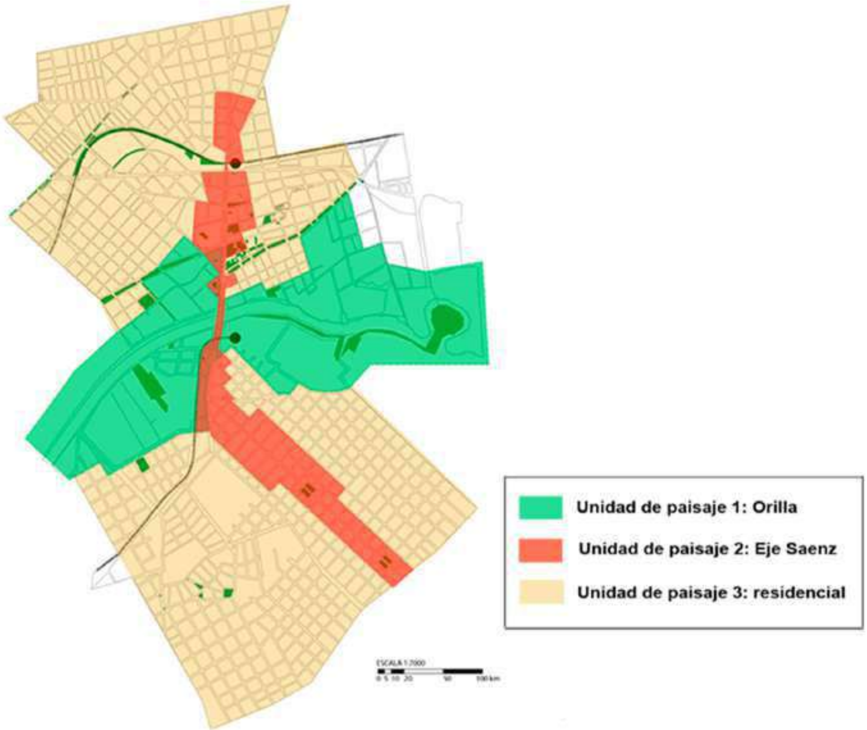

Figure 4. Landscape units detected on the border of the Riachuelo River. South region of Buenos Aires. Source: Urban border mapping: Riachuelo, City and fluxes. Perception of three landscape units in the limit of Nueva Pompeya (CABA) and Valentin Alsina (GBA). (Choi, Corbalán, De Sousa, Di Corrado, Larumbe Araujo, 2017).

Considering the appliance and the comparison between both urban structure (the land uses and the real usage, figure 2 and 3). It is clear to see that the contradictions are pretty evident. While there is a pretty loyal respond to the zoning plan code as it spreads away from the banks, it is evident that the most informal areas are the ones over the shores, as expected. The City of Buenos Aires has a way more diversified zoning meanings which is way more flexible on these kind of places, however the old sites of the abandoned railway system as being a place of uncertain jurisdiction and the illegal occupation within it remains as an huge remnants on the planning code. Synthetically, the cities jurisdiction doesn't know how to handle the growth of this urban issue aside of the fact that most of the people there are informal settlers.

As it can be seen in the figure 4, after the analysis of the factors exposed we have detected three landscape units. The first one related with those who lives by the shores of the river (in green), the second in the commercial corridor (in red) and third the residential homogenous area which both sides share also very strong similarities despite being two different places.

As for the first landscape unit, being both jurisdictions divided and without knowing by the administrative scope of the territory on the Riachuelo, these boundary areas are treated as remnants. However, both shores in the real usage have very strong similarities, mixed with old and new industrial sites that covers quite a big area but with very few constructed space, whether they are new or not. There is an important flux of heavy transport circulation parallel to the river attached to this industrial features. At the same time, it is a place of huge residential profile since in both sides of the banks beneath these industrial sites. There are two slums: Villa Zavaleta in Buenos Aires city and Villa 8 in Alsina, Buenos Aires Province. They are mostly occupying the contradictory site of the railway, as it was explained previously. We have determined that all this common issue with this place, both in political administrative terms and in terms of actual use, allowed us to designate them as a proper landscape unit.

As for the other two that we have made a presumption were: firstly, the mixed usage corridor (in red, figures 2 and 3) through the only bridge of the place (Puente Alsina Bridge). Being one of the few access to Buenos Aires from the south, there is a huge amount of public services as well as a huge corridor for individual transportation. It is a predominantly places of fluxes where most of the commerces depends highly on the intermodal transshipment and also serves as a centrality to people in their surroundings. It is also a place of huge variety of characteristics in the urban structure and it is mostly well respected between the two. As we assumed that most people that reproduce their economies in this place aren't settlers we identify this place as a different landscape unit which, the Riachuelo, is overlooked as a boundary. Finally, the remnant mostly residential with few local commercial sector that has a very homogenous profile in terms of urban structure. It is the place where the urban structure is mostly equivalent and it is usually witnessed by settlers and neighbors of these neighborhoods.

Once the representative work is made, sensitive surveys are carried out to the inhabitants of the detected Landscape Units. This talks represents a recompilation of narrative accounts and heterogeneity of interviews. Allowing one to corroborate the confirmation of Landscape Units Ad-Hoc and to detect also Landscape subunits inside them by the interviews of the key actors. In the case of the study it was a intended, we have identified three kind of inhabitants with three different conceptions surrounding where they usually gather and where they avoid. Essentially, a great deal of the local population were somewhat disappointed with the low permeability that the neighborhood has. For the residential landscape usually their own territorial perception was indeed way self-centered, mostly their reproductions were mostly associated with the neighborhood so a great deal of the subjects that were discussed were more about the problems within the neighborhood, how most of the people avoid going to the slums and how the Riachuelo was a place that was highly influential by the people that lived in the slum (Corbalan, Kestelman, Tella, 2017). Yet, as for the workers of some of the industrial sites and the slums inhabitants in both side they share a common view of the Riachuelo as place of potential subsitency although their reproductions were also territorial, their attachment with their settlements in the first case and the struggle for the right of the city in the second case turned the discussion to be extra-territorial instead of the mentioned Landscape unit. Both don't feel like they belong there even if both have two completely different reasons. However, the shared view of the Riachuelo was enough to break up the common association of this river as a boundary as an absolute place and be a potential tool to give them a place to struggle their rights. One of the gathering interviews with one of the inhabbitants of the slum of the referencing Landscape Unit says in a nostalgic tone that what they could do if the Riachuelo was a usable river for their subsistence “It would have been a great place for living, it would allow us to fish, it would give us food and navigation, anyway…" (Corbalán, De Sousa, Kestelman, Tella 2017: 10).

As for the landscape unit surrounding the accessibility, most of the inhabitants took for granted a big deals of problems of the sector in particular. Most of the workers, the biggest set of the population that we have interviewed, stated that they didn't live near their place of work and that they take the opportunity of the massive influx of people to make a profit out of it. Most of them does avoid places that aren't landscapelly moved. As soon as some doesn't hear a horn or can't see any bus they immediately think that they aren't allowed to be there. To most people the residential area is a set for an uncanny place and knowing that slums are nearby most think that it has direct relation with criminality (Cargnelutti, 2016).

Figure 5. Some footages of the video of different landscape units and the interview with Mario (Inhabbitant of Landscape Unit 1 - Environmental images. Source: https://youtu.be/K70M6c-Q1B0. (Corbalán, De Sousa, Kestelman, Tella, 2017)

This allows one to corroborate the confirmation of Landscape Units Ad-Hoc and to detect also Landscape subunits inside the Landscape Units by the interviews of the actors. Finally we usually use methods of representation, in this case we have used audiovisual productions as a methodology of narrative reconstruction of the landscape: method that allowed us to achieve a common agreement between what was interpreted by the research team and what was represented and the reception of all common questioners. (Jean Nogué, 2014: 15). The next step was, from the construction of this narrative tales around landscape and the finally shaped identified landscape units we have realized a short video with some footages of the commonly associated landscapes of each one of the units. As well, we decided to gather three interviews that represented the most accurate in the common representation of these. This video allowed us to do the final step of this diagnosis which is participatory mapping. In this final step we built, alongside at least this three character, the perceptive social maps , translated by Lynch's representation.

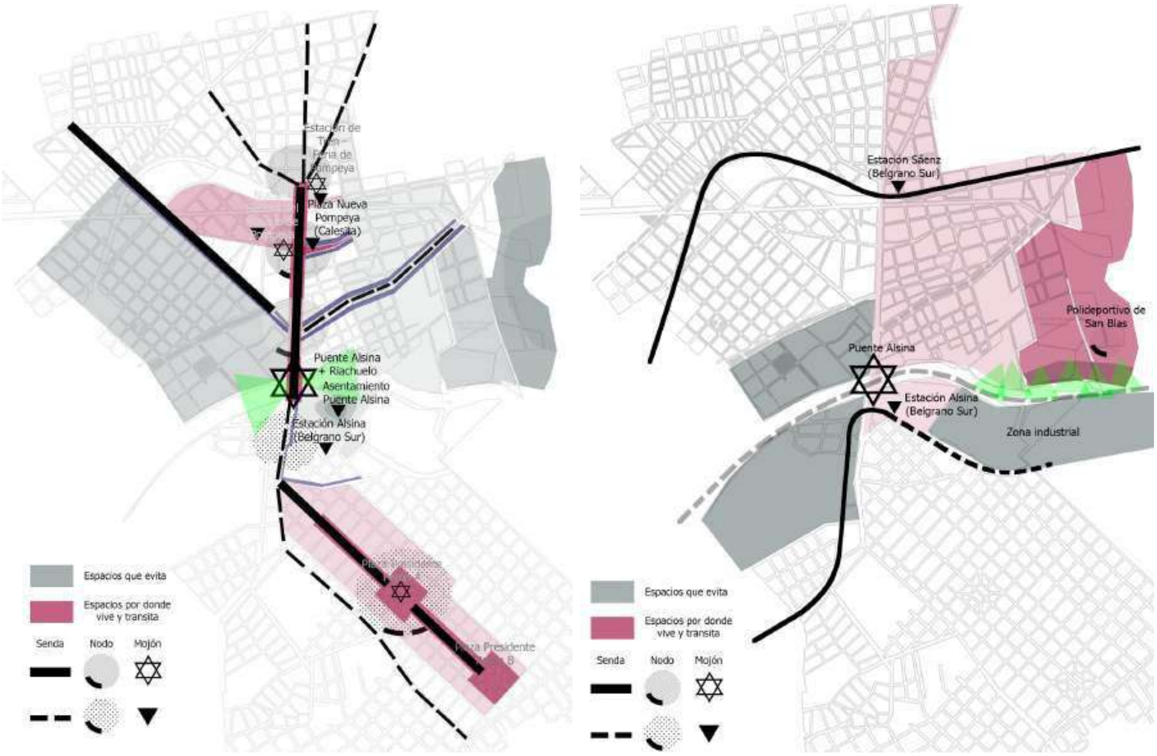

Figure 6 and 7. Perceptive maps from Judith (Landscape Unit 2) and Mario (Landscape Unit 1). The references are based on the imagineability maps from Kevin Lynch (1960). We have added two new factors though, a different grades of places (in grey) that the person in particular does not go because he or she doesn't feel comfortable going to and a pink of which are the places where the person usually goes. Source: Urban border mapping: Riachuelo, City and fluxes. Perception of three landscape units in the limit of Nueva Pompeya (CABA) and Valentin Alsina (GBA). (Choi, Corbalán, De Sousa, Di Corrado, Larumbe Araujo, 2017)..

Conclusion

After explaining our methodology of detection and verifying the landscape units, we undertand that the traditional way of planning it is, usually, based on jurisdictional boundaries to decide and intervene in the territory. Nevertheless, the landscape units as a theoretical construction extrapole those edges and it is successful for creating more complex diagnosis that encompass social problems, economical fluxes, environmental pollution, not only enclosed by a mere jurisdictional area. These landscape units, likewise, turn out to be more dynamic and in constant changes when they are analysed from the collective image of the city and the landscape perception of border.

As stated before, this potential tool should also be treated as a complimentary resource on urban diagnosis. By crossing over hard information of the territory with a more perceptive way, the results are quite precise and more meaningful. Although the steps of this way of study takes a lot of social parameters for granted, it should also reach all kind of interdisciplinary disciplines to continue nourishing the proposed contents.

The following procedure regarding the analysis of territorial frames in places of border proved to be pretty successful on showing more layers of complexity. The daily perceptive landscape of these "Landscape units" of the inhabitants of different parts of the neighborhoods has a more strong bond within themselves rather than with the neighborhood that it is conveniently shaped on.

The success of this diagnostic methodological development demonstrated the validity of studying the territories from the scale of the “landscape units” defined by the identification of the people who inhabit them instead of analyzing them from their official delimitations.

In this context, it would be desirable that this concept arrived can be incorporated in the analysis of future plans of different urban sectors of our country in order to plan cities for they own inhabitants. After all, knowing what people feel towards the environment they belong to is giving the rights of the city to their people.

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S.O.S. – Sustainable Open Solutions to climate waterfront

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1. Abstract

Climate change became a fascinating subject to the urban environment. Our scope is to develop a research network, associating architecture schools, urban research laboratories, local authorities and NGOs on architectural solutions to deal with the problem of the consequences of climate change, more focused on Waterfront Cities. Today, and worldwide, are already many entities working directly on issues related to the effects of extreme swings in the climatic conditions. So, why is it urgent to share, systematize and upgrade knowledge on the subject?

The effect of climate change is increasing at an abnormal rhythm which demands adaptation and transformation of vulnerable territories. In the last years, many projects were interrupted when they faced strong opposition coming either from public opinion, the media or lawsuits. Project proposals seem to address sensitive cultural values and consequently meet years of discussion, only to be put aside eventually. Such difficulties bring a loss of competitiveness on all sides, as well as decreasing quality of life for their citizens. The anterior information represents a problem within the European Community. Data related to historical and geographic records of specific waterfronts are used to construct patterns of development, feed algorithms and integrate the support of artificial intelligence to design possible future scenarios. To face the future challenges in managing, adapting and mitigating the effect brought by the increasing number of disasters, Lusofona University ULHT/LEAU has been cooperating with ten partners, from Portugal, The Netherlands, Italy, Greece, Poland and Sweden to share their best practices, including research on waterfront projects that merge equipment as well as public spaces and infrastructures, to produce and disseminate solutions, that enhance resilience. The research is carried out by four schools of architecture and urban planning, and entities working together with the worldwide market. The final result aims to produce Sustainable Operative Solutions.

S.O.S. waterfront mission is to develop affordable research environment and efficient operational tools between educational and non-academic partners by creating a Doctorate Consortium's to face the effects of climate change. The aim is to make use of the existing strategic network to enhance the research carried on in the field of urban waterfronts.

The main question folds upon the need to distinguish our study and show the added value of our project directly with some initial assumptions. The network has the objective to research in different scales such as:

1) Solutions for urban planning (the vast territory),
2) Solutions for urban projects (in a scale of the district or smaller urban facade),
3) Solutions for public spaces,
4) Architectural solutions at the building level,
5) The contribution of new technologies (warning devices or other) and
6) "Social" solutions (organization of the affected populations).

The research network reinforces the dynamic partnerships and increase the quality and technology innovations of the research, to design tools, to face the growing costs imposed by disasters. S.O.S. Climate Waterfront aims to bring excellence in research to a higher level and to improve its international position. To reach excellence requires the call for (1)

interdisciplinary and international research case studies, (2) steady sustainable research structure, (3) dissemination and open access of knowledge covered by different cultures, sciences and communities in each location.

The problem affects the citizens, the environment, and the local economy. Municipalities, stakeholders, Port Authorities and local communities are involved. Some projects that succeed in conquering public support and integrating the signs of the collective identity are included in the research. Climate change solutions can only be successful in ensuring a resilient city if they also engage citizens, educating them about climate change challenges, solutions, and fostering possible changes in lifestyles. The Doctorate Consortium is building up trans-national collaborative events with local Municipalities to produce solutions needed for waterfront cities to face climate change. The research project is supported by a Marie Skłodowska Curie Action, MSCA Grant.

2. Introduction

Urban waterfronts are facing new challenges when dealing with climate change. The problem affects the citizens, the environment and the local economy. Municipalities, stakeholders, Port Authorities and local communities often disagree upon their own needs. S.O.S. – Sustainable Open Solutions for European urban waterfronts aims to develop new solutions that emerge from the present necessities. Why is it urgent to share, systematize and upgrade knowledge on the subject?
The effect of climate change is increasing at an unprecedented rhythm which demands adaptation and transformation of vulnerable territories. In the last years a number of projects were interrupted when they faced strong opposition coming either from public opinion, the media and/or lawsuits. Projects seem to address sensitive cultural values and consequently face years of discussion, only to be put aside eventually. Such difficulties bring a loss of competitiveness on all sides, as well as decreasing quality of life for their citizens thus representing a problem within the European Community. To mitigate climate change impacts, several solutions have been proposed to reduce greenhouse gas emissions, including modern efficient energy alternatives and enhancing the use of sustainable energy sources (HASAN*, [et al.]*, 2018).
The creation of data on the waterfront uses historic and geographic records of specific locations to construct patterns of development, feed algorithms and integrate the support of artificial intelligence to design future possible scenarios. S.O.S. Climate Waterfront project gathers ten partners from Portugal, The Netherlands, Italy, Greece, Poland and Sweden to share their best practices, including research on waterfront projects that merge equipment's as well as public spaces and infrastructures, projects that succeed in conquering public support and integrating the signs of the collective identity. Climate change solutions are more successful when ensuring resilient urban environments. To achieve results are expected to engage citizens, educating them about climate change challenges and solutions, and fostering possible changes in lifestyles.
Transnational examples and the exchange of best practices benefit from special conditions not available in a single city or a single institution. Local experts, municipal representatives, stakeholders and international scholars are requested to work together, exchanging views, gaining new perspectives and discussing new interdisciplinary approaches, expanding and raising the level of the discussion, creating a think tank. The fundamental changes that are expected to take place in the climate system in the next decades are likely to have severe implications for the stability of the financial system (DAFERMOS*, [et al.]*, 2018).
Through an interdisciplinary methodology, the S.O.S. Climate Waterfront fills the gap in the understanding of how the different scales of urban and landscape planning, architectural design and technology are linked in water-related strategies and how they impact each other in the definition of preventive action plans and in the enhancement of

more conscious solutions to inform the community, human welfare and socio-economic activities along those vulnerable territorial settings of the waterfront.

3. Emergency at the waterfront

Nourishing a structured and necessary transfer of know-how and technology at several levels gives the research team to take excellence in research to the next move, enhancing a better position in the national and international research scenario. The relation between climate change and its potential effects on the stability of slopes remains an open issue (PALAZZI*, [et al.]*, 2018).
Improving the innovative nature of research towards a higher quality to reach excellence the research team focus on the urban waterfront to better prepare them to face the challenges posed by climate change. To achieve this, a steady and interdisciplinary research agenda is required, including environmental issues, smart technologies, strategies of resilience in urban design and culture. To reverse the vulnerability of urban waterfront researchers, accomplish skills and know-how towards advancing knowledge and insights on how to produce strategies; by formulating cross international and interdisciplinary solutions for the future.
European urban waterfronts are a subject of growing impact upon the citizens and businesses in terms of economic competitiveness and environmental quality. Sustainable open solutions are in the center of the debate of waterfront searching for resilient strategies in the context of difficulties stemming from environmental constrains brought by climate change. Waterfront brings together a number of different topics since it relates two different worlds: land and water. From the side of the water there are maritime transportation requirements, natural ecosystems, the necessary reduction of carbon emission, control levels of pollution and sensitive ecological areas. In land, the community, stakeholders and political leaders depend on solutions that require the collaboration of different fields of knowledge; physical, economic and social (MELLO, 2002). The community's quality of life, the environmental improvement and the increasing use of renewable energies are often in conflict with the necessary changes.
SOS Climate waterfront combines two strands of vibrant analyses—waterfront research and disaster studies. To examine specific examples of modern urban waterfronts reactions to the disaster and the disruption of urban structures and buildings. To envision how local, regional, national and international actors, both public and private collaborate to mitigate risks and enhance the resistance to face disasters.
The research project is developed from two approaches:
1) Develop research strategies aiming at designing policies and recommendations to meet the needs of urban waterfronts regarding public spaces, water management and selecting European best practices, to introduce researchers in public design and participatory processes on the transformation of waterfronts. The parameters that influence the transformation of the waterfront are shared with others to implement meaningful tools to deal with the production of future scenarios that integrate environmental, social, economic parameters to visualize and that encourage the community towards more participation in decision-making.
2) Develop new means of research based on historic records, geographic data, digital-methods and co-creation with local scholars to engage them actively in research activities (co-research approach). Additionally, the collected data is used to increase the identification of patterns of previous urban development on the waterfront. To visualize future progression of waterfront, depends on the development of the software produced by the team members. The new software identifies patterns of development in the past to predict future scenarios and include parameters directly related to climate change. The hypothesis produced for the future transformation of waterfronts is capable of engaging municipality representatives and especially technical staff to play a noteworthy

role and envision decision-making in the urban agenda.
The novelty of the approach is to overcome the problems that affect urban waterfronts and join efforts of specialists from different disciplines that have a recognized expertise in the subject and develop complementary research in the field of climatic transformation. The vulnerability of the waterfront and the variety of implications require a method of synthesis and to process similar situations that the present institutions do separately, the project demands an active knowledge and know-how exchange among all partners solving specific problems that emerge from each waterfront, via direct and broad discussion between experts:

Objective 1: Recognize gaps in current research, namely at geographical, historical, cultural, political and climatic among partners, to develop approaches for better understanding and enhance systematic means to relate people to the waterfront.
Objective 2: Introduce experienced researchers to foster collaboration and provide a platform where communities, public spaces and technology is addressed, based on new research fields, new forms of collaboration and new networks.
Objective 3: Upgrade the research group through enabling a stronger networking between its research staff and European top researchers.
Objective 4: Progress the cross-fertilization and interaction between researchers from different institutions and with expertise in different fields.
Objective 5: Supply structured opportunities for developing scientific and personal relations, among and beyond the Project.
Objective 6: Provide the involvement of relevant stakeholders, and the dissemination of results to scientific, academic, practitioners and policy-makers at all levels (EU, national, regional and local), media and the general public.
Objective 7: Distribute know-how on aspects of humanities-led, collaborative sustainable urban development and new insights in order to improve urban and social policies.
Objective 8: Promote the exploitation of advancements and Project results.

3.1 State of the Art

Sea level rise, high tides, storms and floods enhance the vulnerability of urban waterfront territories. The necessary transformations face years of discussions and/or lawsuits involving significant losses and costs, before cities adapting to change and effectively adapt waterfronts to climate change. Resilience is transformative and in each transformation, tries to create a stronger, improved city (YAMAGATA, 2018). In the recent years, most research projects have included regional and municipality representatives and they have highlighted the importance of thinking beyond regulations to face the present challenges. The alternative thinking or so called "out of the box", brings the risk to open the Pandora box with all the problems involved.

Cross sectorial and interdisciplinary solutions are successful if dealing with conflict existing in every process of transformation in an environment free from current administrative procedures. However, for the future, waterfronts will need to formulate lasting solutions efficient and imaginative strategies. The necessity to create more resilient cities, increase livable public spaces, promote urban natural environments and support a sustainable urban waterfront is expected to improve healthier communities.
The necessary changes do not represent a problem. Transformation does not by definition compromise resilience. Quite the opposite, according to the Principal Researcher at the National Institute for Environmental Studies in Japan: Resilience is not a static state of a system. It is a process. A city is dynamic and is always changing. (…) Resilience is transformative, and in each transformation, tries to create a stronger, improved city's (YAMAGATA, 2018) that is, resilience itself can be understood as change. According to the United Nations Development Programme the concept of

human development is used in all research actions thus focusing on people, their skills and opportunities rather than depending only on resources or profitable income. The main goal is to expand the realm of possibilities so that urban waterfronts can adapt, transform, develop skills and opportunities to be meaningful areas for the community. It goes therefore beyond economic features, and into reflect cultural, political, environmental and social, characteristics that influence the quality of human life in the context of climate transformation. Planning a waterfront development, require the city officials or a developer to start by envisioning a network of well-connected multi-use public spaces that fit with the community's shared goals (MOSTAFA, 2017).

One of the central challenges is how commit with citizens and waterfront territories where opportunities for educating cities can be offered for everyone. It is directly linked with equality, sustainability inclusiveness cohesion and education for peace. Educative cities promote, policies and democracy, integrated and lifelong learning education based on knowledge on how modern cities recover from disasters (CAMPANELLA, 2005).

The research project is in line with the European Commission proposal for increasing climate-related expenditure. Since 2010 EWWUD (GARCIA, 2017) has produced research, published five books and exhibited results, considering that it is strategically important for waterfront investment to be climate-resilient.

3.2 novelty inter/ multidisciplinary

SOS Climate waterfront builds a new multidisciplinary collaboration network involving top European research institutions in architecture, urban design, regional planning and landscape architecture articulated within existing networks in specific fields of expertise – to better understand the impacts of climate change in urban waterfronts and explore them from social, environmental, educational, technological and urban design perspectives. The research project is innovative by bringing together high profile scholars from complementary disciplines and geographies, academic experts and researches to work with municipalities, local actors and stakeholders, and together develop new concepts, formulate and communicate innovative design proposals (GARCIA, 2017).

Urban waterfronts are challenged by human, educational and urban development that cannot be comprehensively tackled by traditional approaches. The co-creation concept for urban waterfronts is a concept that fundamentally differs from traditional public engagement approach, as it focuses on the collective influence and responsibility of all stakeholders by creating the public good (SMANIOTTO, 2017).

SOS Climate waterfront focuses on the expanding potential of networked society to exchange information, education and spatial related issues, aiming to share strategies, policies and improve civic engagement in cities. It will increase the views on co-creation experiences and step up innovative research methods and techniques supported by exchange of knowledge and digital systems. Due to the nature of the topics, only an interdisciplinary research approach can reinforce staff capabilities and the profile of ULHT and partners. The network will provide an ideal environment to emerge knowledge on co creation and co-research and can be considered itself as a co-creation ecosystem. This will enable the development of approaches to community education programmes with tools, workshops, and publications that explain complex processes and/or policies for specific/targeted audiences.

3.3 knowledge sharing to achieve innovative objectives

The ground-breaking nature of the project comes from the methodology we have been testing since 2010 by bringing together municipality representatives, environmentalist, designers, geographers, cultural agents and researchers to exchange knowledge and cooperate in finding solutions and define strategies. The methodology to meet those established goals includes, in particular for the transfer of knowledge, joint initiatives for capacity building, and trans-national collaborative activities. The selected parameters cover a wide range of data resulting from human activities and environmental conditions. The costs involved to mitigate and adapt are significant and covers a broad range of expertise. To process data from different fields of knowledge and interpret their consequences it is necessary to exchange data and to cross references with other experts. The various developing countries in Asia like China, Malaysia, South Korea, Singapore etc. are developing their infrastructural facilities at an exponential rate (PUROHIT*, [et al.]*, 2015).

The problem of the waterfront has been developed by each partner participating in the project. It has been address from complementary perspectives, economic, cultural, data management, social and environmental. The diversity of themes covered by the partners is crucial for the success of the project. Expertise, exchange of interdisciplinary knowledge with others lead to a broader perception in the field of interest of a particular waterfront. The exchange is oriented to include preliminary research of selected waterfront, following three major guidelines; historical, cultural and geographical records. After the workshop edition, the dissemination of results is able to reach broader audiences, planning and designing adaptation programs and strategies, considering aforementioned variables help to increase the efficiency of efforts (JAMSHIDI*, [et al.]*, 2018).

To imagine the future, it is necessary to understand the past through the historic records available, that provide background on previous conditions. The geographic data is fundamental to relate urban territory with natural territory, as the water currents shape the landscape and the fluvial or/and maritime activities. Waterfront activities are essential for the construction of collective memory and operate as a tool for identity of the community. The cultural influence has a deep influence in the opinion of the communities and the political leaders. Historical urban and geographical research contributes to a rigorous evaluation of particular waterfront potentialities: a way for products distribution, fishing activities or others cultural valences. With climate change it is difficult to predict the impact on waterfront areas as they are vulnerable and their resilience depend on competent but fragmented studies. S.O.S. Climate waterfront methodology allows to strengthen collaboration, to investigate new techniques, to cross references and learn to access to specific instruments and/or methods.

Workshops; the participation in the workshops brings together the interdisciplinary team that integrate permanent staff, scholars and researchers cooperating with the scientific committee. To engage the present debate, the scientific committee invites external consultants and professionals from partner institutions to integrate the research group participating in the workshop. Each workshop addresses one specific waterfront location. A transnational multidisciplinary perspective contributes for the necessary integration of the local waterfront urban environment. The cooperation with experts coming from international partner institutions provides the opportunity to develop a set of local proposals. During the event participants exchange views, gain new perspectives on the researched topic, discuss new approaches of resilience and have the opportunity to test their methods in an international environment.

Conferences gather local experts, municipal representatives, partners and international scholars to share them researches on urban waterfronts. This is useful to exchange mutual visions and common practices, which constitute a relevant tool for future research. Conferences are designed to disseminate the knowledge produced to the wider audience of policy-makers, stakeholders, environmental associations, local communities, media, and the general public and to improve the skills of its staff. The research community promotes the active participation in international science and technology related conferences by providing the framework to include host presentation of papers from external guests previously selected.

This is an important output for the research proposal since communication is oriented towards different audiences.

The overarching methodological framework is backed by the concepts of co-oriented and adaptive and comparative research. The scientific strategy encompasses measures for stepping up and stimulating scientific excellence and innovation capacity. This includes the development of research design and digital tools to playfully engaging companies and communities in research activities and create opportunities to gather with specialist to collect the results of them researches.

- Dissemination and outreach activities - S.O.S. Climate waterfront research community promotes the scientific and public dissemination of the outcomes and findings. A website operating as a knowledge platform will be set at an early stage organized towards providing easy access to knowledge and know-how around the project's key areas and issues detected within the topic. It will also serve as central for social media activities. Further dissemination efforts include publications in relevant/indexed journals, policy briefs, studies reports, booklets and cooperation with other organizations, programs, networks, operating in the areas related to the project. The benefits from creative and innovative solutions contribute for most desirable sustainable development of urban waterfront in Europe. ISOCARP, is expected to list institutions that will continue to provide an international interdisciplinary vehicle for dissemination of results.

Cultural institutions, urban design exhibitions and art festivals have been actively involved in the dissemination of previous results of the waterfront topic. The creation of a body of knowledge on the subject of waterfronts that contribute to the identification of long and short term solutions is sustained by the edition of the web based material, production of documentaries, oriented towards the different audiences and publication of books. Everything is the central outcome of the research. The investment in communicating to reach new audiences through web tools, social networks and local media intends to disseminate and bring for public awareness, solutions that transform the waterfronts and the lives of their communities if local actors converge efforts and collaborate. It plays an important role in this process, because they influence the public opinion to think differently and attract the public interest to support the necessary transformations.

Our previous publications succeed to influence local administrations to take in consideration the results thus the challenges now facing climate change are required to receive feedback from local and international partners and the results of a comprehensive set of field observations, surveys and controlled laboratory experiments demonstrated that the waterfront suction, which remained thus far unexplored in soil mechanics (SASSA*, [et al.]*, 2013).

The activities develop a strategy to maintain the cohesive and sustainable collaborative network beyond the Project S.O.S. Climate waterfront scientific strategy is focused on four main research lines:

1) environmental planning for climate change, the influence of geographic and historical factors on the construction of the new territories over the water. To illustrate the precarious condition and the complexity existing at the waterfront, the analytical cartography will inform several stakeholders and citizens about the artificial landfill and the risks associated with extreme swings in climatic conditions.

2) economic impact. The unsuccessful implementation of the necessary transformation for waterfront sites is simultaneously affected by discontinuous and contradictory decisions lead by politicians. Such situations conduct to by an extensive waste of effort. The economic costs are significant and represent a large percentage of the necessary investments thus highly permeable to political short term decisions. Consultants for this project have been involved technically but not politically at the waterfront transformation process.

3) cultural influence and public space the top-down approach, based on desk-based macroscopic diagnostic and prospective analyses, plans and projects, has prevailed in urban development planning and decision making, thus neglecting the fact that the present city dynamics and future options depend on the changing presence, character and activity of a great number of individual and institutional actors as development stakeholders. This is especially evident in waterfronts, one of the most valuable and indeed unique urban area.

4) data management. The team will collect data to produce visual animations of possible scenarios that envision the vulnerability of waterfronts when exposed to climate change. This has been done by local institutions integrating geographic data. To envision the implications of future projects, management of public spaces that merge equipment's as well as squares, gardens and road structures, data will cover previous projects and future scenarios. The development of possible waterfront urban scenarios using technology spreads a wider understanding regarding waterfront transformations. It is innovative to use material from different fields of knowledge to simulate new outputs. Data related to historic and geographic records will feed the information of specific waterfront development. The information regarding the transformation of the built environment will allow the identification of patterns of development.

Such information will be used to feed algorithms and trace the storyline to speculate on climate change effects. Also, using patterns is useful to integrate the support of artificial intelligence to visualize future possible scenarios. Though speculative this is useful for researchers to be in dialogue with citizens, practitioners, decision makers and engage them in innovative solutions. It is not the cities that can be intelligent, but the societies that inhabit them that must be prepared (OLIVEIRA, 2017).

3.4 participating organizations

The achieved results since 2010 have revealed that the project is innovative by bringing together scholars to conceptualize and formulate design proposals to be brought forward for discussion, some present solutions in a new methodology that engage citizens, and their representatives. The research focus on changes affecting both, the city and the port are neither strictly private (investors 'concern) nor public, but are rather collective responsibility.

Indicators show that the methodology is effective within the local context. The results become a reference to coach the dialogue between residents, governmental institutions and investors. It will be necessary to consolidate the network of exchange knowledge since common topics were found with other partners:

LUSOFONA UNIVERSITY - Portugal

POLITECHNIKA GDANSKA - Poland

ARISTOTELIO PANEPISTIMIO THESSALONIKIS - Greece

UNIVERSITA DEGLI STUDI DI FIRENZE - Italy

INTERCULT PRODUCTIONS EK - Sweden

GDANSK MIASTO NA PRAWACH POWIATU - Poland

CHAMBER OF COMMMERCE - Portugal

FUNDACJA RIVER//CITIES PLATFORM - Poland

INESC ID – INSTITUTE OF COMPUTOR SYSTEMS - Portugal

CPO Noord-Holland (CPONH) – The Netherlands

Conclusion

The working plan of S.O.S Climate Waterfront was discussed and approved by all team leaders. The agreement about the number and dates of visits as well as about visiting persons is established according to their profile (MNG, ER, ESR) and specialization. All the partners agree that the project is feasible regarding both implementation of the tasks formulated and the timeframe. The tasks assigned to each participant are designed according to the work plan in order to meet their expertise and focus in the field of their scientific and scope of interests. Furthermore, the partners welcome knowledge sharing in the structure of the S.O.S. Climate Waterfront project provides a good opportunity to expand their field of research/expertise and enhance scientific innovation of their institutions. The collaboration in the project is profitable for all the members.

A strong consortium with unique combination of expertise will implement the S.O.S. Climate Waterfront (academic and non-academic). All partners work at the forefront of their discipline areas and have well-known scientific and leading reputation, thus ensuring research excellence. The consortium will train new researchers, expand research competencies in innovative design, partner with private sectors in research projects, thus providing substantial opportunities for real world testing of the research and introduce creative/innovative practice research methodologies to a new generation. The project will develop interdisciplinary and multi-sectorial competences that will have significant impact on leading researchers that will be experts in the assessment of waterfronts environmental adaptations and will provide successful water resilient strategies. Beneficiary will also be staff, practitioners, policy makers. S.O.S.'s extensive dissemination (website, media web, books, exhibitions, conferences, scientific articles,) will ensure that the results achieved are open-access and are widely shared.

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Between fjords and mountains: Climate changes vs. cultural heritage sites in northern Norway – an example from Mosjøen in Nordland county

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ABSTRACT:

Cultural heritage sites in northern Norway are manifests of a lifestyle long-lost to industrialization and centralization. Often located between fjords and mountains, many of the sites, such as the fisherman villages in Lofoten and Sjøgata in Mosjøen, consist of wooden buildings that date back to the 18th and 19th century. The buildings are well-kept as they are still in use by the locals; they also serve as important identity markers for the people living in the areas as well as being beloved tourist attractions. The last couple of years climate change has begun to show its presence more than ever in the northern parts of Norway. Heavy rain and unstable winters lead more often to floods, avalanches, and landslides, and the cultural heritage sites that previously were resilient and withstanding are now vulnerable.

In the city of Mosjøen in Vefsn municipality urban planners are trying to develop a new zoning plan for the cultural heritage area Sjøgata. The zoning plan should also function as an adaptive strategy to climate changes so that the historical environment of Sjøgata can be kept for the future. The highest climate risks to Sjøgata are flooding, a rise in the sea level and avalanches, one of the consequences of this is that insurance companies refuse to offer home insurances due of the risk of damage.

The challenge for the urban planners is how to plan for landslides, avalanches and floods, and how to safeguard the historical buildings when this happens. As a part of the work with the zoning plan, the planning department in Vefsn has looked at the possibility to alter the landscape by raising the wooden buildings as well as the terrain up to the future expected sea level. The department also tried to find out if the zoning plan could allow new ways of anchoring and detaching buildings from the foundations so that the buildings could “float” both on water and avalanches without being too damaged.

The new zoning plan for Sjøgata is still is a work in progress. There are several issues due to climate changes that have to be solved in order to complete the plan and whether the strategy will work is yet to be seen.

It is certain that urban planners in northern Norway need more knowledge and research on adaptive strategies to handle climate changes so that the cultural heritage can serve as identity markers, tourist attractions, and homes for another 100 years.

Adaptive Strategies for Mobility Planning in Remote and Coastal Cities and Towns - "LAST MILE" project case

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Short abstract:

Mobility and Accessibility are vital elements for sustainable urbanization with a direct impact on climate change. The INTERREG Europe Project "LAST MILE" is presented with its focus on developing adaptive strategies providing user oriented services for the travel chain's last segment in remote tourism destinations and coastal cities and towns.

Introduction

Mobility and Accessibility are vital elements for sustainable urbanization but there is a need to change the current supply driven approach which gives preference to cars, and adopt a new planning paradigm focusing on people. Transport must remain at the heart of urban planning, providing sustainable solutions to mobility needs through the introduction of transport systems that focus on access, safety and efficiency within the larger context of reducing the need to travel in urban areas. Sustainable transport is included in seven of the 17 SDGs of the 2030 Agenda and is directly covered by 5 targets and indirectly by 7 targets. Four possible goals are considered important: Accessibility, Efficiency; Safety; and Climate respect. From the other hand upholding the right of people to travel safely using efficient and sustainable transport networks is a fundamental human right that is described in the UN Universal Declaration of Human Rights as "freedom of movement". This is why many EU projects aim to connect people to adequate transport services in rural communities, to reduce congestion in cities, and to link urban and rural areas by sustainable means of transport.

1. Project objectives

The LAST MILE project (INTERREG EUROPE, 2016 – 2020) aims to find innovative, flexible solutions for sustainable regional mobility systems. It wants to offer visitors the possibility to travel the 'last mile' of their travel chain sustainably and, at the same time, provide alternatives to car use for residents on their daily trips.

The project sets a concrete focus on the problematic accessibility of the last link of the travel chain from origin to destination (the so called "last mile") and collects and analyses solutions to cover this bottleneck with sustainable modes of transport. The environmental benefit and resource- and cost-efficiency in the long run are considered.

LAST MILE aims, among others, at pointing out how sound institutional framework facilitate the implementation of especially demand-responsive transport (public, sharing, pooling). The project will take on-board lessons learnt here, to further encourage at a later stage of the project partners and regional stakeholders to implement new successful approaches from other regions in Europe when preparing their regional action plans.

Transfer of best practices and innovative approaches to regional policies is also an aim of LAST MILE project. The 6 regional project partners have elaborated a set of regional reports analyzing their territories in relation to the status-quo of sustainable mobility, flexible transport and tourist activity. This exercise is the first step towards building a backbone of the interregional exchange.

Regional reports have been consolidated and summarized in a Synopsis Report that deals with analyses of the institutional frameworks and barriers of each region and the evaluation of good practices, and identifies common opportunities and challenges shared among all regions.

2. **Methodological approach**

The project focuses on user oriented services for the travel chain's last segment in remote destinations offering and promoting door-to-door accessibility. Still, in terms of the full distance to cover between origin and destination, there is often a bottleneck on the last link of the journey, i.e. the distance between the regional railway station and accommodations. This missing link is crucial for deciding what kind of transport to use. Experiences have shown that a demand-responsive transport system combined with regular public transport is a thankful enhancement in many cases. The last-mile problem can be solved by introducing a variety of flexible transport services (FTS) making the transportation multimodal, on-demand, seasonal, shared, and increasing passengers' choice and convenience. The overall transportation system step by step becomes more digital and therefore more efficient by better matching demand and supply.

Last Mile aims at developing adaptive strategies for providing user oriented services for the travel chain's last segment in remote tourism destinations and coastal areas of 6 European countries: Austria, Bulgaria, Luxembourg, Poland, Slovakia and Spain. These countries are situated in different European areas but all have remote tourism destinations with difficult accessibility for visitors. In the Alpine regions of Upper Austria, on the Black sea coast of Bulgaria, in the natural parks of Luxembourg, in West-Pomeranian coastal zone of Poland, in the mountain region near Kosice in Slovakia and High Pyrenees in Spain still major transport systems face difficulties in achieving last-mile connectivity, so people have to travel by car or take a taxi. This missing link is crucial for deciding what kind of transport to use. Experiences have shown that a demand-responsive transport system combined with regular public transport is a thankful enhancement in many cases. The last-mile problem can be solved by introducing a variety of flexible transport services (FTS) making the transportation multimodal, on-demand, seasonal, shared, and increasing passengers' choice and convenience. The overall transportation system step by step becomes more digital and therefore more efficient by better matching demand and supply.

In the frames of the project 7 partners from 6 countries ask for common solutions for the mobility services in the last mile. The major part of activities is dedicated to exchange of experience between the participating regions. Study visits have been performed in every country in order to demonstrate the existing last-mile mobility solutions. The best practices were evaluated in terms of impact on the climate change, sustainability and transferability. Actually they are part of the Good Practices Collection of the IE program thus supporting the International Public–Private Platform named "Global Partnership for Sustainable Transport" which focuses on three main areas:

• Promoting best practices in mobility and accessibility

• Starting dialogues – encouraging governments and businesses to talk about transport sustainability and come up with concrete solutions.

• Working in partnership with other projects and initiatives promoting resilient and sustainable cities and transport.

3. Project implementation

The project is developing on 2 phases. The Phase 1 (April 2016- September 2018) started with a thorough research including 3 different joint analyses, which build the backbone of the INTERREG exchange:

- Analysis of the national legal and institutional frameworks and economic aspects related to sustainable demand-responsive/flexible transport systems and the identification of the barriers that are hindering the implementation of especially small scale systems in remote areas/hinterland
- Analysis of the technical state-of-the-art of sustainable transport, in particular of flexible systems in the different regions
- Analysis and evaluation of existing practices in regional flexible transport policies. This joint research evaluates good practices of and beyond the regions, taking into account former best practice collections of other projects as well. During the study visits the regional approach including the specific framework conditions, financing structures and the concrete mobility systems is discussed and evaluated using two specific questionnaires prepared by CSDCS. In this regard, potentials for optimization or innovation are identified, and if applicable concrete solution approaches are elaborated.

The analyses prepared by each partner region were consolidated and summarized thus allowing the preparation of a **Synthesis and policy recommendations.** Based on the results, it derives recommendations for policy makers at different levels. They were used for elaborating regional adaptive strategies for mobility planning with Action Plans **for implementing flexible transport services** that prepare actions and investments to improve the door-to-door accessibility of peripheral tourist/recreational destinations benefitting also the inhabitants. These strategies will make sure that lessons learned from the research and interregional exchanges are integrated in the regional policies. Actions defined will be put in practice during the Phase 2 of the project (October 2019 – March 2021).

4. Outcomes of the research

For all project partners the project is a real challenge because of the need to introduce the modern concept of Mobility-as-a-Service (MaaS) in the transport schemes of remote and coastal regions where the transport connections are rather scarce and are not a priority to local governments. The Bulgarian case is very indicative, because the Black sea resort region of Varna abounds of attractive tourism landmarks (sand beaches, pictoresque lagoons, roman remains, rain-forest parks, etc.) that can be accessed only by car becaus eof the lack of public transport.

The Bulgarian partner CSDCS analyzed the national legal and institutional frameworks and the economic aspects related to sustainable mobility services and the identification of the barriers hindering their implementation in remote areas. The goal was to elaborate a strategy for implementing flexible transport measures that prepares actions and investments to improve the door-to-door accessibility of remote coastal recreational destinations. It was elaborated with the large collaboration with all levels of decision-makers in the region, tourism and transport experts, as well as a large public participation. A series of awareness raising events and public consultations were conducted for identifying the most appropriate strategic measures for improving the accessibility.

To establish contact with and to sell the last mile idea to players in the fields of tourism, transport, and environment (tourist entrepreneurs, transport authorities, protected area management, local politicians etc.) who might have a vested interest in the policy or project, and whose involvement could have a positive financial or political impact was crucial for the project's success. For the first time the tourism and transport sectors in Bulgaria meet and discuss their common problems and interests having the possibility to exchange experience with more advanced European regions. The project made it possible to bring together all the important subjects involved in people's mobility to try and find points in common and to encourage partnerships both locally and across borders.

5. Conclusions

As a result of the project, adaptive strategies were elaborated and Regional Action Plans were set in all 6 regions. For the Varna coastal area in Bulgaria the strategy was developed with focus on how to bring people and places together by creating relevant flexible transport services rather than simply increasing the length of urban transport infrastructure or increasing the number of movements of visitors.

As Varna coastal region and the other 5 project regions are tourism destinations, the project outcomes would be: improved urban-rural connectivity; improved regional environmental/climate conditions; strengthened institutional capacity for tourism destination management; and effective project implementation and knowledge management. This project represents one more step to the appeal of a seamless, technologically-facilitated transportation ecosystem, universally accessible yet designed for maximum efficiency and site-specificity.

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Study on the relationship between urban climate change and urban development construction in severe cold area

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Abstract: A sizable majority of researches show that urban climate change has great relationship with urban development construction. However, because of the big climate environment difference in summer and winter, for cities in severe cold area, urban climate environment affected by urban development construction has its own complexity compared with that in warm area.

In order to study the importance of urban development construction in affecting the urban climate environment in severe cold area, this paper takes a typical winter city Harbin in northeast China as the research objective. On the basis of analyzing the climate evolution and urban development from 1988-2017, the paper makes a correlation analysis between urban climate elements and some typical urban development construction indexes in summer and winter separately, finding the underlying mechanisms of the two factors' mutual influence. At last, according to the correlation analysis results, this paper confirms the key urban development construction indicators, and advances some urban planning strategies to avoid the negative effects that urban development construction brings to urban climate environment in severe cold area.

1. Introduction

A sizable majority of researches show that urban climate change has great relationship with urban development construction, especially in recent decades. T.R.Oke is one of the earliest experts who discuss urban size 's influence on urban heat climate[1]. Peter Bosselmann analyzes urban form and climate in 1990s[2]. Some researchers focused on studies of how urban construction affect urban climate environment in different regions. Du Yin and Rohinton Emmanuel discussed the urban climate change under urban expansion and shrinkage respectively in warm areas[3][4]. Bernard Kumi Boateng and S Piketh took Ghana and in Africa as the research object, studying the relationship between urban growth and thermal climate change. Y Shi pays much more attention on microclimate spatial distribution in sub-tropical high-density urban environment[5]. Climate change is also connected to urban planning policy in some developed countries[6][7]8. In addition, some researchers integrates climate change considerations into related urban planning technical specifications and guidelines, as well as some urban planning strategies, in order to make the research results much more effective[9][10][11].

However, because of the big climate environment difference in summer and winter, for cities in severe cold area, urban climate environment affected by urban development construction has its own complexity compared with those cities in warm area. For example, as the urban grows and develops, in summer, heat island effect in winter cities are also noticeable, extreme hot weather often happens; In winter, unreasonable urban design makes the microclimate of partial urban areas very bad, especially big wind velocity and lack of sunshine. In fact, temperatures of winter cities in China are far below those in other countries at similar latitudes; the mean temperature in January is lower than -18°C due to the cold air that comes from Siberia every year[12]. So winter cities in China face much more complicated climatic issues than those in other area.

Related research on cities in severe cold area is rare in the literature. This study took Harbin, a typical Chinese winter city, as the research objective. The main purposes of the study are (1) Analyze the climate evolution and urban development construction in recent 30 years in typical winter cities; (2) Develop the correlation analysis between urban climate and urban development construction in typical winter cities; (3) Advance some planning implication to improve climate environment in winter cities.

2. Methods

2.1 Study site

Harbin is located at 45° latitude N and 128° longitude E, and it is known as a typical winter city in northeast China. Harbin is the capital city of Heilongjiang Province, and also the transportation, political, economic, cultural and financial center of northeast China, with a total population of 9.62 million at the end of 2016. The city of Harbin encompasses approximately 53000 km^2, urban area 10198 km^2, with the GDP of 610 billion. The location map of Harbin is shown in Figure. 1.

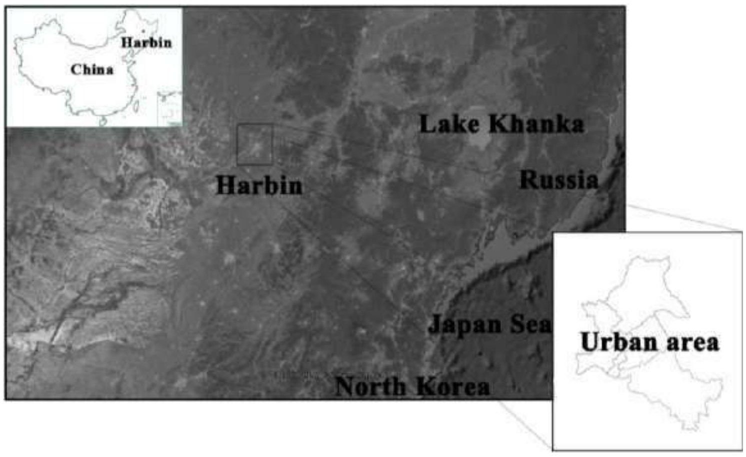

Figure 1: The Location Map of Harbin

Harbin belongs to the temperate continental monsoon climate zone, the annual mean temperature of which was 3.6℃. The mean temperature of the coldest month, January, is approximately -19.5℃, and the lowest temperature of -37.3℃ occurred on Jan 26th, 1985. The mean temperature of the warmest month, July, is approximately 22.8℃, as shown in Figure 2. Usually, summer is from June to August, in which the mean temperature is higher than 20℃; winter is from November to March, in which the mean temperature is lower than 0℃. The heating period in Harbin is from October to April, and only about 140 days in the year are frost-free.

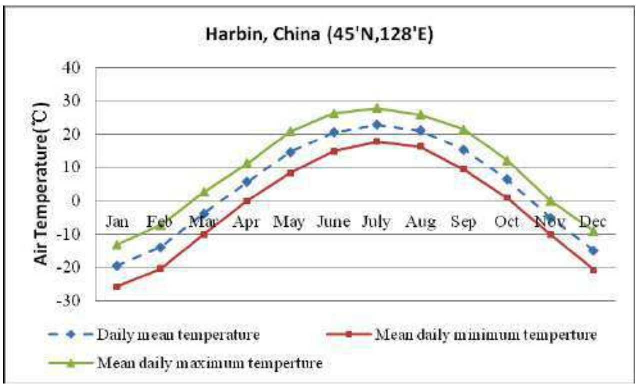

Figure 2: Mean daily mean, maximum, and minimum air temperature in Harbin ,China

2.2 Basic data analysis
Meteorological data for Harbin from the China Meteorological Data Sharing Service System from 1988 to 2017 was used to study the climate environment evolution in Harbin, which offers authoritative meteorological data for scientific research. This study used the average adjacent day or month value instead of using incomplete data in the system. The main climate parameters are temperature, sunshine duration, wind velocity and relative humanity in the 30 years. Temperature parameters contain mean temperature, minimum temperature and maximum temperature; wind velocity parameters contain mean wind velocity and maximum wind velocity; relative humanity parameters contain mean relative humanity and mean precipitation.

Urban development construction data from China City Statistical Yearbook from 1988 to 2017 was used to study the urban development construction in Harbin. The main indexes are population, urban built-up area, land use intensity, green coverage ratio and GDP. In addition, some satellite image maps of Harbin in different typical years are from the website of United States Geological Survey, through which the urban evolution in recent 30 years can be seen clearly.

2.3 Correlation analysis
Based on the meteorological data and urban development data in the 30 years of Harbin, the Person correlation analysis between meteorological data and urban development construction index is discussed. All the indexes in the Person correlation analysis pass through the test of independent. In order to show the specialty of winter cities, the analysis process was performed based on the data in summer and winter respectively. In the analysis, summer meteorological data is the mean value from June to August, winter from November to March.

3. Results

3.1 Climate environment evolution
Figure 3 shows the climate environment evolution from 1988 to 2017 in Harbin. In the 30 years, the annual mean temperature rises up 3.1℃, urban heat island effect begins to come up. The raise range of mean minimum temperature in Harbin is more than the decline range of maximum temperature within the 30 years. In addition, the temperature change characteristics shows the level of warming in winter is higher than that in summer, so the urban heat island's influence on urban temperature mainly focuses on night and winter in Harbin.

The mean sunshine duration in Harbin drops year by year. Harbin was the region of abundant solar energy resources, there was 250 days in which sunshine duration is more than 6 hours[13]. Before the year 2006, the annual sunshine duration hours are 2500, and after that, the numbers are about 2200, with a reduction of 1 hour per day. As the urban development construction advances, air pollutant concentration and total cloud cover increases and direct solar radiation decreases, so the sunshine duration reduces in the past 30 years.

Wind velocity in Harbin has a significant decline in the 30 years, the wind velocity variation slope is about 1.5m/s, and the mean wind velocity is about 2m/s in recent 5 years. The days with strong wind (11m/s) in 1960s are 10.8, but in 1990s they are only 0.6[14]. Annual maximum wind velocity reduces greatly before 1990s, and after that, the reducing speed is lower. The annual maximum wind velocity stays in about 10m/s in the nearly 15 years, which is a similar result as 'the wind energy resource census', the reserve of wind energy resource are shrinking in most region of China[15].

The mean precipitation peaked at the year 1998 with the value of 800mm, and since the year 2000, the value begins to reduce, annual mean precipitation is only about 500mm. Because of the decrease of precipitation, the relative humanity shows a decline in the 30 years in Harbin.

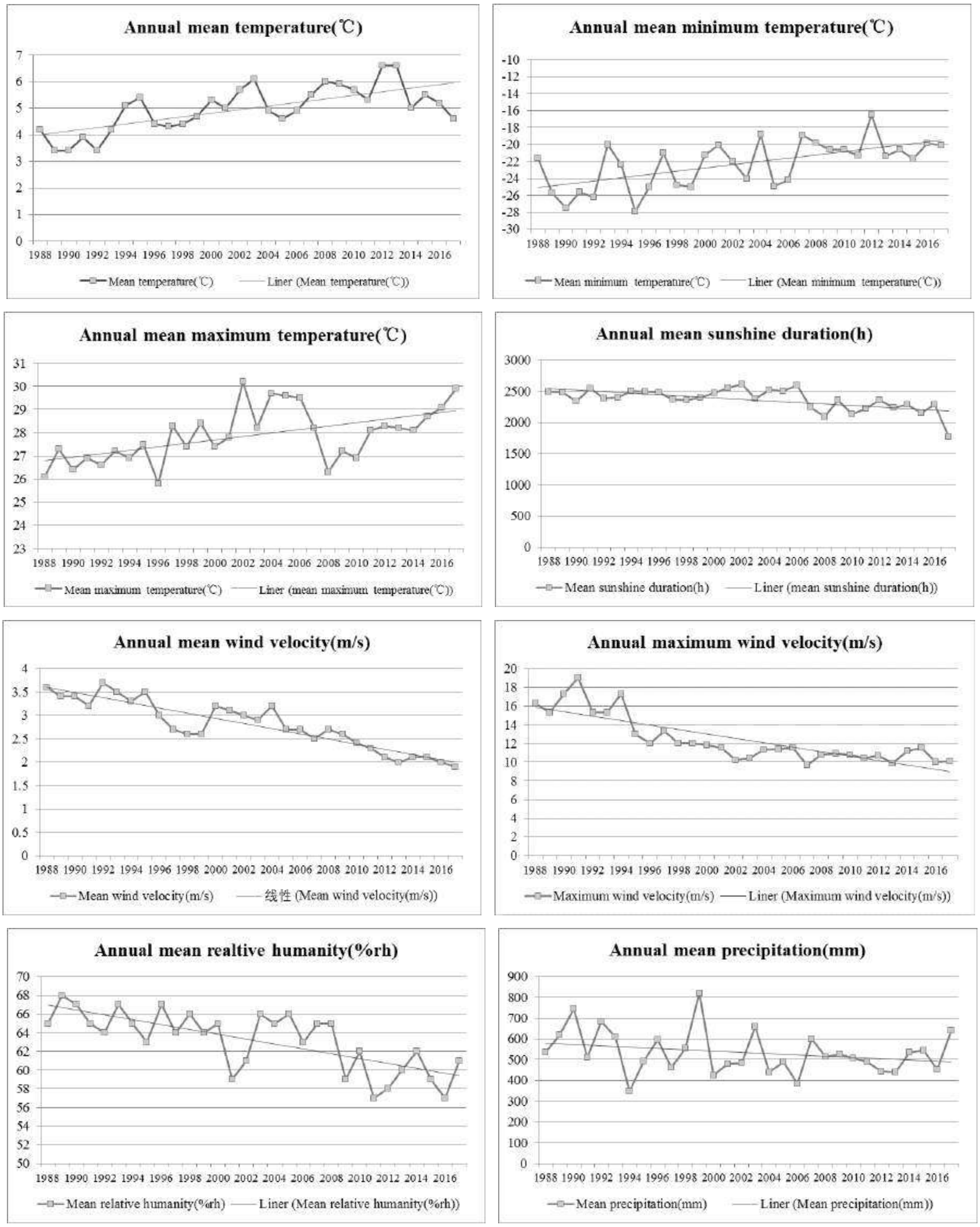

Figure 3: The climate environment evolution in the 30 years in Harbin

3.2 Urban development construction

Figure 4 shows the Harbin main urban area spatial patterns change situation in the year 1988, 1997, 2007 and 2017. Urban construction land in Harbin is expanding within the 30 years, especially in the recent 10 years. The main urban area in Harbin has a significant expansion to the north and south along the Songhua River. Table 1 shows the urban development construction condition of Harbin in typical 5 years, and it has a fastest growing in the recent 10 years, urban built-up area in 2017 is triple the number in 1988, and urban area in 2017 is nearly 6 times as that in 1988.

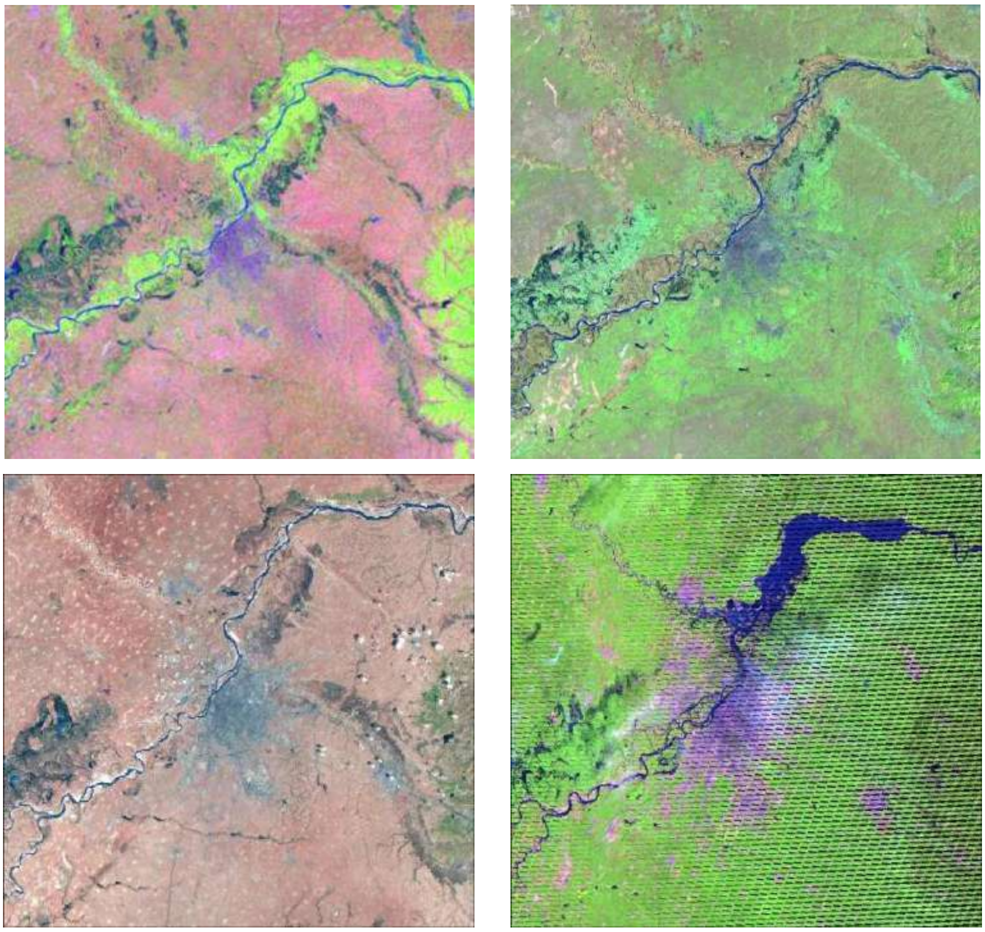

Figure 4: The Urban evolution of Harbin

Table1 Demographic and geographic information of Harbin

Items/ Year	Year 1949	Year 1988	Year 1997	Year 2007	Year 2017
Urban built-up area (km^2)	86.31	153.27	291.09	398.95	428
Urban area (km^2)	930	1637	1637	4275	10098.32
Green coverage ratio (%)	6.34	11.2	19.7	28.87	38.51
Population (Million)	0.76	2.46	2.59	3.99	5.49
GDP (Billion)	0.38	9.68	53.2	183	575

3.3 Correlation analysis

(1) Results in winter

Table 2 shows the correlation index of meteorological data and urban development in Harbin in winter. First, mean minimal temperature has no relationship with urban development, but mean maximum temperature has significant correlation with urban development factors at level 0.01 except urban exploitation, which is similar to the results of mean temperature. Land use intensity has no relationship with any three temperature indexes. Mean sunshine duration in Harbin in winter is influenced greatly by urban development construction factors except land use intensity. Mean sunshine duration declines with urban development, and the correlation coefficient is more than 0.6. Mean wind velocity has a strong relationship with all the urban development construction indexes at level 0.01. Active influence with population, urban built-up area, green coverage ratio and GDP, negative influence with land use intensity. However, urban development construction has little effect on mean relative humanity in Harbin in winter.

(2) Results in summer
Table 3 shows the correlation index of meteorological data and urban development in Harbin in summer. Mean minimum temperature has relationship with all urban development construction indexes except green coverage ratio, and all the correlation coefficients are more than 0.67. However, there is no statistically significant difference between mean maximum temperature and urban development construction indexes. Mean temperature is influenced by population, urban built-area and GDP at level 0.01. Mean sunshine duration in Harbin in summer has a negative relationship with population and urban built-up area, and the correlation coefficients are about -0.5. Mean wind velocity has a strong relationship with all the urban development construction indexes at level 0.01, active influence with population, urban built-up area, green coverage ratio and GDP, negative influence with land use intensity. The more land use intensity is, the more mean wind velocity is, which has the same result as the climate change analysis in the 30 years. However, urban development construction has little effect on relative humanity in Harbin in summer, which has the same results as that in winter.

From the correlation analysis results shown above, it is can be seen that some climate environment evolution indexes have strong relationship with urban development construction indexes except land use intensity in Harbin which is only related to mean wind velocity in both seasons. Land use intensity changes with the urban master planning updates. Land use intensity is the ratio of urban construction area and urban administrative area. In one urban master planning cycle, there is little change in urban administrative area, however urban construction area changes irregularly some time. Therefore, land use intensity in different years and urban master cycles can be similar, which in individual years maybe even smaller than the last year. As a consequence, land use intensity is an index has little effect on climate environment factors.

For showing the specialty in winter cities, there are some certain rules in winter and summer respectively.

First, for winter cities in severe cold area, there is significant difference between urban development construction’s influence on summer and winter temperature. Mean and maximum temperature are the main aspects that urban development construction affect temperature in winter, but mean and minimum temperature are the main influenced objects in summer. Based on the results mentioned above, it is can be seen that as the city grows, maximum temperature in winter is decreasing and minimum temperature in summer in increasing, furthermore, and almost all the correlation coefficients are more than 0.6, which shows a strong relationship. Urban development construction in Harbin has an irreversible influence on urban heating island effect.

Second, mean sunshine duration in Harbin declines with urban development construction in both summer and winter, which validates increasing urban heating island effect in Harbin aggravates air pollution and total cloud cover, as well as its negative effect on urban sunshine environment. In addition, green coverage ratio and GDP is related to sunshine duration only in winter, which indicates cold weather make urban green land have different effects on sunshine duration.

Third, even though the trend of mean relative humanity in Harbin of 30 years is declining, and dry island effect exists, urban development construction has a little influence on relative humanity, no significant difference. Therefore, it is deduced that urban relative humanity has much more relationship with underlying surface patterns and structure. The main precipitation pattern in winter is snowing, so the mean relative humanity in four winter months are similar to each other.

At last, Green coverage ratio has much more influence on winter than that in summer, and that maybe caused by the cold weather, which caused big difference in vegetation forms and patterns in winter compared to summer. In addition, compared with other climate parameters, green coverage ratio has the closest relationship with wind velocity in Harbin in both summer and winter. The correlation coefficients are more than 0.8, and the significances are all at level 0.01.

Table 2: Correlation index of meteorological data and urban development in Harbin in winter

Meteorological data/ Urban development factors		Population	urban built-up area	Land use intensity	Green coverage ratio	GDP
Mean minimum temperature	Person	0.322	0.316	-0.132	-0.198	0.155
	Sig.	.082	.089	.488	.403	.413
Mean maximum temperature	Person	-0.508**	-0.54**	0.167	-0.560*	0.491**
	Sig.	.004	.002	.376	.010	.006
Mean temperature	Person	-0.493**	-0.527**	0.152	-0.533*	0.479**
	Sig.	.006	.003	.423	.010	.007
Mean sunshine duration	Person	-0.611**	-0.699**	0.217	-0.705*	-0.68**
	Sig.	.000	.000	.249	.0150	.000
Mean wind velocity	Person	-0.688**	-0.648**	0.458**	-0.808**	-0.58**
	Sig.	.000	.000	.007	.000	.001
Mean related humanity	Person	0.127	0.076	-0.215	0.402	0.184
	Sig.	.502	.691	.254	.079	.330

*-Significance at 0.05 level, **- Significance at 0.01 level

Table 3: Correlation index of meteorological data and urban development in Harbin in summer

Meteorological data/ Urban development factors		Population	urban built-up area	Land use intensity	Green coverage ratio	GDP
Mean minimum temperature	Person	0.673**	0.707**	-0.455*	0.375	0.675**
	Sig.	.000	.000	.011	.104	.000
Mean maximum temperature	Person	0.361	0.358	-0.228	0.293	0.34
	Sig.	.05	.052	.225	.210	.066
Mean temperature	Person	0.562**	0.513**	-0.345	0.292	-0.488**
	Sig.	.001	.004	.062	.211	.006
Mean sunshine duration	Person	-0.499**	-0.583**	0.328	-0.286	-0.592
	Sig.	.005	.001	.077	.222	.001
Mean wind velocity	Person	-0.732**	-0.703**	0.536**	-0.815**	-0.605**
	Sig.	.000	.000	.002	.000	.000
Mean related humanity	Person	-0.307	-0.297	0.147	-0.053	-0.163
	Sig.	.099	.111	.439	.825	.39

*-Significance at 0.05 level, **- Significance at 0.01 level

4. Discussion

4.1 Implications for urban planning and design

Previous studies found that urban planning and design has close relationship with urban development construction. However, in different countries and climate region, the correlation analysis results kinds are totally different. Based on the analysis results in Harbin above, population and urban built-up area are the most important influencing factors on climate change, thus for cities in severe cold area, proper urban scale controlling and compact urban form building are available approach to mitigate the climate change. For controlling urban scale, appropriate population size and environment capacity are the main methods. For building proper compact urban form, optimizing land using structure, slowing down the speed of urban construction land expansion, proper multi-functional urban land complex are the main methods. Even though these strategies are also suitable to cities in other climatic zone, it is much more meaningful to winter cities, which can slow down the speed of climate change, meanwhile reduce the problem of urban traffic and energy consumption much more effectively.

According to the results, for optimizing temperature conditions in winter cities, decreasing the minimum and mean temperature in summer, meanwhile increasing the maximum and mean temperature in winter by taking some measures on urban development construction are available, because it has opposite effect on the two seasons. For optimizing sunshine duration and wind velocity conditions in winter cities, taking the same measure on urban development construction would has the same effect on the two seasons. Therefore, further urban planning policy and strategies need to pay attention to the difference in summer and winter.

However, urban development construction is not the only criterion affecting climate in cities. Other factors such as people's behavior, energy consumption, even the movement of the earth and the force from the universe space are also key points[16], so there are lots of measures can be taken to mitigate the climate change in winter cities. Some experts suggest make the urban climatic map to guide the urban planning practices in different seasons and urban scale, in order to ease the conflict between urban development construction and climate changes more intuitively[17][18].

In addition, for cities in severe cold area, at the same time of mitigating the climate change, adapting regional climate condition and improving local microclimate environment are also extremely important[19], as well as studying the relationship between them and urban development construction in different urban scale, through which would enhancing the entire urban climate adaption for winter cities[20]. These should be taken into deep consideration in future design and policy.

4.2 Limitations of the study

There are also some limitations in this study. There are only five urban development construction indexes discussed in this study, some other indexes may also affect climate a lot. In addition, compared with the meteorological data from related official website, in situ measurement in some typical urban area may reflect much more real problems, which should be combined with the official data in the study. Furthermore, for winter cities, there is a particular period in the whole year-marginal season, which are the periods between winter and spring, fall and winter[21]. In sunny days without cold wind, a lot of people go out for outdoor activities in marginal seasons, so the urban climate research in marginal season is also extremely important to winter cities

In further studies, the correlation relationship between climate change and urban development construction in winter cities need to be quantified by studies with more depth. Through more precise calculation and simulation results, it is useful to the cultivation of environmental urban policy in winter cities.

5. Conclusion

Based on the meteorological data and urban development construction data, this study concludes that climate change and urban development construction change a lot within 30 years in Harbin, finding that maximum temperature in winter is decreasing and minimum temperature in summer in increasing as city grows. Besides land use intensity, all four urban development construction indexes have important effects on climate change in summer and winter respectively.

The research results can be used to guide the urban planning and design for cities in severe cold area, as well as providing technical support for urban material space design based on urban climate environment adjustment in the future, enhancing the sustainable development capacity for cities in severe cold area, which are of great significance and the key points in the field of urban climate environment research.

Acknowledgement:
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Study on Residential Design and Renovation Planning of Villages in Forest Areas of Severe Cold Region Based on Resilience Theory

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Abstracts: With resilience concepts is increasingly expanded in urban planning and architectural design industry under global climate change, renovation planning and residential design of the resilient village gradually show the key significance in rural areas, as important as urban field. In addition, development of the resilient village has been subject to many restrictions and security risks, especially in forest areas of severe cold region in China, due to the special climatic and ecological characters. In this context, the paper mainly focus on the connotation, characteristics, systematization and application of the resilient village in forest areas of severe cold region, through theoretical research, field research, system modeling and empirical research, based on resilience concepts. From the overall perspective, the paper aims to promote the process of resilient renovation planning and residential design in special climatic and ecological areas, through systematic research of the resilient village, in order to deal with climate change and other adverse factors
Keyword: Resilience concepts; forest areas of severe cold regions; the resilient village; stability landscapes; renovation planning and residential design

1. Introduction

In recent years, more and more researchers in China start to focus on researching the corresponding design strategies to deal with the impact of climate change, and pay great attention to renovation planning and residential design under special climate and ecological conditions. However, villages in the vast forest areas of northeastern China have been neglected by these researchers for a long time, which is the main component of the forest area compared to the cities. At present, the planning and residential design of these villages are lagging behind, due to the particularity of its climate, ecological environment, social economy and other factors. The problems of the forest villages mainly center on the settlement structure, energy utilization, building materials selection and ecological regulation. Furthermore, cause of the large amount and individual small scale, most of the forest villages scattering in the vast forest areas are more vulnerable to climate change and interdependent with the surrounding forest ecosystems. In order to change this situation, it is necessary to introduce resilience concepts in village renovation planning and residential design

Resilience is defined as “the ability of a system or organization to withstand and recover from adversity” (Holling 1973). A resilient organization is one that is still able to achieve its core objectives in the face of adversity through a combination of measures. Resilience concepts is composed of four dimensions: latitude, resistance, precariousness and panarchy, with adaptive cycles, cross-scale effects and transformability (Brian Walker 2004). As resilience concepts is widely applied to urban and regional planning field, the concept of resilient city has been gradually accepted, which is known as the capacity to absorb external disturbances and maintain the primary features, structure and key functions of urban or urban systems (Resilience Alliance 2007). Meanwhile, it has been defined that rural resilience is a new development concept (Heijman 2007). The idea of combining resilience concepts with village panning has also sprouted. For example, there are research on the analysis of rural community resilience (Skerratt 2013), the components of rural resilience (Buikstra 2010), the resilience capacity to a developmental shock (Daisaku 2013), and spatial and productive development of coastal resilience (Diego 2014), However, there is currently a lack of systematic and empirical research focusing on the resilient village under special climate and ecological conditions, and cross-branch resilient research that combine village planning with architectural design.

Therefore, from theoretical and practical perspectives, the paper mainly focuses on renovation planning and residence design of the resilient village in forest areas of severe cold regions in China, based on resilience concepts, in order to deal with climate change, improve integrated adaptability and promote sustainable development. During the research process, the regional characteristics are highlighted, such as special climate and natural resources. Simultaneously, the organic integration of village planning and residential design is emphasized, in order to form a more systematic and interconnected resilient system.

2. Field Research

With case-based reasoning (Aamodt 1994), several typical villages were investigated through field research, and outstanding issues were summarized as original database for modeling.
Specifically based on the research requirement, 10 villages were selected and field surveyed with representative characteristics in terms of scale, age, development and planning, which locates in forest areas of severe cold regions in Northeastern China (Figure 1-3).

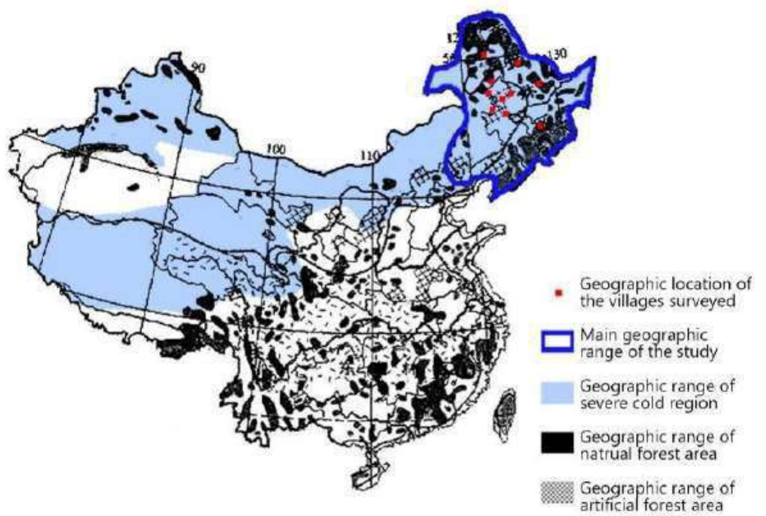

Figure.1 Research ranges and village location on a national scale (Source: Author).

Figure.2 On-site interview (Source: Author).

Figure.3 Field mapping (Source: Author).

In each village, one relatively typical house was selected for detailed surveys, which are mapped and evaluated to analyze plan area, construction status, and average daily energy consumption. Based on the results, basic information and current situation of the villages and residences were compared and analyzed (Table 1, Figure 4-7).

Figure.4 Comparison of village land area (Source: Author).

Figure.5 Comparison of village population (Source: Author).

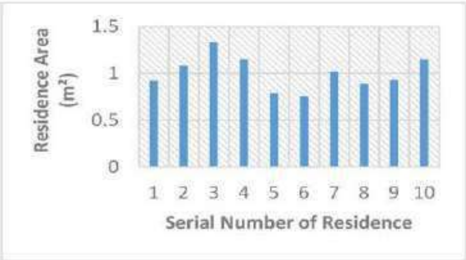

Figure.6 Comparison of typical residential area (Source: Author).

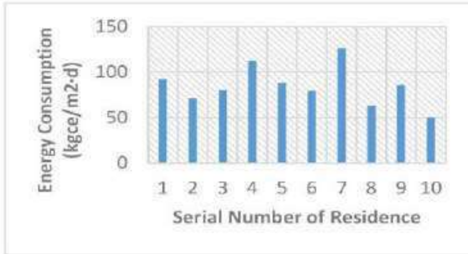

Figure.7 Comparison of average daily energy consumption of typical residence in January (Source: Author).

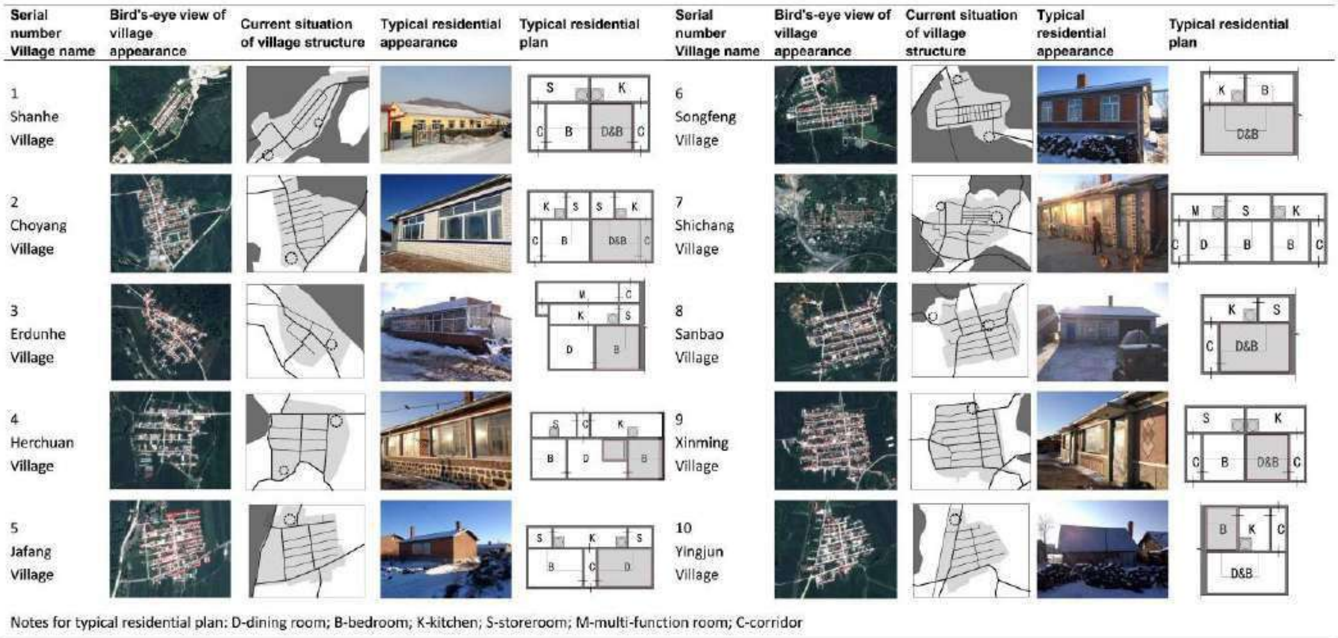

Table.1 Basic information of typical villages and residence (Source: Author).

By analyzing and summarizing the results of field research, many current problems was found in villages of forest areas in severe cold region. Main outstanding issues include the following four aspects:

Firstly, in the social aspect, the problem of “over-dilution” is serious， which was caused by the loss of population and the vacancy of land. With the development of urbanization, the number of residents in the village has continued to decrease, while land wastage and inefficient use have been increasingly severe. To remedy this kind of problem, it is necessary to reconstruct rural areas in a timely manner, however, which is in contradiction with the current urbanization policy pursued by the local government. The gaps between the existing problems and policy preferences poses a great threat to village resilience ability.

Secondly, in the economic aspect, the industrial structure and development model of the villages are relatively rigid. In recent years, as the transformation of traditional centralized forestry management in China, many villages in forest areas have lost their economic status, with external attractiveness declined. At present, the villages are still dominated by traditional planting industries without rational occupational guidance to the residents. Therefore, the local industrial structure needs to be adjusted and diversified.

Thirdly, in the ecological aspect, there is a lack of reasonable forest protection plan and special disaster prevention plan. As most villages in forest areas of severe cold areas are located in the mountainous area, the villages are faced with more disaster challenges compared to other natural areas in China. These challenges, such as winter cold waves, forest fires, and landslides, have posed great security risks for many villages. Otherwise, the existing protection mechanism of forest resources is not sound enough, and the relationship between the villages and the forest is lacking of balance and symbiosis

Fourthly, in the technologic aspect, the village's municipal facilities and building technology are relatively backward. Most villages are lacking in centralized drainage facilities, centralized heating facilities and standby electric generation system. In addition, as the main type of architecture in the villages, residence is generally faced with a series of problems from function design to construction technology, such as unreasonable functional layout, non-recyclable materials, and high energy consumption in winter.

3. System Modeling

3.1 Conception of the Resilient Village

Based on the results of previous investigation and analysis, it is very urgent to carry out resilient village renovation planning for villages in forest areas of severe cold regions, which is an active, nonlinear and complex process. The concept of resilience has important implications for village renovation, which reveals that villages, as an important part of the social-ecosystem, also have resilient characteristics, such as complexity, precariousness and adjustability within certain limits. Through various methods, the resilience concept will play a positive role in promoting village renovation

Compared with other villages in China, the area and population of villages in forest areas of severe cold regions are relatively small. Therefore, in the process of village renovation, the resilience of individual residential units is superimposed, which will form a great synergy in the residential settlement and directly influence the construction of resilience villages. Thus the resilient village construction requires the integration of residence, village and surrounding environment.

3.2 Space-time Characteristics of the Resilient Village

In terms of basic characteristics, the resilient village includes redundancy, flexibility, learning capacity and restructuring capacity (Figure.8).

In terms of spatial situation, the spatial form of the resilient village is dynamic with the resilient capacity. Resistance and precariousness are a set of opposition factors, and the degree of dispersion is determined by the resilient capacity. Thus the spatial situation model of the resilient village is similar to a dynamic cylinder, the section of which expands or contracts with the size of resilient capacity, and the height expands with the influence of social, economic, ecological and technological factors (Figure.9).

In terms of time series, precariousness and resistance of the resilient village system interact with each other over time, and the result determines the resilient capacity of a village. If the resilient capacity gets larger, the system is still in the original stable landscape, or towards a higher level. If the resilient capacity gets smaller, and the threshold also reaches the maximum, then the village will go beyond the threshold into another kind of stable village, or fall into a temporary system collapse (Figure.10).

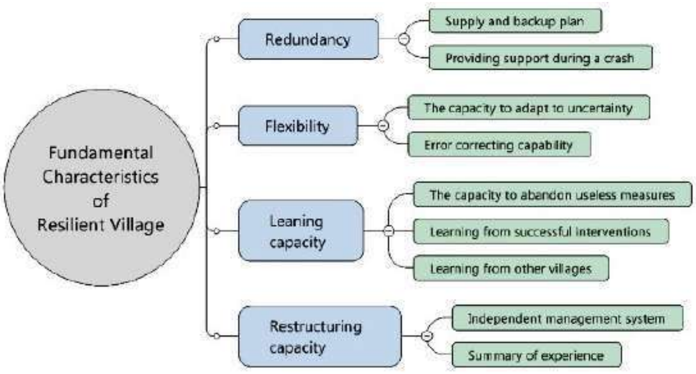

Figure.8 Fundamental characteristics of resilience village (Source: Author, derived from Surjan 2001).

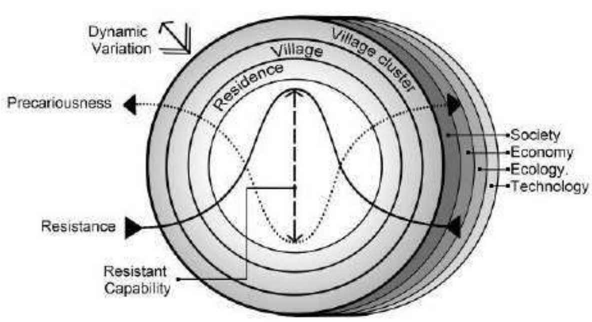

Figure.9 Spatial situation model of the resilient village (Source: Author).

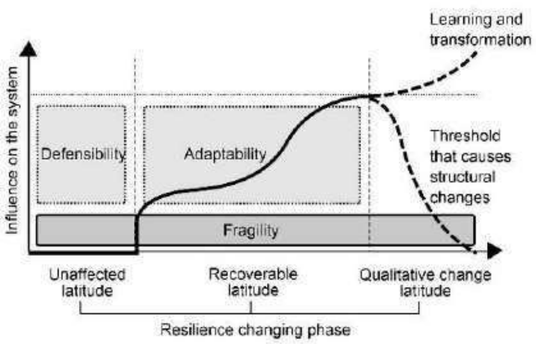

Figure.10 The time series model of the resilient village (Source: Author, derived from Wilhelm 2012).

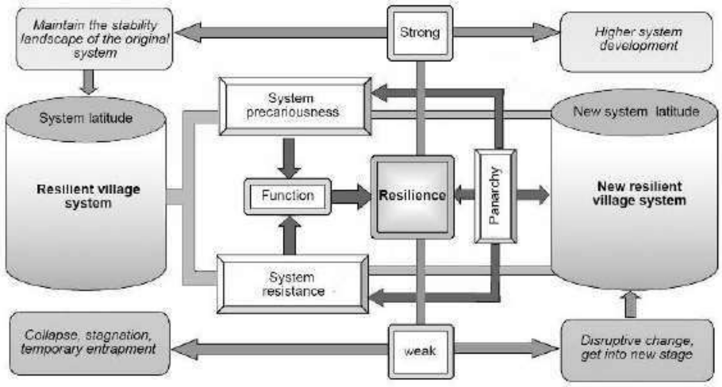

Figure.11 Stability landscapes on the resilient village system (Source: Author, derived from Wilhelm 2012)

3.3 The System Model of Rural Resilient Capacity

According to the research progress of, resilience concepts, Basin Model (Walker 2006) can describe the properties of restorative force in a vivid and accurate way, which includes state space, basin of attraction and stability landscapes. Among them, stability landscapes presents four primary elements that construct the resilience concepts, which are altitude, resistance, precariousness and the distance from the system to the threshold (Figure.11).

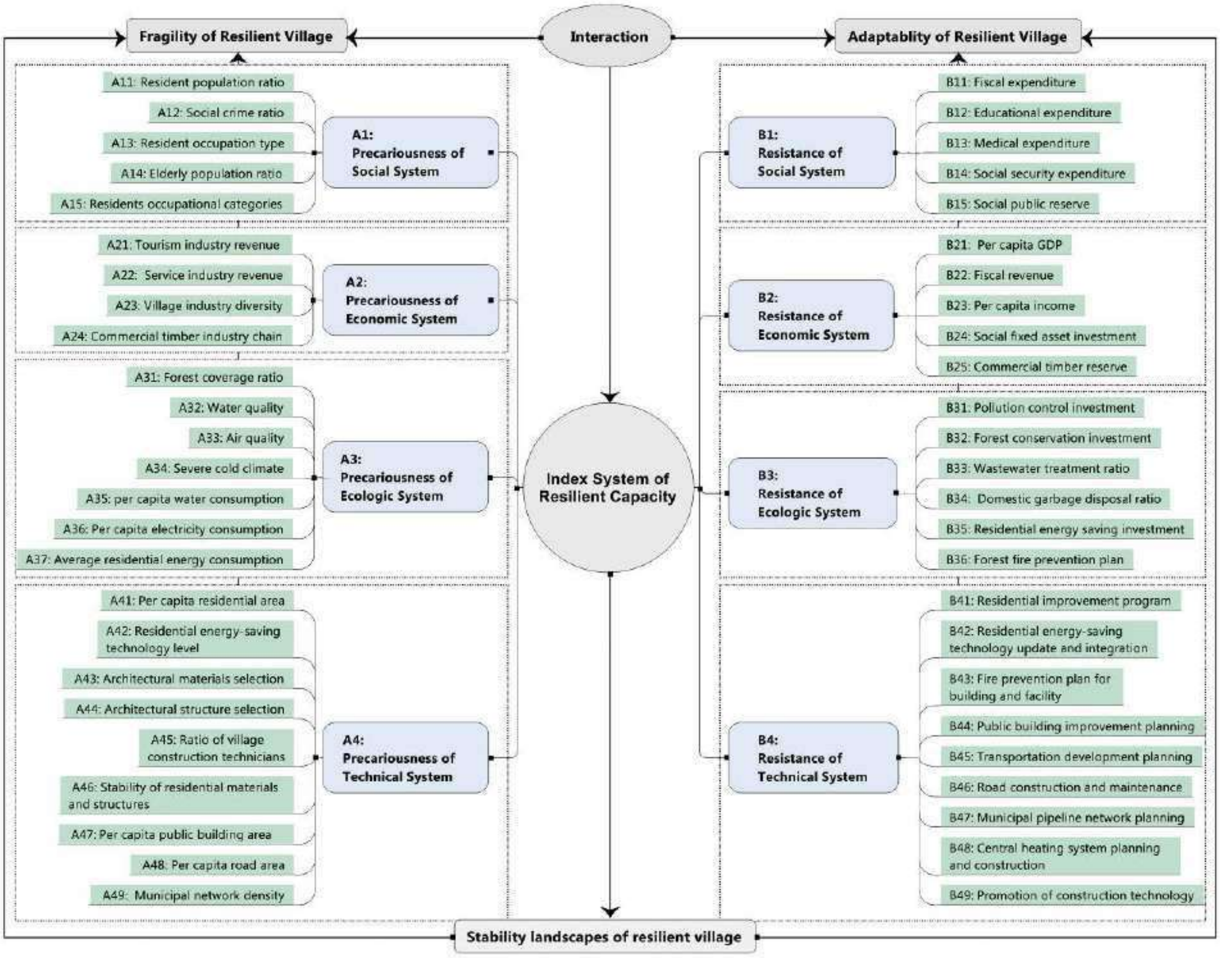

Figure.12 Index system of the resilient capacity for villages in forest areas of severe cold region (Source: Author).

Based on stability landscapes, the rural resilient capacity system has the characteristics of openness, complexity and dynamics, which constructs the basic rudiments of the resilient village. By Delphi method, the impact factors are accurately screened. Then, through Set Pair Analysis (Jingzhong 2004), the active and passive effects of impact factors on the system are calculated in detail. Furthermore, the index system of the rural resilient capacity was constructed to support the village renovation in forest areas of severe cold region, including four sub-systems, including society, economy, ecology and technology, and 50 impact factors (Figure 12). According to different action properties, the impact factors are divided into two categories: precariousness and resistance, forming a dynamic balance of the rural resilient capacity.

4. Empirical Research

Empirical Research is a practice of relevance combining engineering practice with planning theory (Benbasat 1999). Based on the previous research, Shanhe Village was selected for empirical research, for renovation planning and residential design. Shanhe Village is located in in the forest areas of Daxingan Mountain, belonging to Pingshan town, Archen City, Heilongjiang Province. After the disintegration of traditional centralized forestry management in China, Shanhe Village has been faced with slow economic development, while the industry of which has been dominated by traditional agriculture and aquaculture for these years. Compared with the surrounding villages, Shanhe Village has certain typical characteristics, with a wide range of urgent problems to be solved.

4.1 Renovation Planning of the Resilient Village

According to the specific situation of Shanhe Village, comprehensive renovation planning was conducted (Figure 13-16), including the following four aspects:

In the social aspect, the information feedback mechanism should be established so that the system can have good information circulation and self-adjustment ability. At the same time, intergenerational assistance at the community level should be promoted to develop social networks and community leadership. In addition, overlap land use should is allowed, to activate diversified living and production modes. Furthermore, residents are encouraged to participate in the planning work, to reflect their living needs and creative ideas.

In the economic aspect, the development of diversified economic modularity is encouraged to enhance the innovation and utilization of featured resources, reducing economic risk. A modern timber processing factory is planned to replace the original quarry, in order to end the traditional crude exploitation of natural resources and make refined and sustainable utilization of the commercial timber resources. With the theme of featured village experience, the local tourism industry chain is carried out, including guest service facilities, planting experience farm and a forest sightseeing route.

In the ecological aspect, the ecological service system should be constructed to realize the management and evaluation of local environment. To protect the forest, it is necessary to take fire prevention as the first priority, with popularizing fire prevention knowledge and establishing inspection system. The natural stream around the village should be reasonably protected and moderately exploited. In addition, aquaculture ponds can be set up with the topography, to mitigate the risk of rainstorm in combination.

In the technologic aspect, the plan advocates the application of technological innovation and supports the integration and utilization of efficient technologies. To achieve this goal, emphasis is placed on the renovation of energy-saving technology in residence, in order to reduce energy consumption in winter and improve indoor thermal comfort. At the same time, improving the municipal management network has been placed in an important position, including setting up centralized drainage and wastewater treatment facilities. In addition, it is also necessary to carry out technical transformation of central heating facilities.

Up to now, the renovation plan of the resilient village has been partially completed with initial results, due to the active support of local governments and residents (Figure 17). A series of hydrophilic facilities has been built including the dike, platform and bridge, forming an important hydrophilic landscape node. Rare tree species have been recorded and protected, while natural streams nearby has been cleaned to maximize ecological authenticity. The residential square has been built to hold large-scale activities. The forest sightseeing project have been carried out, along with cultivation experience fields, tourist center, tourist hotel and restaurant. In general, the positive function of the resilient village has been beginning to emerge, which has shown certain demonstration effect to the surrounding areas.

Figure.13 Overall planning (Source: Author).

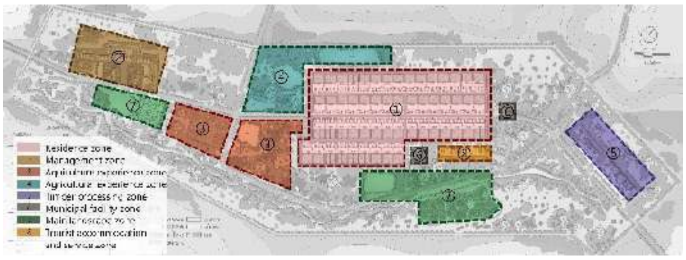

Figure.14 Resilient function partiton (Source: Author).

Figure.15 Resilient traffic planning (Source: Author).

Figure.16 Resilient landscape structure (Source: Author).

(a)

(b)

(c)

(d)

(e)

(f)

(g)

(h)

(i)

(j)

(k)

(l)

Figure.17 Present condition of Shanhe Village after the latest phase of village renovation: the river bank construction (a); the small dam construction (b); the low bridge construction (c); rare tree species statistics (d); natural river cleaning project (e); street facilities improvement (f); resident square construction (g); square seat setting (h); landscape corridor setting (i); farming experience fields development (j); tourist center and hotel construction (k); tourist center and hotel construction (k); tourist restaurant construction (k) (Source: Author).

4.2 Residential Design of the Resident Village

A demonstration residence has been built in the Shanhe Village. In the process of design, construction and application, enhancing resilient capability is always being an important content, which is mainly embodied in the following stages:

In the functional design phase, the functional pattern of demonstration residence can be converted from the fourfold mode to the double mode or the single mode, based on the diverse family structure and dynamic residential pattern of the residents (Figure 18).

In the structural design stage, a variety of environmental protection materials and energy saving technologies are integrated to construct the structural system. Among them, timber is selected as the main material, to found the prefabricated light-wood structure system. The new EPS module insulation system is selected to realize the integrated construction of insulation, structure and template. The electric geothermal heating system is chosen as the heating system to reduce heating energy consumption in winter (Figure 19).

In the construction organization stage, the construction process consists of three main stages. The construction organization mainly focuses on promoting of building techniques and generalizing of the self-construction model. The self-construction model encourages the local government to be responsible for the organization and promotion, professionals for leading technical support, and residents for participating in construction of their own accord. Finally, it took about 4 months to complete the residential construction (Figure 20).

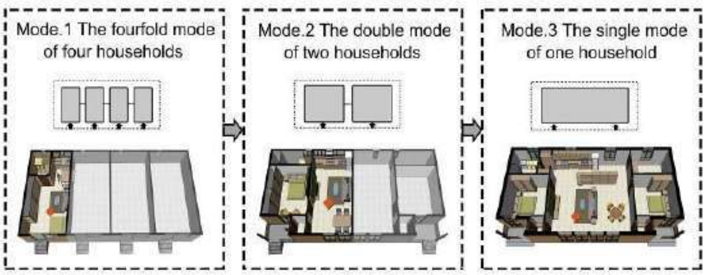

Figure.18 The residential pattern conversion (Source: Author).

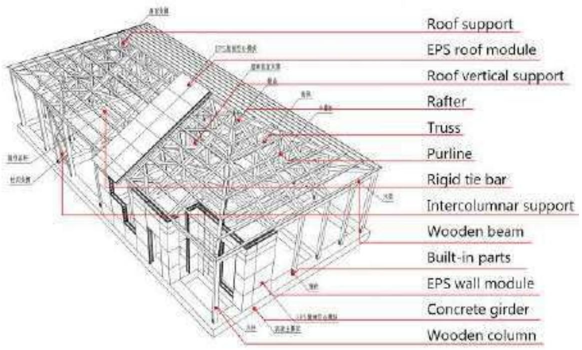

Figure.19 The prefabricated light-wood structure system (Source: Author).

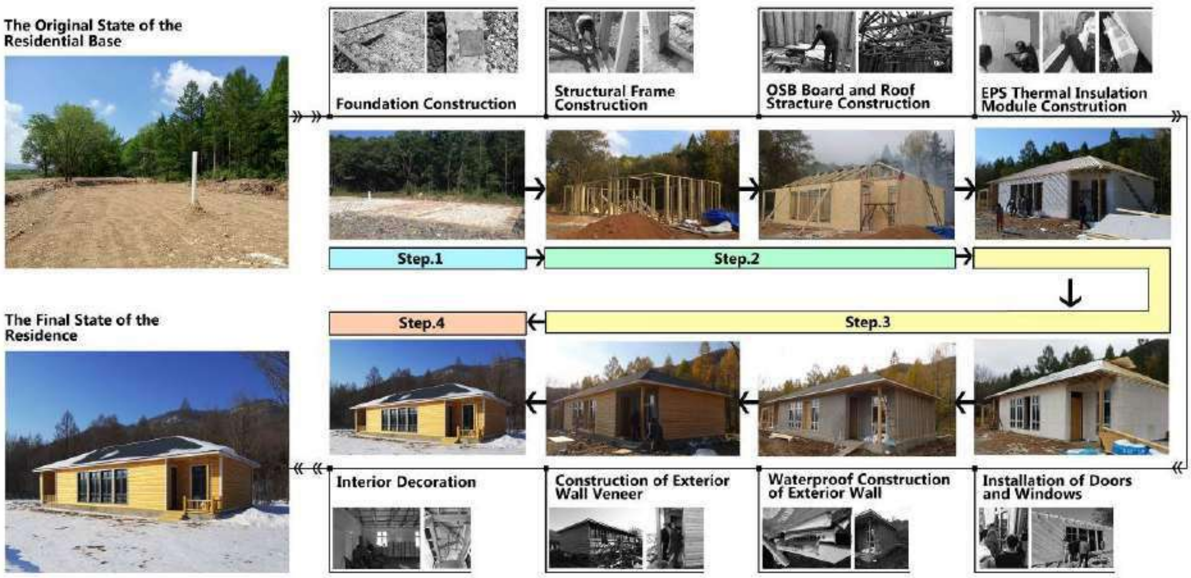

Figure.20 The construction process of demonstration residence (Source: Author).

In the testing stage, one traditional residential house in the same village was selected for comparison. During a seven-day testing in January which is the coldest month of the year, the room temperature and energy consumption were analyzed and compared of the demonstration residence and comparative residence. It is found that the average temperature and thermal stability of the demonstration residence are better than those of the contrast residence (Figure 21). Otherwise, it is confirmed that the energy consumption of the demonstration residence is less than that of the comparison residence, with the total average energy-saving ratio being 35.8% (Figure 22).

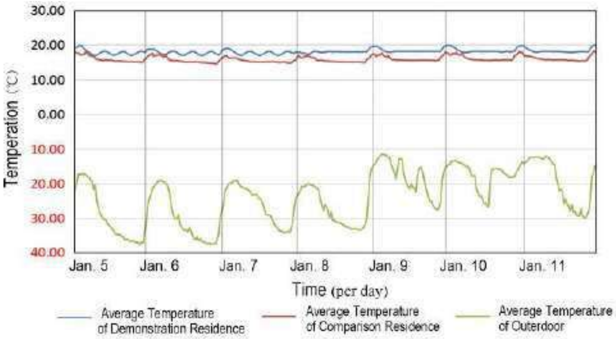

Figure.21 Comparison of average Indoor and outdoor temperature (Source: Author).

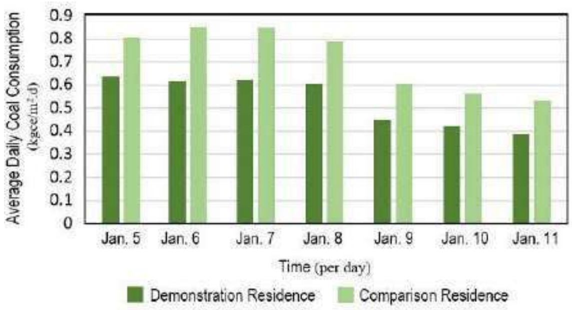

Figure.22 Comparison of daily energy consumption (Source: Author).

5. Discussion and Improvement

Based on the serial process of theoretical research, field investigation, systematic modeling and empirical research, this paper makes a relatively systematic study on the resilient village in forest areas of severe cold regions. The period of empirical research is relatively long, and the procedures are relatively complex and dynamic, according to the construction situation. So far, part of the village renovation plan has been completed, and the demonstration residence has been basically completed. Although there are still some disadvantages, the positive impact of the empirical project to Shanhe Village cannot be ignored, especially in aspects of society, economy, ecology and technology, which has promoted the resilience concept to the surrounding area as a demonstration.

By comparing the results of the empirical research with the system model of the resilient village, it is found that the resilient village system needs to be improved and revised in some aspects. For example, in the ecological aspects, it is found that local residents' awareness of environmental protection needs to be improved through systematic demonstration, and the proportion of science popularization should be increased in the ecological part of the resilient village system. In the social aspect, the system of the resilient villages need to be constantly revised and updated, according to the situation in the construction process. Therefore, the work handover of key participants needs to be properly implemented to prevent deviation from the initial target. In the technical aspect, the demonstration residence have a good guiding role for the reconstruction of endangered residence and the reformation of wooden residence. But the guidance for the reformation of general brick-concrete-structured residence still needs to be improved.

6. Conclusion

From the overall perspective, the resilient village is an systematic and dynamic concept for coping with climate change and improving the comprehensive ability of villages. For the villages in forest areas of severe cold region of China, it is necessary to carry out rational renovation planning and residential design under the guidance of resilient concepts, which also requires multi professional knowledge, support from various sides, and long-term efforts. At present, the resilient village system constructed in this paper is at the initial stage of deepening research, including qualitative research, preliminary quantitative research and empirical research. In the future, it will be a meaningful development direction to quantitative the index and to build a comprehensive evaluation system. Moreover, adhering to the resilient concepts, it is also of theoretical significance and application value to carry out the research on the expansion of the resilient village for other rural areas in special climate and ecological areas

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Using Computer Simulation to Plan and Design Traditional Dong Towns & Villages in Mountainous Areas of Tongdao, Hunan, China

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Abstract

This paper details the use and outcomes of an automated computer planning and design simulation program, using Dong towns & villages in Tongdao, Hunan as the basis for research. The planning and design program simulates the traditional "site selection" and "expansion" processes for these towns and villages, automatically taking into account the cultural customs, community structures, and spatial characteristics of the Dong people. Encouragingly, the simulation program has successfully reproduced the traditional layout and expansion manner of existing Dong towns & villages. It is considered that the use of this program will help to protect traditions and landscapes as China continues to undergo rural-urbanization.

1 Introduction

The New Rural Construction is accelerating in China (Guo, J. Z. and Li, K. 2006). Therefore, how to protect the towns & villages' traditional cultures and rural landscapes has become a hot topic (Feng, J. C. 2013), in the face of large-scale relocation and resettlement of towns & villages. It is difficult for traditional planning and architectural design institutes to systematically research the traditional cultures, architectural forms and geographic information of varied towns & villages, due to the short design cycle and limited manpower (Figure 1).

Figure 1: Damage to the rural landscape by simple and crude planning and design. Image Source: https://www.worldphoto.org/zh/node/1549

This paper introduces a new rural planning and design program that can computer simulate the traditional "site selection" and "expansion" process of small towns & villages in China (Figure 2). We have used the Dong nationality (Figure 3) in Tongdao, Hunan, as the research basis. The simulation is structured around the traditional cultures, spatial patterns and geographical environment information of Dong towns & villages. The program can be used to assist in the protection of rural cultures and landscapes in light of rapid urbanization of the rural landscape.

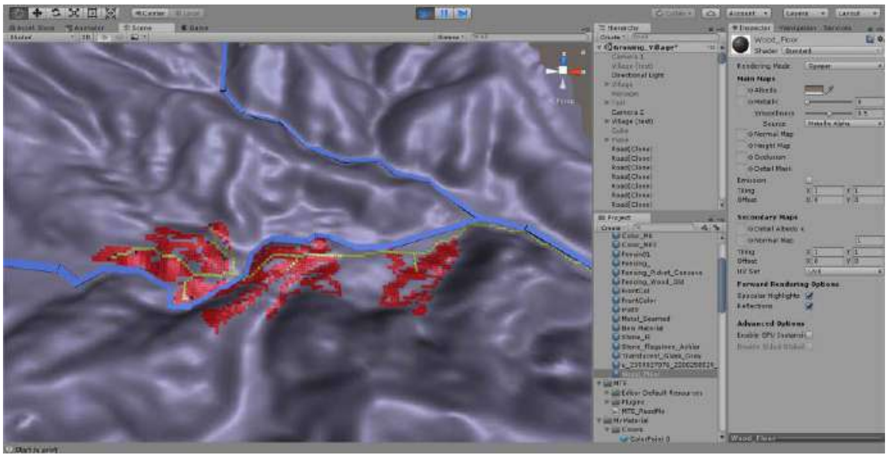


Figure 2: A town pattern created by the simulation program (with the main menu).

Figure 3: Representative examples of Dong towns. Image Source: https://www.gettyimages.co.uk/detail/photo/dong-minority-girl-royalty-free-image/168505385

Tongdao is located in the southwest of Hunan province, China, bordering Guangxi and Guizhou province, and is one of the major settlements of the Dong people. Located in the mountains and physically isolated from major centers of population, Dong towns & villages are less influenced by Han culture and customs. As a result, the traditional culture and ethnic characteristics of the Dong people are well preserved through the distinctive built character and design of their settlements. The Dong nationality is the most "architectural" nation among the ethnic minorities in China (Liu, S. 2008).

The Dong people have a unique social organization and town structure. The traditional Dong society is mainly composed from the bottom up of families, ethnic groups, clans, villages, towns and grand towns (Figure 4). Towns in the same area comply with the same local law "Kuan" to form an alliance. The layout of the Dong towns & villages is significantly affected by this social structure, where clan inhabitants form a clustered layout around a traditional drum tower (further detailed in Section 1.4).

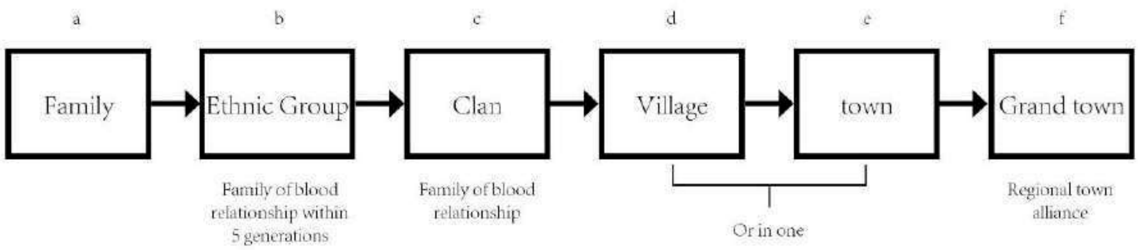


Figure 4: Social structure of Dong nationality. Image Source: Cai, L. 2013 (redrawn)

The cultural characteristics of the Dong towns & villages are unique, well-kept, and clear in organizational structure, which are characteristics that are conducive to being input into a computer simulation.

2 Background

The use of computer simulations in relation to human settlements has become more common in recent years. For example, Parish and Müller proposed a user guided city-generation based on an L-system (2001). Weber et al. developed an interactive geometric simulation of 4D cities (2009). Vanegas et al. presented an interactive dynamic system for the design of urban spaces using geometrical and behavioral modeling (2009). Emilien discussed village growth simulations on arbitrary terrains (2012). Beneš et al. demonstrated procedural modelling of urban road networks (2012). Batty simulated the urban form of a randomly established tree structure (2009). Leach established the concept of "group intelligence" to generate swarm cities (2009). PanahiKazemi and Rossi applied computational strategies for intervention in informal settlements (2014).

The pattern of human settlements are most often related to geographical conditions, nationalities, and cultures. Therefore, a simulation could be meaningful only if it captures the specific local geographical, ethnic characteristics, and cultural customs. By studying the site selection, growth and expansion of Dong towns & villages, the simulation program tries to extract the "genes" of the traditional Dong settlements and simulate it in a way that meets the traditional context and is compatible with the local environment.

3 Simulation Procedures

1.1 Overview

The author conducted a field survey of 13 Dong towns & villages in Tongdao (Figure 5, Table 1). Among them, there are 4 mountain-type towns and 9 riverside-type towns.

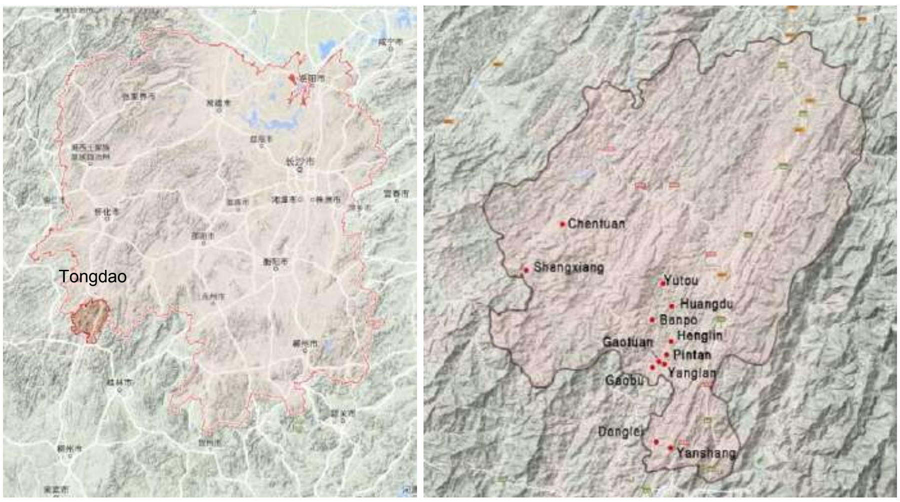


Figure 5: Location of Tongdao in Hunan province (left), distribution of the surveyed towns in Tongdao (right). Image Source: Google map (redrawn)

Table 1: Surveyed villages sorted by type

Mountain-type				Riverside-type				
Yutou	Yanshan	Banpo	Gaobu	Huangdu	Pintan	Gaotuan	Shangxiang	Donglei
				Hengling	Yanglan	Zhongbu	Chentuan	

A comprehensive statistical analysis of the Dong towns in Table 1 is conducted through related paper reading, field investigation, aerial photography, three-dimensional model reconstruction and CAD drawing. The results of this analysis are then used to establish the towns & villages' site selection, growth rule formulation and parameter settings, which can then be input into the computer simulation.

The main contents of the simulation program can be divided into four parts: environmental analysis; site selection & assessment; selection of the first drum tower site; and selection of new drum tower sites and settlement expansion.

1.2 Environmental analysis

1.2.1 Classification

Farmland is an important factor that affects the layout of towns & villages. Farmland located in flat valleys close to a river is a basic principle that forms the foundation of the layout of Dong towns & villages. By observing the layout of farmland and buildings in different types of towns, the author divides the Dong towns & villages into two terrain types: the mountain-type and the riverside-type (Figure 6). In mountain-type towns & villages, all flat valleys close to the river are primarily used as farmland, and housing will traditionally be located on gentle slopes at the foot of the mountain. Riverside-type towns & villages are usually located in wide, flat areas nearby a river. Having abundant flat land for farmland, housing will usually be located in the middle of the plains. Due to flood control considerations, housing is often kept at a distance from the river, and will form a clustered pattern surrounded by farmland.

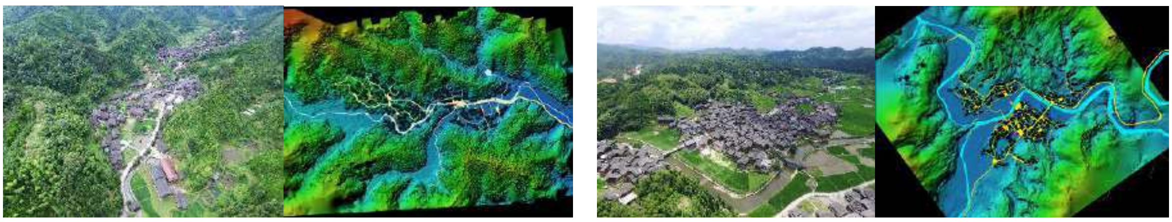


Figure 6: Mountain-type town Yutou (left) and riverside-type town Gaobu (right). Image Source: self-photographed and self-drawn

Therefore, the simulation program will first perform a slope analysis of the terrain to determine its type and will then use different slope and altitude parameters to perform an environmental assessment according to the different terrain types.

1.2.2 Analysis

The Dong people live on rice farming and plantation forestry (Cai 2013), therefore, the basic principle of site selection is being close to a mountain or river. From the cultural point of view, the Dong people inherited the remains of the ancient Baiyue culture, namely the tradition of "being in the valley, among bamboos," and " mountain and water". This is because rice cultivation requires a source of water, and the mountain can provide wood for the construction of houses, while providing space for plantation forests and terraced fields (Cai 2013).

Mountain and water are the most important influence factors for Dong towns & villages. The program simulates the influence of mountains and water resources on the site by analyzing the hydrophilicity, elevation, slope, and geographic dominance of the given terrain (Figure 7).

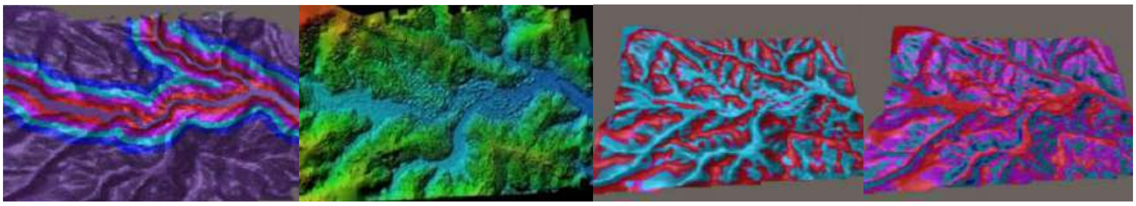


Figure 7: Yutou town's hydrophilicity, elevation, geographic dominance and slope analysis

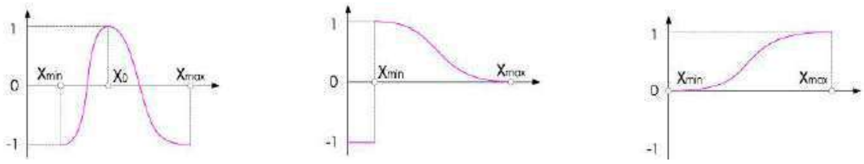


Figure 8: From left to right, function of slope & elevation, hydrophilicity, geographic dominance

The results of the environmental analysis are reflected in a scoring function at each point ("P") of the terrain model. Each point has a score range of -1 to 1. Negative numbers indicate sites undesirable for selection, and positive numbers indicate sites ideal to be selected. There are different functions for different environmental criteria to obtain the corresponding scores (Figure 8). x_{min}, x_0, and x_{max} are parameters set according to different function. x_{min}, x_{max} represent the maximum and minimum values of an environmental factor. The x_0 value represents the ideal value. Finally, the program combines various criteria scores with different weight factors. From these results, we can choose the area ("G_0") that is geographically suitable for the location of the village or town (Figure 4). However, the area obtained at this stage is not the final site selection area, but rather a collection of all possible site selection areas of the terrain model (Figure 9 and Figure 11). In the next step, we need to determine the first village (Figure 4d) that forms part of the town. The area that best suits the Dong culture will be selected from area G_0.

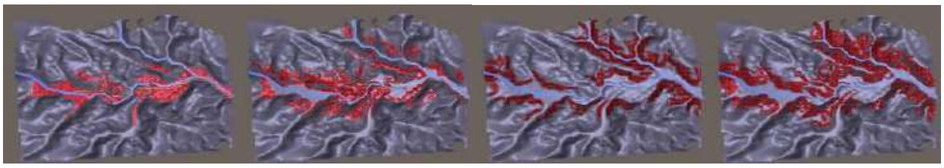


Figure 9: Influence of slope on site selection. x_0 value: 0, 15, 30, 45 degrees (from left to right)

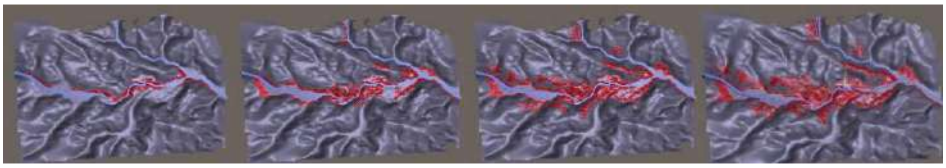


Figure 10: Influence of hydrophilicity on site selection. x_{min} value: 40, 100, 160, 200 meters (from left to right)

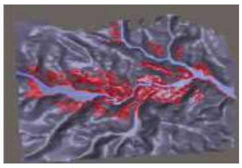
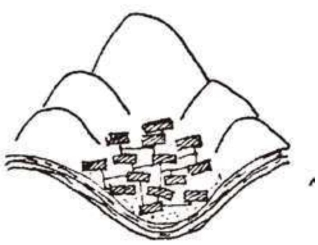


Figure 11: Influence of elevation in site selection. x_0 value: 280, 400, 520, 760 meters (from left to right)

1.3 Site Evaluation

Environmental analysis is objective based on the influence of slope, hydrophilicity and elevation. However site evaluation will also require consideration of emotional and cultural factors. The site selection of Dong towns and villages follows the “Fengshui” concept similar to that of the Han nationality. Song identified (2016) that traditional settlements of the Dong people are mostly built with the characteristics of “sitting west, facing east, leeward to the sun, facing water and backing to the mountain”. As most Dong people live in mountainous areas, with constrained direct sunlight, and little airflow, facing east is conducive to receiving sunlight in the morning for the purpose of heating. Zhou mentions (2008) that ancient towns & villages in west Hunan are usually settled on the side of the mountain that is embraced by a river, which is the “lucky side” in the native “Fengshui” concept, while the opposite side is the “unlucky side”. Flood control is another important factor that influences site selection (Figure 12). Cai summarized (2013) that the ideal site of a town based on the “Fengshui” concept is with its back to the mountains, with “guarding” mountainous areas to the sides, facing a flat and wide plain, embraced by river, and that the downstream of the river should bend.



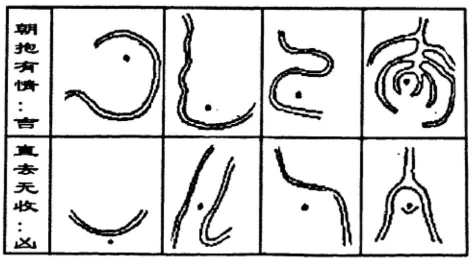


Figure 12: Ideal site selection (left), lucky (right upper) and unlucky (right lower) river side. Image Source: Zhou, T. 2008

In summary, the best site location for the Dong people would be a town located on the south-east side of a mountain, facing a flat and wide plain, embraced by river. At the same time, a large enough site area is necessary for future development. Based on this logic, the program selected the area G_1 from G_0 as the first village site of the town (Figure 13).

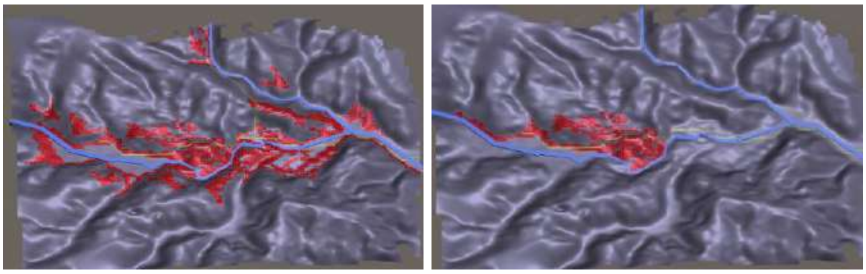


Figure 13: All possible site selection areas G_0 *(left), and the first village site area* G_1 *(right)*

1.4 Organizational Structure of Dong Villages and Towns, and Drum Tower Siting

Several clans (Figure 4c) cluster together around a drum tower to form a village (Figure 4d), and several villages will form a town (Figure 4e). This is the basic organizational structure (Figure 4) followed by the Dong people. Drum towers are a symbol of the political and cultural center of Dong towns & villages, and are an important meeting place, including for festivals and daily life of the Dong people. During times of war, drum towers are also important buildings for defense and transmission of information between nearby Dong villages. Drums placed on the tower would be knocked to summon clan members (Cai, L. 2013).

After the simulation program determines the suitable area for the first village, the next step is to locate a drum tower. Based on the core position of the drum tower, the most common location is at the center of the village. As a defense building, a drum tower needs to be situated in a position that can overlook the village. Therefore, riversides and main entrances are also common site selection locations. Among 32 drum towers the author visited (Table 2), there are 15 located in the village center, 13 located on the riverside, and 12 located at the village's main entrance, with a probability of approximately 4:3:3.

Table 2: Drum tower statistics

Type	Name of town	Name of drum tower	Location factor*	Distance to the nearest drum tower (m)	Number of houses attracted	Influence radius (m)
Mountain-type	Yutou	Longshi	ME	105	40	108
		Yashang	RS	105	52	83
		Lushen	C, RS	98	56	104
		Tianzhong	C	98	25	94
	Banpo	Zhaiqian	C, RS	108	55	155
		Banpo	C	108	57	137
	Yanshang	Zhongxin	C	NA	35	126

	Huangdu	Touzhai	ME	32	50	84
		Weizhai	ME	32	52	77
		Chongyang	ME, RS	54	47	103
	Henglin	Zhaimen	ME	125	50	91
		Hebian	RS	125	58	81
	Pintan	Zhongxin	ME	NA	85	100
	Yanglan	Zhongxin	C	59	40	80
		Yanglan	RS	59	57	74
	Gaotuan	Cuntou	ME, RS	75	26	62
		Zhongxin	C	70	33	56
		Cunwei	ME	70	24	48
Riverside-type	Gaobu	Shangtun	ME, RS	119	67	88
		Yangtian	C, RS	131	47	96
		Longxin	C	95	84	74
		Hebian	RS	95	77	102
		Cunkou	ME	114	67	89
		Yanzhai	C	114	43	87
	Zhongbu	Zhongxin	C	100	64	103
		Xinzhai	ME	100		
	Shangxiang	Shangxiang	C, RS	NA	79	104
	Chentuan	Lao	C	101	75	118
		Xin	C	101	68	127
	Donglei	Lao	C	97	163	193
		Zhaimen	C, RS	97	78	112
		Hebian	RS	192	62	132
Averages				96	59	99

*ME: Main Entrance; RS: Riverside; C: Center

1.4.1 Siting the first Drum Tower

We can use the following steps to calculate the position of the first drum tower. 1) Calculate center of mass of G_0 area, to get point A (Figure 14a). Then find the nearest riverside location B from point A (Figure 14a). 2) Generate a path L (Galin et al. 2010) from A to the outside point of the village (predefined). The intersection point C between L and the G_0 area boundary is the main entrance location of the village (Figure 14b). 3) The drum tower location is determined by the probability of 4:3:3 among points A, B, and C. When located at elevation, it will have the advantage of good outlook for purposes of defense. We adjust the location by "geographical domination" analysis (Figure 14c). 4) Based on the results of this analysis, better defensive positions of A_1, B_1 and C_1 are selected within the search radius (Figure 14d).

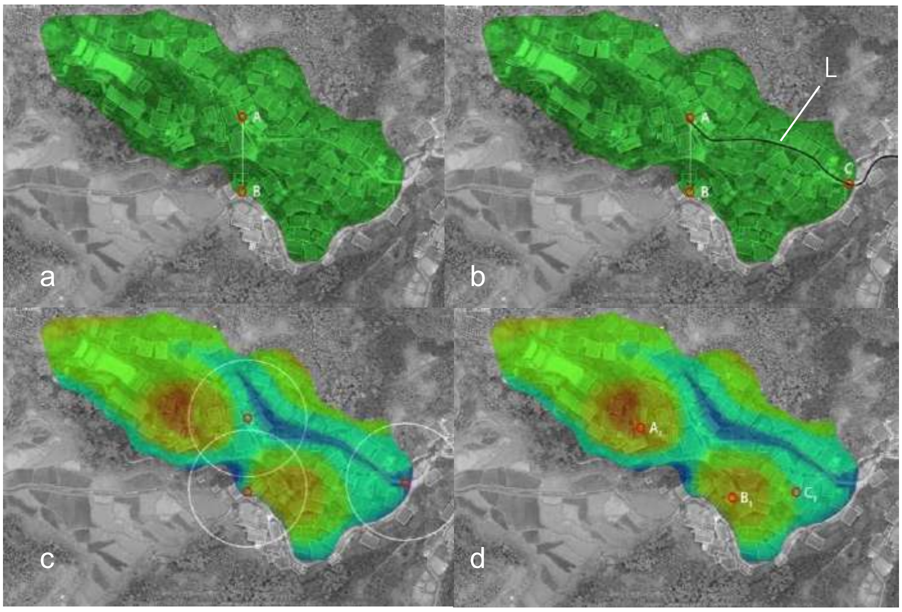


Figure 14: The process for selecting the location of a drum tower

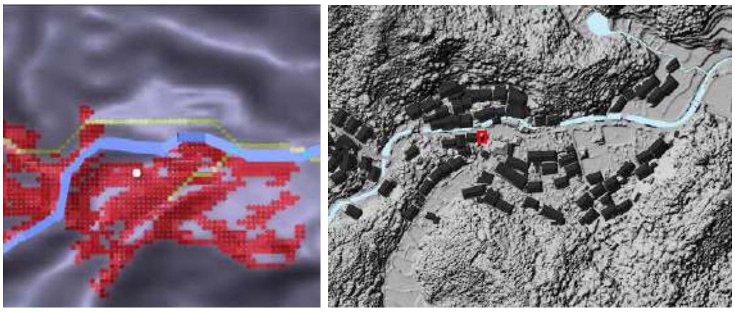


Figure 15: Comparison of simulation result (left) with real position of the drum tower (right)

1.4.2 New Drum Towers & Settlement Expansion

The expansion of a Dong town (Figure 4e) will involve the birth of a new village (Figure 4d) and new drum towers. Culturally, a drum tower is like an invisible magnet, which attracts a cluster of clan (Figure 4c) houses around it. The "magnetism" of a drum tower to attract clan houses weakens as the distance increases. Thus, a Dong village will have a maximum physical area. Any exceedance will eventually lead to an end to v illage expansion. This will usually result in some clans separating from the original village and building a new drum tower nearby, around which a new village will be established (Figure 16).

Figure 16: "Magnetism" radius of drum towers in Yutou town (left), and Gaobu town (right). Image Source: self-drawn

The results in Table 2 show that the “magnetic” radius of a drum tower is fairly regular, being on average 100 meters, and attracting approximately 60 clan houses.

The relationship between Dong villages can also be drawn by analyzing the location of the neighboring drum towers. For the purpose of local alliances, mutual defense and signal transmission, the neighboring drum towers are usually not far from the others, with an average distance of about 100 meters. When villages are located on both sides of the river, a new drum tower is usually sited on the riverside or in highlands for enhanced signal transmission (Figure 17).

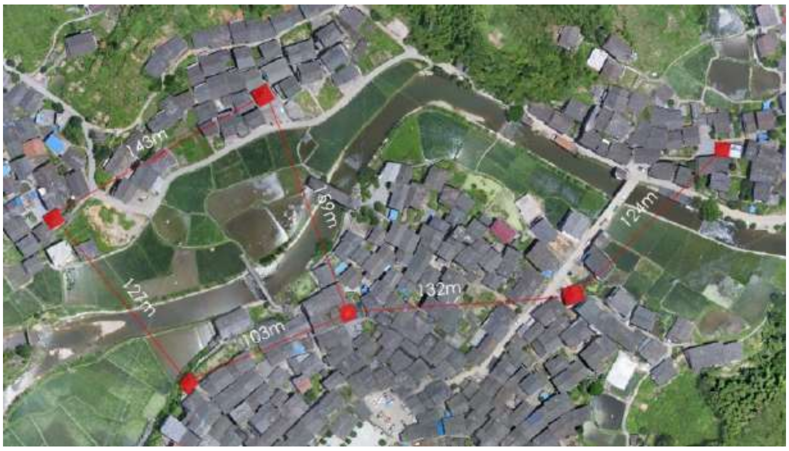


Figure 17: Drum tower network locating on both sides of the river

The program uses a drum tower network-based expansion method, based on the data collected on the “magnetism” of existing Dong village drum towers. The search area for a village is roughly an annular zone centered on the first drum tower (Figure 18a). The program calculates the intersection of this ring-shaped area with the G_0 area and selects the block with the largest area. This will then indicate the initial area of the new village G_{2a} (Figure 18b). We set the center of mass of G_{2a} as the initial position of the new drum tower and calculate the intersection of the G_{2a} region with the tower’s likely influence area. This then allows us to draw the expansion zone of the new village, represented as G_2 (Figure 18c-d).

Using the same site selection principles as the first drum tower, such as center of village, riverside, main entrance and physical elevation, we can determine the final site of the new drum tower from the G_2 area.

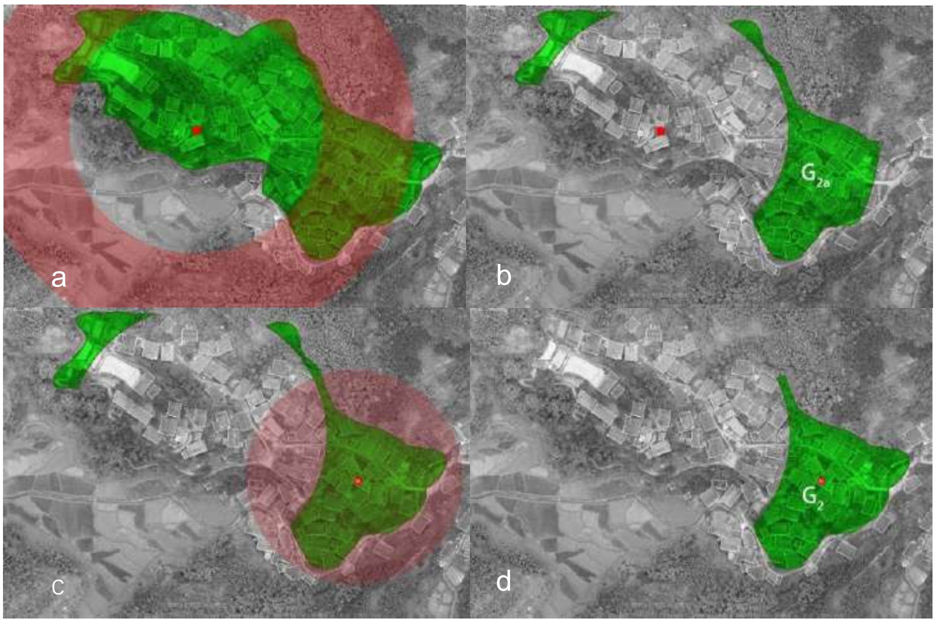


Figure 18: Site selection process of new village.

4 Results

The simulation program introduced in this paper has been used to analyze the site selection and expansion of D ong towns & villages throughout Tongdao, Hunan. The fol lowing functions are implemented:

1. Through a comprehensive analysis of the env ironment, appropriate village and town sites can be selected. Different location strategies can be adopted for different terrain types (Figure 19).

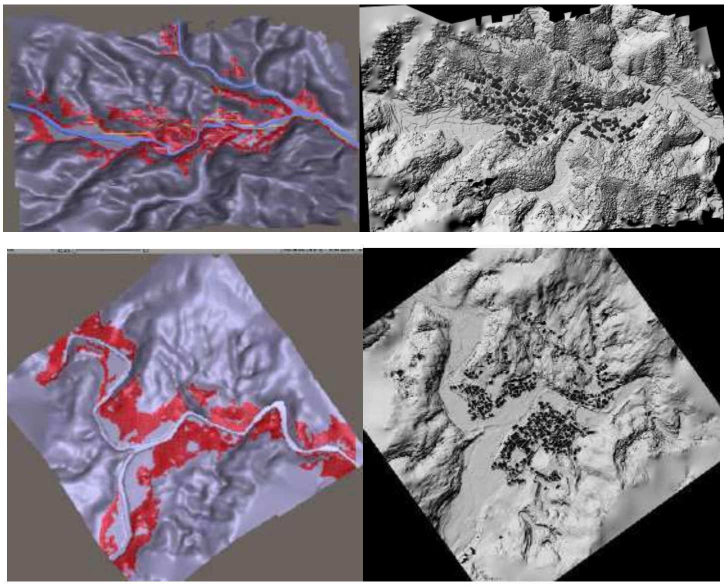


Figure 19: G_0 area of mountain-type town mainly located in sloping land (top-left), while riverside-type mainly in flat land (bottom-left), real layout of Yutou town (top-right), Gaobu town (bottom-right)

2. Cultural factors of Dong site selection can be added to the simulation by applying the traditional “Fengshui” concept to the evaluation process. The site that suits the “Fengshui” concept can be selected from all possible site selection areas to determine the location of the first village (Figure 20).

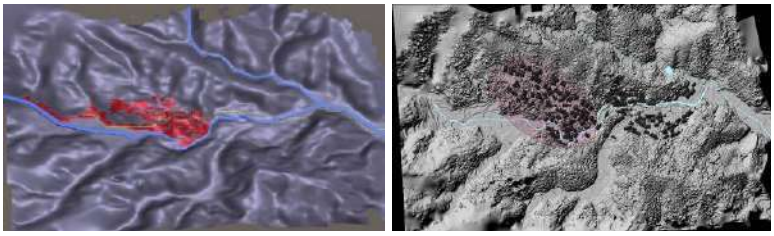


Figure 20: Program selected G1 area (left), first actual village of Yutou town (right, marked in red)

3. The ideal location for a drum tower can be determined through analyzing the village area (Figure 21).

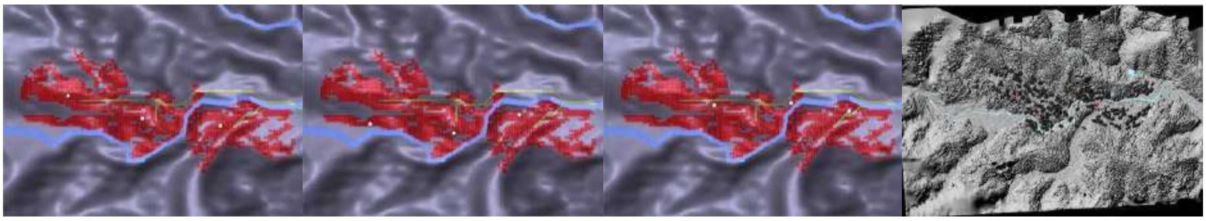


Figure 21, left-to-right: Location of Drum Towers with key factors of center of mass, riverside, main entrance, and the real drum tower’s location (marked in red)

4. The expansion of the Dong towns can be simulated through the growth of new villages and determining the location of the new drum towers (Figure 22).

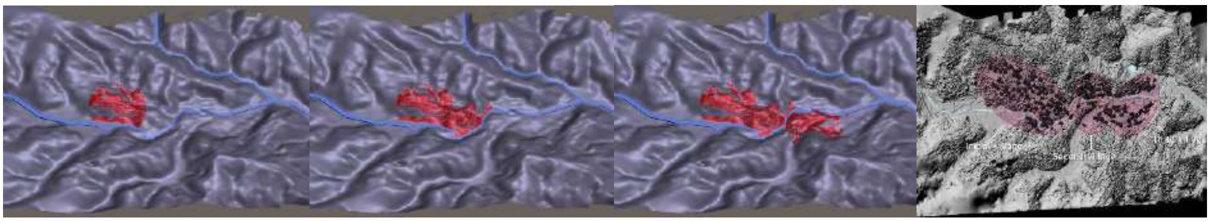


Figure 22, Left-to-right: Simulation of first, second, third villages and the real layout & sequence

5 Conclusions

This paper has detailed a novel planning & design program that can be used to simulate the establishment and growth of Dong towns & villages, through automated “site selection” and “expansion” planning based on varying terrain types. With appropriate inputs based on an analysis of existing, traditional growth patterns, the program can successfully reproduce the layout and expansion sequence of existing Dong towns & villages.

However, the use of this program is not limited to the replica simulation of existing traditional towns and villages, but can be used to guide the planning and design of new rural settlements in China, in a way that captures and preserves culture and history.

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Planning for the north-European waterfront cities – issues and strategies

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1. Introduction

Redeveloping urban waterfronts is nowadays a part of planning agenda or already implemented practice in many (if not most) of the cities worldwide. Even in case these projects are not fully implemented yet, a number of the successful examples can be identified [Breen, Rigby, 1994] [Breen, Rigby, 1996]. Since the phenomenon of waterfront redevelopment is a subject of interest of many scholars, a number of the analysis of this was developed. These included such the issues as generation of the waterfront project, various types of those as well as in-depth analyses of the most appealing case studies [Schubert, 2002], [Bruttomesso, 1993].

Within these cases tourism development was identified as one of the major driving forces for many of those projects. But tourism depends to some (if not to large) extend on climate realities and associated with these issues. Therefore, these have to be taken into account while considering the design and functional solutions of these structures. Another issue is associated with the attractiveness of the waterfront itself – and it depends (among others) also on the size and attractiveness of the “host city” itself.

Within this paper the specifics of small-and medium-sized waterfront cities, located outside the “climate comfort zone” are elaborated. Within this group the special attention was paid to the cities located in the northern Europe. Usually these are small and medium –sized municipalities, rarely aspiring to become the leading centers of urban development in their respective countries. At the same time their economy was traditionally based on fishing, small-scale maritime industries and local trade. In addition, in many cases these cities are not extremely attractive for mass tourism and are located aside from major transportation routes. Therefore, it seems necessary to rethink the “urban waterfront development pattern” within these sites, as the strategies based on copying the solutions known from larger cities cannot be effectively used.

2. Waterfront redevelopment as the global success story

Redevelopment of urban waterfronts is one of the leading themes in contemporary planning practice. This issue is a subject of interest to many scholars and practitioners, associated with development of waterfront cities. In literature on this topic one can find a lot of information regarding leading examples of this process, discussion of issues and problems associated with this phenomenon as well as analysis of the results achieved [Lorens, 2013]. In addition, many specialists in this field managed to developed a sort of “guide of good practice” for cities and planners interested in undertaking an effort associated with reshaping the waterfront site [Interreg II-C, 2002]. But one can easily spot that most of the cases discussed are based in climate zones allowing extensive public use of the waterfront sites for the most part of the year. In addition, most of the appraised cases are located in the relatively large cities, which allowed development of the diversified urban program and extensive networks of public spaces. Therefore, the phenomenon of waterfront redevelopment is frequently associated with extensive development of large scale urban structures, in the climate realities allowing extensive public usage of these.

This process has been pioneered by such cities as Baltimore, Boston, London, Liverpool, Oakland, Seattle, and San Francisco. The transformations of water-based areas in these cities began as early as the 1960s. In that period was the building of the famous Sydney Opera in the early 1970s, as well as the Paseo del Rio in San Antonio, Texas. However, it was the Inner Harbour project in Baltimore that played a significant role, being the template for many other ones, e.g. Darling Harbour in Sydney. This similarity goes yet further than the principles for the realization of transformations (in the functional sense), but embraces also the cooperation between public and private sectors that leads to the realization of these projects. Generally speaking, the beginning of the transformations of the former port areas occurred in the United States, (Boston, Baltimore) and blazed trails for other centres [Lorens, 2014].

3. Complexity of urban waterfront regeneration

The revitalization of waterfronts is a complex process of many dimensions, considering the scale of issues it embraces [Brenn, Rigby, 1994] and includes the following:

Economic dimension: the transformation of traditional industrial domains is its main element, realized by such means as the introduction of new technologies and the relocation of factories beyond traditional industrial zones[1]. In effect, changes in the economic structure of cities appear, including the disappearance of traditional forms of production and processing. Hence, the new projects carried out in the areas close to water prove helpful in the economic regeneration of a city thanks to the creation of new domains of entrepreneurial activity and the creation of new work places in the service sector, etc.

Social dimension: social changes – including the growing wealth of societies – foster the interest in tourism and increase the needs for recreation. The notion of *cultural tourism* appears. It denotes the emphasis put firstly on the use of cultural values of a given site, being linked to the raised interest in local colour and the need for learning about a given place, as well as on experiencing different cultures and customs. It is also linked to the increasing sense of identity of local communities, expressed by such things as the cultivation of tradition and local customs, including those concerning water, the port and the sea.[2]

Environmental dimension: Since the 1970s, the urge to protect environmental values of valuable places has been increasing, along with the growing interest in removing pollution from degraded sites. The programs for the purification of reservoirs, also in harbor and industrial areas, are the best examples of this urge. Purity of water is an important factor in the revitalization of waterfronts and can largely determine the success or failure of the whole undertaking. The same pertains to the purity of the soil. If the land is polluted (because of former industrial activity) its purification becomes a prerequisite, which the initiators of the functional and spatial transformation project must undertake;

Cultural dimension: the protection of the historic heritage of cities, including the elements related to their identity has also been enjoying the increased interest of both public sector and urban communities. This is particularly related to the preservation of maritime tradition, expressed by cultural undertakings and a respect for particular sites shown by their refashioning alluding to local history. Of chief importance here is the revitalization of old buildings related to the harbour tradition in such a way that their adaptation to new functions can preserve the basic elements of their former design.[3] These buildings, when suitably incorporated into the new urban structure, can even work as catalysts in the development of new urban programs. The return to tradition and cultural values of former harbours is also expressed by the creation of open-air museums, the development of educational institutions (like museums or marine aquaria), and finally, the creation of new objects that develop relations with the former structures of ports both in their scale and character. They serve not only commercial purposes but are also a specific kind of depository of the collective memory of the local community, encompassing the history of former harbors and people related to them [Edwards, 1992]. These tendencies have provoked a crucial turn in the paradigms of urban planning, previously dominated by a heritage of modernist urban planning from the 1950s and 1960s.

It can be observed from the above examples that water-based areas have been transformed all over the world and that – in each case of the transformation program – an array of issues had to be taken into account. But – at the same time – it seems to be possible to define a number of key types of waterfront redevelopment patters. These may constitute a general typology of waterfront transformation schemes.

4. Key types of waterfront redevelopment patterns

The analysis of regeneration programs introduced in degraded waterfronts in port-cities may include a number of issues. Among the most important ones one may identify such the issues as: role of a project in the city structure, functional program of the project, attitude to the cultural heritage of the city as well as realization strategy adopted. These issues are presented in more detailed way in the following parts of this chapter.

4.1. The role of a project in the city structure

A different definition of a project within the city structure can be formed, depending on the scale and character of a given project:

- **a project of a significant role for the structure and functioning of the city** – this denotes first these ventures which aim at more than the solution of the problems of degraded post-harbour areas and the creation of the new quality of urban environment. Therefore, the basic elements here are the facilitation of city life and the creation of opportunities for the economic development of the city, along with the significant new residential areas and a great concentration of work places. As an example one can quote the **Canary Wharf** in London which has considerably changed the structure of the city causing, among others, shifts in main spatial arrangements;
- **project of minor importance** which do not significantly change the mode in which the city functions. These are small projects, addressing only fragments of degraded urban structures. Among the examples are **Rowes Wharf** in Boston, *South Street Seaport* in New York and particular elements in the revitalisation of the old ports in Barcelona and Genoa.

Certainly, the scheme for a given revitalisation program can be a mixture of different types. Basically, there is a combination of a single or two big projects – called the leading projects – with a series of supporting actions which are only the support and aid for the main one. A classical example of such a program are London Docklands, where the *Canary Wharf* was the main project, realized within the assumed framework and was surrounded by many smaller ones of marginal significance.

However, a slightly different situation happens in many cases. The transformation program is built from a bunch of minor projects. Yet then there is no feeling of the "new quality" being created in the waterfront area of the city and this may affect the success of the venture. The examples of such types of program can be found in Boston, San Francisco, Barcelona, and Genoa. Obviously, sometimes, certain programs became more significant than others, yet they did not gain a clear dominance in the functional and/or spatial structure of the cities.

4.2. Functional program of a project

The projects realized in the framework of waterfront transformations in cities have a very diversified functional program; therefore, some of the projects are determined as to their specific role and location in the entire structure of transformation. The following groups can be enumerated here:

Commercial projects – related to the development of downtown functions, especially service program; these can be divided into two categories:

- ***festival marketplace*** – the introduction of a commercial programme addressed to a wide public, such as shops, restaurants, entertainment, safeguarding the vista to the water, space for artistic appearances and extensive public space, i.e. the combination of places of catering and shopping with opportunities for socialising, all of this being a concentrated enterprise. The superior goal here is the creation of a specific *genius locii* as a magnet attracting people to spend time in a carefully created space. The concept of the "festival marketplace", invented by James Rouse from Rouse Development Corporation and designed, among others, in Baltimore by Benjamin and Jane Thompson, was incorporated especially in American programmes for the transformation of degraded port structures. This is linked to the lack of the European-type public spaces in American urban structures. Thus, the "festival marketplaces" served as the surrogate of such European marketplaces and blazed trails for another phenomenon, namely, artificially created urban spaces.
- ***mixed-use projects*** are multi-function structures, with a large participation of commercial and service functions, alongside a considerable office, hotel and residential programs.

Cultural, educational and environmental projects. Urban waterfronts have always provided unique placement for religious architecture, monuments, public art and big public institutions. This practice is continued today. For instance, the symbol of the post-war Australia is the opera house in Sidney, located on the Bennalog promontory. Similar, contemporary waterfront buildings often become city symbols, as Osaka Aquarium does. Waterfronts are also a logical location for the buildings which testify and document a marine heritage of a city, for example: marine museums (e.g. in Auckland and Stockholm) and historic ships mooring nearby. The buildings of these museums themselves can be significant symbols in these cities' structures as *Suntory Museum* in Osaka is (1994). However, the prerequisite for enterprises like that is the purification of water in the waterfront area. Beside symbolic and aesthetic values, these sites have also an educational value; they inform the public on the importance of water in our life and serve as the source of knowledge

– especially for young people – about environmental interdependencies governing our life. As an example, one can quote here huge marine aquaria the construction of which became the starting point for many revitalisation programs on many post-harbor areas (Boston – 1969, Baltimore – 1981). They have an exceptional power to both fascinate and educate people and are one of the most interesting examples for contemporary port-cities.

Recreational projects, An important role of waterfronts is providing leisure for its users and inhabitants. This is realized in various forms: angling, swimming, sailing, quiet musing, etc. Thus, new parks, public spaces, promenades, marinas, children playgrounds and vantage points are being created. It seems safe to presume that recreational areas with related cultural functions will dominate new waterfront projects, taking into account catering and shopping facilities, addressed to the clients of these recreational areas, aimed at the strengthening of "the waterfront experience".

Residential projects. People have lived on waterside for centuries, both for practical and aesthetic reasons. Living next to water is today so attractive that developers will quite often create artificial little lakes and ponds, to later build new residential houses around them. It is an axiom of the real-estate business that a plot near water is more expensive than a similar one, lacking water in the neighborhood. Despite the threat of hurricanes and floods, people are still building their shelters in waterside areas. The increasing demand for houses near water is an important element of the waterfront phenomenon. However, due to the fact that a house – a private space – is located on water – a public space (in a sense) tensions between these two worlds appear. When a given waterfront object is well-devised and carefully executed, a direct vicinity of water is guaranteed to the wide public and the waterside passages and boulevards become attractive and inviting. Unfortunately, an untoward tendency to separate the area from its surroundings in some residential waterfront projects has appeared, especially considering expensive luxury flats. Consequently, fencing and sentry boxes appear to create an impression that a given waterside area belongs to residents and trespassers are really unwelcome. A demanded effect can be achieved by, e.g. the introduction of a certain number of subsidized social flats, as was done in the *Entrepot West* project. The style of the development of such planes depends on location very much.

Industrial-and-port constructions. Many of the most fascinating waterfronts in cities are related with ports functioning still and operating transportation equipment on their premises. A port view with its huge cranes and ships mooring at quays is very attractive. While many of the port functions are now being carried out on the peripheries of urban structures, some have still remained in the city centres; examples of this are Oakland, San Francisco, Hamburg, Rotterdam. Heavy industrial installations, small factories, sewage processing plants, bridges and passenger terminals – all these institutions are located on waterfront land and sometimes render great influence over the shape of the whole waterside area of a city. Other elements here are small enterprises and firms linked with port sites for years, even centuries, which are situated in the direct vicinity of city centers. These institutions create a more diversified and authentic image of a given waterfront. Looking at this issue from a strictly economic point of view, such functions as marinas, boat building workshops and small shipyards, bases of fishing cutters and other objects may easily be replaced by more intense commercial functions. Therefore, they quite often leave their old location in the search for cheaper land or, even, cease their activity. Industrial users of waterfronts, especially the larger and more significant ones will remain; however, cities enjoy the possibility of making their installations more attractive, making them an attractive element in the project. In case of small marine businesses, the decision is more complicated: should one interfere to preserve these small enterprises or should one let them go. This type of enterprises, although not so spectacular as large commercial ones, offer work places, anyway, employing unqualified people, and retain the maritime character of a given local community.

4.3. Realization strategies adopted

The kind of land use in waterfront areas is based on the type of realization strategies adopted. Although, it may be possible to identify three key approaches: creation of **new physical spaces;** use of **cultural heritage spaces** and revitalization of **the space for a local community**. But – despite the adopted mode of intervention – it appears that revitalization programs for post-harbor areas usually embrace a series of single investment programs, filling the entire structure of the post-harbor area. Quite often, still abandoned and degraded areas can be neighbors to already completed projects. The projects themselves are of a different scale and character and they perform different functions in the structures of their cities. However, the rule is that they complement each other and make defined functional and spatial relations.

Still, one can distinguish certain characteristic modes of behavior:

- The entire regeneration process is based solely **on individual ventures**; in this instance there is no common idea to link them. As a result, we obtain a rather haphazard set of investment projects, often conflicting with each other in function and space. Therefore, the success of such a venture is rather doubtful. A classical example of this is the Manhattan waterfront in New York.
- Comprehensive revitalization programs are prepared and they assume the considered transformation of the entire post-harbor areas. This has a double dimension: the revitalization (in the sense of organizational and financial structures, along with the working mode) and the design. In this particular case, entire districts are subject to an all-embracing design, which tackles the whole of the architectural and urban form. This is the case with Amsterdam.
- The entire process is divided into smaller autonomous investment tasks within the framework of a general concept. This is an intermediate type of regeneration, assuming a common general regeneration scheme, embracing the realization of necessary infrastructure investment within the entire area (financed from public funds) and then, individual schemes are applied to defined projects, financed and designed according to their own schemes. Examples: London, Genoa, and Barcelona.

Considering the utility of the program introduced into post-harbor areas, one can distinguish at least two situations in the world, where:

- The goal of revitalization is to **regenerate degraded spaces into new downtown functions** of a diversified character. Such is the case of, for example, London Docks or Kop van Zuid in Rotterdam
- The revitalization programme delegates a part of the area to various port functions – both cargo handling and passenger service. As examples, one can refer to passenger terminals and ferry terminals in Genoa and Barcelona or the new port structures in the old docks of Antwerp.

One of the prerequisites for the success of revitalization programmes is the **cleaning of the natural environment**, especially water systems; an example is Boston. Usually, the formation **of an autonomous public agency** proves necessary as this body might foster such a process. Example: Baltimore Harbourplace.

The key tools guaranteeing the success of such a transformation process are:

- **Development strategy** – that allows for the avoidance of many spatial and organizational conflicts, guarantees a suitable character for the project, its division into stages and the support of the local community. Its framework should be comprised of, among others, decisions on new roads, public spaces, etc.
- **Emphasis on the adaptation of existing structures** – wharves, etc. to new purposes. This facilitates the elaboration of projects of a unique character and, simultaneously, perfectly suits the context of the given site.
- **Social research and consultations** – initiated by both private developers and public agencies, they facilitate the achievement of the best possible projects and the avoidance of unnecessary social resistance, corresponding to the use of all the advantages of the site (e.g. the use of areas of water, preventing them from being desolate, offering the possibility of a wider view of the situation on the water, etc.).
- **Cooperation with the local community** – this not only helps to avoid conflicts with the community but also, rather, gains community support and cooperation in carrying out the project, thanks to the guaranteeing of defined benefits. This also permits the improvement of the project making it more attractive, for example, by facilitating suitable conditions for the development of local artisans or art

The above comparison proves that the key elements in revitalization programs of post-harbor areas are:

- *Defined operations on infrastructure*, new roads and public spaces, bestowing new areas with a defined new structure
- *Varied scale and character of investment programs*, which will impose a defined structure onto entire areas
- *Coherent financial and organizational modes for the realization of particular tasks*, which guarantees a well-organized, efficient realization of particular programmes and their parts

Public spaces and infrastructure are designed individually so it is difficult to speak about any sort of classification. However, the issues for particular projects in different cities are often of similar character, so their arrangements can be applied appropriately in pre-defined ways in various places. The case of the organizational-financial team is difficult to classify, as are the organizational and financial modes, of which thorough analysis is a necessary supplement to the discussion of strategy and the realization of particular objects.

4.4. Attitude to the cultural heritage of a city

Historic waterfront areas are inseparable from the maritime heritage of local societies and as such are related to the prosperity years of many port cities. Traditionally, waterfront neighbourhoods are counted the most colourful parts of cities, with regard to the medley of historical architecture. In many cases, the option of the purification of architecture from some part of historic structure for preservation and revitalisation is decided upon, instead of cleaning the huge areas from the remains, considering such a choice proceeds a rich (in the cultural sense) milieu. However, the process of "gentrification" and the creation of "false history" are often spoken about. Nevertheless, were the redevelopment of old structures does not go along with the income from selling the exclusive flats located in old warehouses and other structures, these structures, often ancient, would dilapidate as unprofitable.

While a former warehouse shines again, now being i.e. a wine shop, the renewed structure becomes even more interesting in its form and atmosphere than many modern buildings, even if it is no longer received as "authentic" old warehouse. **The atmosphere of a city which has been able to preserve its historic waterfronts is now helping the city face an opportunity to profit from modern tendency to maintain links with the past.** There are many examples of operations, each different in its nature, which result in:

- **the removal of the whole of existing structures and the introduction of a new layout**, no links with the site are developed. This type of activity is only exceptional, e.g. the non-durable character of existing building structure or the lack of any aesthetic values. The glaring examples of this approach are Manhattan waterfront in New York, especially Battery Park City.
- **the preservation of old urban layout and single structures** and the removal of the remains of the to-date existing economy. This type of intervention is the most often rendered because it quite often proves impossible to preserve many of historic buildings of little or no cultural value at all. What is preserved, instead, is the wharf layout, extensive water system, while selected objects of high aesthetic values are being renewed. Examples of this are: a significant portion of London Docklands, especially St. Catherine's Dock and Albert Dock in Liverpool.
- **the full preservation of old structures and filling them with new content.** This type of intervention is rather rare because the condition and structure of development hardly ever permit the preservation of the majority of buildings.

5. Climate and location issues vs waterfront redevelopment schemes

On the basis of the “success stories” of many cities undertaking the waterfront urban redevelopment process also municipalities located in “less privileged” from the climate point of view areas as well as small- and medium-sized cities tend to rethink their water related urban structures. This relates both to cities located in the hot and cold climate zones – which to large extent make the traditional type of waterfront redevelopment patterns unviable, both due to climate conditions and – being the result of those – different economic and cultural realities. In result, the design patterns based on the traditional “success stories” seem to be unsuitable for these locations and the designers and developers of waterfront sites located in such cities have to look for the alternative solutions. Same applies to small- and medium-sized cities, which not necessarily bear potential for implementation of the mixed-use, large-scale urban projects. In these cases also the problem of relations between “global” trends associated with development of mass tourism as well as with implementing the typical mixed-use patterns and specifics of local economy and cultural environment has to be taken into account.

In case of those cities one can identify the following key specific approaches associated with the nature, scope and character of the smaller scale and located within the less-privileged climate realities waterfront redevelopment program. These were developed in relation to an overview of the issues associated with this topic as presented in the previous part of this paper.

5.1. The role of a project in the city structure

One has to note that in this case transformation of the waterfront is associated with the redevelopment of the entire city economy – as it takes place of former fishing industry and small port operation facilities. This means that implementation of such a program is based on the fact that traditional small-scale maritime industries are fading away and that the new type of economic activity – which is associated with spatial transformation – are taking the place of the "old" industries. This is associated with transformation of the fishing industry, diminishing importance of the small-scale cargo shipping etc. Therefore, since the scale of the intervention is usually medium to large (in relation to the scale of the existing city) and also due to the fact that its associated with transformation of the key economic sector of the city, it can be stipulated that the role of the waterfront redevelopment for the entire urban development process is much larger in case of small-and medium-sized cities than in case of large cities and metropolitan areas.

In this case one can state that the new intervention not only aims to solve the site-specific programs of the degraded post-harbor and post-industrial sites, but also can change the entire economic and spatial profile of the city, including introducing its new water-oriented face. This may be associated with diminishing the importance of the historically developed main streets or urban centers, but this depends on the existing spatial structures of the cities. Also, the functional composition of such an intervention depends heavily on above mentioned role. Similarly to other cases, usually the transformation program is built from a bunch of minor projects, but – usually – due to the scale and character of the intervention – these constitute the new "urban quality" not only for the site involved but for the entire city.

5.2. Functional program of a project

The projects realized in the framework these transformation schemes – in line with the typology presented in the previous chapter – may be very much diversified from the functional point of view. But there are two sets of factors, which make the functional profile of these projects different:

- Climate realities – which make the open-air recreation very limited in time throughout the year;
- Realities associated with the scale of the cities – which decide about the different profile of the users – both in terms of tourists, inhabitants and businesses – than in case of the large cities and metropolitan regions.

Therefore, within each of the functional categories (as listed in the previous chapter) the following specifics of the particular types of the projects may be observed:

Commercial projects – are usually associated with more traditional **mixed-use projects**, with a large participation of commercial and service functions. These may include hotel and residential programs, although most of those are focused on tourist industry and – to some extend – on creating the new offer for the inhabitants of the city. Also, the new office spaces may be part of such the developments, but usually these do not constitute the most important part of the intervention.

Cultural, educational and environmental projects – these may become the very important parts of the transformation schemes of the small- and medium-scales waterfront cities. Especially the projects associated with local history, traditions and culture are of great importance for the success of the entire scheme. In case of some of the cities, these projects may draw attention of tourists and visitors, planning to visit these sites just because of these attractions. The best example may be the small Polish city of Hel, which is famous in the country because of two institutions: center for rehabilitation of Baltic seals (the only one in the country) and fishery museum (occupying the old church).

Recreational projects – are usually limited to the public spaces which are used only for the short periods of time (due to climate reasons) as well as marinas and yacht operation facilities (which are also active only for the fraction of the year). Therefore, on the contrary to the many of the world-famous waterfront projects, the recreational facilities do not play the leading role in the structure of the entire scheme. But at the same time one has to note that these elements still constitute the very important part of the overall "waterfront experience".

Residential projects – play a very important role in these schemes, although it has to be noted that usually these are places of the “second apartments” or “holiday places” rather than permanent living areas. This comes from the fact that small-and medium-scale cities are not in need of such the prestigious and posh places to live, and their communities are not interested (in general) in moving to these places. Therefore, the rules which are applied to other residential projects, do not work in these cases.

Industrial-and-port constructions – still are (and probably for long will be) still of great importance to the analyzed waterfront sites. Although many of the small-scale maritime industries are gone (like fishing, food processing, small cargo handling etc) due to major shifts in economic realities and globalization (to name just a few), still there is room for niche type of functions – like pleasure fishing, yacht maintenance / repairing / production etc. It has to be noted that these activities usually are not aimed to compete on the larger markets, but do decide about the local identity of the space and are focused on local customers only. In fact, many of these may – due to these factors – actually decide about the attractiveness of the project and / or the city itself. Of course, many of those may have historic origins and long years of tradition, but also the entirely new businesses within this sector (and spatial constructs associated with these) can be identified [Kautto, 2001].

5.3. Realization strategies adopted

When discussing the realization strategies, all three models described in the preceeding chapter (namely: creation of **new physical spaces;** use of **cultural heritage spaces** and revitalization of **the space for a local community**) can be employed. It also appears that – in the end – revitalization programs for small-and medium-scaled cities usually are based on comprehensive transformation of the infrastructure (public spaces, embankment improvements etc) along with an array of individual small-scale building interventions (in form of individual building projects).

When discussing the utility of the program introduced into post-harbor areas, usually within the regeneration scheme includes both various small-scale port functions (as described above) as well as downtown / city center type of structures. Of course, in each case one of the prerequisites for the success of revitalization programs is the **cleaning of the natural**

environment, especially water systems; but it has to be noted that this usually is not a huge problem and a major obstacle for the regeneration program.

5.4. Attitude to the cultural heritage of a city

As discussed above, historic waterfront areas are inseparable from the maritime heritage of local societies. In addition, these areas usually are home for interesting parts of the maritime heritage, including port cranes, warehouses, embankments etc. But at the same time in case of the small- and medium-sized cities the scope of this heritage is much smaller than in larger cities and ports, and – in addition – the structure and character of these elements are much less important form the architectural and industrial heritage point of view. Therefore, in many cases it is decided to keep a lot of the historic elements, but usually these are reused for the new functions – although keeping their heritage character. This contributes to the outstanding identity of the site as its “unique feature” [Brattberg, 2001].

6. Conclusions

As discussed in this paper, waterfront regeneration is one of the leading themes in contemporary planning agenda. In addition, it can be perceived as a world-wide urban success story. There are many examples of the successful transformation, although usually only the cases from large cities are taken into account.

It was argued in this paper that the small-and medium-sized cities as well as ones located in the “less privileged” climate zones do require slightly different approach due to their specifics and character. But at the same time it seems that transformation of the waterfronts in these cases may be of much greater importance for the city as such than in case of larger urban areas.

In addition, it has to be stated that not only the character of the urban structure in these cases is different but also the economic rationale of this transformation is of different character. In the end, the entire process has to be dealt with in an alternative way than in bigger urban centers.

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[1] This is related to the abandonment of on-water areas by their former users and the development of modern industrial districts in other parts of a city

[2] Examples: festivals of maritime culture, staging of historic events, etc

[3] This trend, dubbed as *adaptive reuse*, has been described in many publications

The annulment of urban perimeter as a technical tool for urban planning: the unsustainability of the cities in the Brazilian state of Parana

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1. Introduction

In Brazil, the Urban Growth Boundary (UGB), called as “Urban Perimeter” and as part of the Comprehensive Plan, is defined by a specific municipal law. It is a polygon that outlines the urban area of a municipality and, by exclusion, the rural area. The spatial distribution of urban occupation in a municipality territory may produce, and in fact this occurs, a plurality of UGB polygons. For legal effects, only the land inside these polygons are recognized as urban land. These polygons demarcate urban settlements, urban expansion areas and specific urbanization areas (communities in rural areas with urban characteristics).

Urban perimeter is the most used urban planning tool in Brazil - present in 85% of Brazilian municipalities (IBGE, 2015) -, to arrange and control urban growth. Besides that, it is also used for tax purposes, since it delimits the areas where municipal property tax can be applied.

However, it is observed that urban perimeter does not play its role due to: i) its original oversize setting; and, ii) its subsequently progressive enlargement. This is an evidence of poor urban planning and technical fundamentals, used to provide throughout the city social housing, gated communities or other typologies as well (Santoro, 2014). This is also reinforced by municipalities’ legislators, managers and technical staff understanding of urban perimeter as a mere instrument to regulate conversion of rural into urban land, allowing without limits horizontal urban expansion pushed by real estate market dynamics. Thus, this common understanding leads to the annulment of urban perimeter as a technical tool for arranging and controlling urban expansion.

This is a relevant issue for the international debate about sustainable urban growth, considering the opposite models of urban development: compact and continuous vs. fragmented and dispersed. According to the United Nations sustainable development requests the ability to ensure that “it meets the needs of the present without compromising the ability of future generations to meet their own needs” (Brundtland, 1987). The former model better applies to the objectives of sustainable urban development considering the three fundamental principles: economic growth, social equality and environmental protection.

Based on this development model, urban planning should consider urban expansion economic feasibility (where benefits exceed investment costs needed to urbanize new areas); social equality (where all citizens of new urban areas access urban infrastructure, facilities and services) and environmental protection (where natural resources are preserved, environmental fragilities are respected and urban expansion negative impacts are mitigated).

Nevertheless, there are, by innumerous perspectives, opposing theoretical sides in the international debate about the real effectiveness of the UGB, or similar, as an instrument to control urban sprawl and, consequentially, to preserve agricultural and natural areas from uncontrolled urban occupation. It can be mentioned, as examples, the initiatives of: Seoul in South Korea (Bengston & Youn, 2006); Melbourne in Australia (Ball, Cigdem, Taylor & Wood, 2014); Brussels in Belgic (Boussauw, Allaert &Witlox, 2013); besides many others in Portland

and in the State of Oregon, in the United States (Mildner, Dueker & Rufolo, 1996; Weitz & Moore, 1998; Jun, 2004).

In this context, this paper's objective is to contribute to the discussion about urban perimeter adequate shaping and dimensioning towards sustainable development in the state of Parana, Brazil. Thus, the following spatial metrics related to urban perimeter are considered: i) gross demographic density; ii) occupation rate; iii) displacement of its centroid from city center; and iv) shape irregularity degree. To produce the required geostatistical information, considering urban perimeters of Parana state municipalities, it is used the GIS application called "SEDU/PARANACIDADE Interativo".

However, initially, aiming to better understand urban perimeters performance in Parana, it is briefly presented the context of Brazilian municipalities concerning: i) their political and administrative autonomy; ii) their competence to legislate on urban issues; iii) the urban perimeter in the context of Brazilian urban legislation; iv) the relation between the urban perimeter and the Comprehensive Plan; and v) the financing system for urban development in Parana, managed by the Autonomous Social Service PARANACIDADE.

2. Urban perimeter as an urban planning tool in federal legislation

Brazil, located in the subcontinent of South America, is a federative republic composed of the indissoluble union of 26 states, a federal district and, peculiarly, 5.570 municipalities. The latter are also federative entities and are political, administrative and financially autonomous. They share duties with the federal and state governments and have their own as well.

According to 1988 federal Constitution, municipalities are ruled by "organic laws" (leis orgânicas), which act in a similar way to constitutions. Furthermore, they ought to legislate about local issues, in compliance with the state and federal legislations. Likewise, they are responsible for their territorial arrangement, through urban land planning, parceling and, use and occupation control. Municipalities ought to plan and implement the municipal development policy, considered by the Comprehensive Plan, which is itself prescribed as an urban planning tool in municipality's organic law.

Even though the definition of urban perimeter, by a specific law, is a municipal duty, there are general legal requirements to be considered regarding federal legislation. According to Braga (2016), the very first reference to municipalities' requirement to define an urban perimeter is the 1966 National Tax Code (Law 6172/66). As stated by this author, the municipal urban property tax can only be charged to real estate owners whose properties are within urban perimeter. Afterwards, in 1999, an amendment to the federal Urban Land Parceling Act (Law 6766/79) set rules to land parceling restricted to urban areas, urban expansion areas and specific urbanization areas, as defined in the Comprehensive Plan by means of the urban perimeter law.

In 2012, an amendment to the 2001 Brazilian Statute of the City (Law 10257/01), which establishes general guidelines to urban policy, defined criteria to be followed when municipalities change the urban perimeter. By means of a specific urban development plan, it must be considered: i) the delimitation of the new urban perimeter; ii) the definition of areas restricted to urban occupation or subjected to special control due to natural disasters threats; iii) the definition of specific guidelines and areas where infrastructure, transport system, public facilities, either urban or social, will be available; iv) the description of land parceling and use and occupation parameters, so that use diversity, employment opportunities and income generation are enhanced; v) the definition of areas for social housing; vi) the definition of guidelines and specific tools towards environmental protection, and historical and cultural heritage preservation; and vii) the definition of an equitable sharing mechanism considering the benefits and the burden arising from urban growth.

Although the Statute of the City addresses the urban perimeter issue in the context of the Comprehensive Plan Chapter, their relationship is fairly weak, as far as the former is not, in fact, considered neither as an urban policy tool nor as part of the Comprehensive Plan. Besides that, the latter is only mandatory to 30% of the Brazilian municipalities: those with more than 20 thousand inhabitants, that conform metropolitan areas and urban agglomerations, that make part of tourism regions, and those where investments may significantly harm the environment or are vulnerable to natural catastrophes.

2.1 Urban perimeter as an urban planning tool in state legislation

The state of Parana, located in the South region of Brazil, is one entity of the Federative Republic of Brazil and is subdivided into 399 municipalities. In its 1989 state Constitution are established guidelines to urban policy, more specific than those in the federal Constitution. Likewise, the state Constitution also defines that Parana cities with population less than 20 thousand inhabitants will receive technical assistance from an urban development state agency to fix general rules for urban land occupation, aiming to guarantee the city and private property's social function. The state agency created in 1996 by law (11498/96) is the Autonomous Social Service PARANACIDADE.

Replacing an older one founded in 1972, its aim is to foster urban, regional and institutional development in favor of Parana municipalities, following state urban policy guidelines, and to encourage them to participate in the formulation of state urban policy and Parana financing system design to support them.

Since 2002, Parana government has established the State Financing System for Municipal Development (Decree 5631/02), which is managed by PARANACIDADE, aiming to finance urban infrastructure and institutional strengthening actions. Among the latter is the Comprehensive Plan. PARANACIDADE provides to state's municipalities its Terms of Reference and related technical support. The delimitation of the urban perimeter is implied.

PARANACIDADE's Comprehensive Plan Terms of Reference content strictly follows the State Urban Development Act (Law 15229/06). Differently from other Brazilian states, it sets the Comprehensive Plan's scope, to be considered by Parana municipalities, which includes:

i) Collection of data, diagnoses and guidelines regarding both urban and rural as well as regional municipality's reality considering environmental, socioeconomic, socio-spatial, public infrastructure and services and institutional aspects;
ii) Guidelines and proposals, establishing municipal urban and rural development policies and a permanent planning system;
iii) Urban legislation: Comprehensive Plan, urban perimeter, urban land parceling, urban and rural land occupation and use control, street network, building code, code of ordinance, and urban instruments as proposed by the Statute of the City;
iv) Investment Plan, according to Comprehensive Plan's priorities, as a tool for municipal capital budgeting;
v) Monitoring and controlling system of Comprehensive Plan implementation based on indicators;
vi) Urban planning and managing administrative unit within local public administration.

This same state law also prescribes that state government will only lend money from the State Financing System for Municipal Development to those municipalities that have a Comprehensive Plan and therefore an urban perimeter law.

Among 152 municipalities of Parana state that signed financial agreements, in the last two years, 81 did not change urban perimeter polygon after Comprehensive Plan's approval, while other 71 did. Most of these (41) have changed it only once in a 10-year period, although 6 have reached up to 25 amendments in the same period of time. This indicates that urban perimeter changes occur in periods shorter than the maximum time gap established by the Statute of the City as mandatory to Comprehensive Plan updating.

3. A theoretical approach to Urban Perimeter and UGB effectiveness as an urban planning tool

The arranging and controlling urban tools effectiveness, as in the case of urban perimeter in Brazil and the Urban Growth Boundary in other countries, has been a controversial subject of international theoretical debate. In a positive perspective, there are those that defend that urban perimeter sets limits on horizontal expansion, contributing to urbanization costs decrease, by making it more compact and sustainable. On the other hand, some doubt about its effectiveness due to the lack of scientific evidence.

According to Braga (2016), urban perimeter is one of the most important urban tools to urban development policy implementation, since it qualifies municipal land for urban use by recognition of areas suitable for urbanization. The author also reinforces that incorrect urban perimeter delimitation, due to its oversize, contributes to increase environmental, social, urban mobility and infrastructure costs.

In line with the need to control urban sprawl, Silva, Silva & Nome (2016) argue that the lack of instruments to arrange and control urban growth, such as the urban perimeter, contribute to worsen citizens' quality of life. The authors point out that, in a country like Brazil, which presents extreme social inequalities, it is a contradiction to defend dispersed, low population density cities, which is inconsistent with sustainable development. This idea brought by all these authors was already present in Mascaro (1986).

Haughton & Hunter (1994) defend high urban population densities in favor of sustainability, because: i) it maximizes the use of available infrastructure and reduces both the relative cost of its implementation and the need for its extension to distant areas; ii) it contributes for reducing commuting, since concentration of people favors economic activities at the local level; and iii) it tends to favor pedestrianism and the implementation of collective transportation systems.

Although some recognize that urban growth control produces more sustainable cities, there is no agreement on formal UGB effectiveness. Jun (2004) compared the metropolitan area of Portland urban growth, which has an UGB, with other metropolitan regions of the United States that do not have it, between 1980 and 1990. The author's conclusion was that in both cases, the process of urban sprawl was similar.

As in Portland, Boussauw, Allaert & Witlox (2013) pointed out that urban sprawl excessive control and compactness in Brussels, capital of Belgium, increased surrounding cities urbanization, intensifying the suburbanization process. Although this phenomenon usually occurs in metropolitan areas, it cannot be ignored that it may happen in any other smaller urban contexts as well.

Another important aspect, regarding urban delimitation, aiming to increase occupation density and optimize the available infrastructure, is urban land price increase. Ball, Cigdem, Taylor & Wood (2014) suggest, from a study of the metropolitan region of Melbourne, in Australia, that land prices rose within the UGB after its enactment. Land price increase and interference with free real estate market forces are some of the main arguments against UGB as an instrument to arrange and control urban space.

In Brazil, as adequately pointed out by Santoro (2014), urban perimeters are, in general, flexible, responding to local real estate market forces, rather than a restrictive and controlling tool. The author states that urban perimeter laws, in Brazil, are usually modified on a case-by-case basis, without clear urban planning objectives and guidelines.

Although urban perimeter effectiveness to arrange and control urban sprawl can be the subject of important theoretical questionings, the way it has been used in Brazil - flexible and on demand under pressure of real estate market forces – makes it, in fact, an annulled instrument of urban planning.

4. Method of analisys

To achieve this paper's objective, a method, similar to that used by Braga (2016) to the city of Piracicaba – SP, enables Parana municipalities urban perimeter sustainability evaluation through the following 4 spatial metrics: i) gross demographic density; ii) occupation rate; iii) displacement of its centroid from city center; and iv) shape irregularity degree.

The current analysis considers 388 polygons, corresponding to Parana municipalities that have Comprehensive Plan, 97% of the total number. Only the main municipal city urban perimeters are taken into account, although in some municipalities there are more than one urban perimeter that likewise delimit urban occupations within municipal territory.

These 388 municipalities have distinctive features: more than half of them (203) are small (with less than 10 thousand inhabitants) and isolated in the agricultural rural area; some few are located along the Atlantic coast, others conform conurbation areas or belong to metropolitan areas.

For the sake of analysis, Parana municipalities were grouped into 8 populational range sizes, considering 2010 demographic data census, based on the mix of 2 methods of classification: "equal interval" for the 4-lowest population size ranges and "natural breaks" for the other 4-highest ones, taking into account the great population size disparity among Parana municipalities.

The first spatial metrics is gross demographic density. For the sake of its calculation, it is considered 2010 demographic data census relative to main city urban perimeters and urban perimeter areas, as defined by municipal laws, available in SEDU/PARANACIDADE Interativo database. In principle, the higher the gross demographic density, the smaller is urban sprawl.

The second spatial metrics is urban perimeter occupation rate. The urban occupation polygons of Parana municipalities were obtained from the SEDU/PARANACIDADE Interativo, based on 2017 and 2018 satellite images. The indicator value is obtained dividing the total of urban occupation areas within urban perimeter by its total area. In theory, the greater the urban perimeter occupation rate, the greater the arrange and control municipal capacity over urban growth. It should be noted that, high values of urban perimeter occupation rate may also mean that urban perimeter outline is outdated or being disregarded as a tool of local urban growth control.

The third spatial metrics is the displacement of urban perimeter centroid from city center. Its evaluation was done taking into account the distance in a straight line between the urban perimeter polygon centroid and a point considered as the center of the city. Usually, most of urban infrastructure, facilities and services available to population are concentrated in the city center. Therefore, it could be said that the more distant is urban perimeter polygon's centroid from city center, the less equal is urban infrastructure, facilities and services people's access (if its whole area were to be occupied).

At last, the fourth spatial metrics is the urban perimeter shape irregularity degree. It is calculated by the ratio between the length of the current urban perimeter polygon and the length of the circumference of a circle with the very same area, subtracted by one. So zero means perfect regularity. The closer the two measures are, the less irregular the urban perimeter polygon tends to be, near a circle shape, the most regular and compact geometric figure. The less irregular is the urban perimeter polygon shape, the more likely organized tends to be its occupation (if its whole area were to be occupied).

Thus, the four-spatial metrics here considered allow to evaluate urban perimeter performance towards urban sprawl control, as shown by high gross demographic densities, high occupation rate, low urban perimeter centroid displacement from city center and low degree of its shape irregularity, in favor of environment preservation, commuting costs and emission of air pollutants decrease and conversion of rural into urban land decline, as well as, urban infrastructure, facilities and services rational use. Preventing urban perimeter annulment, aiming to control urban sprawl and guarantee sustainability, is one of the main tasks of local administrations towards the correct use of this tool as prescribed by urban legislation.

5. Results and Discussion

Parana municipalities total urban perimeter area is approximately 6,000 km², corresponding to 3% of state total territory, in the same order of magnitude of world's land surface covered with urban areas, according to Schirber (2005). Yet, the state average urban occupation rate of urban perimeter area is only around 50%.

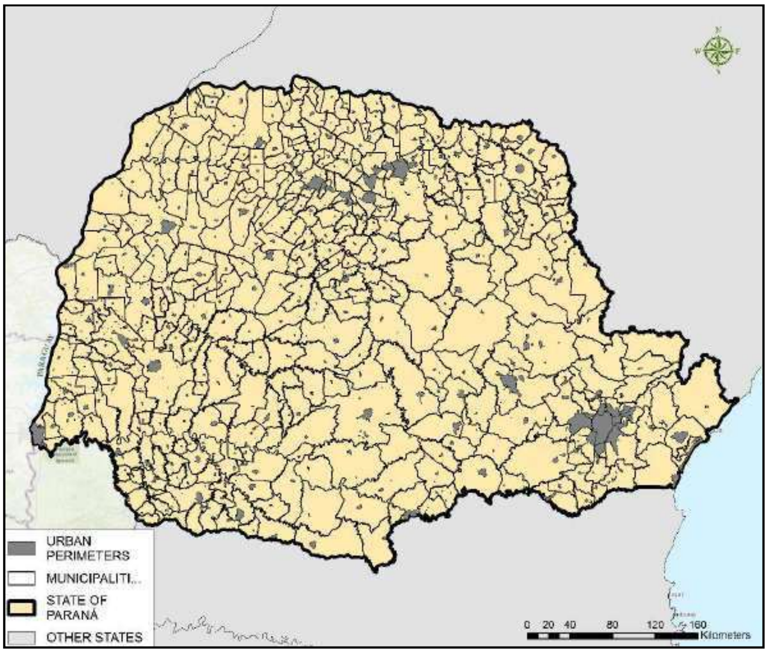

Figure 1 – Parana urban perimeters
Source: SEDU/PARANACIDADE Interativo, 2018

5.1 Gross demographic density

Urban perimeter gross demographic densities observed in Parana municipalities were classified into three ranges, considering the state average gross demographic density (15 people per hectare) and the minimum gross urban demographic density reference postulated by Braga (2016), which is 50 people per hectare. Here it is also considered a state reference value – 20 people per hectare – obtained from average values of urban parcel size (360 sq meters) and number of residents per household (2.9 people). The three ranges defined, within

Parana state context, are: i) very low (less than 15 people per hectare); ii) low (between 15 and 20 people per hectare); and iii) regular (more than 20 people per hectare and less than 50 people per hectare).

None of Parana municipalities present urban perimeter gross demographic density greater than 50 people per hectare, what makes Parana a fairly low densely urban populated area. Curitiba, the state capital, shows the closest value to Braga's parameter, 40 people per hectare. On the other hand, the municipality of Quatro Barras, in the Metropolitan Region of Curitiba, has the lowest urban perimeter gross demographic density, less than 2 people per hectare (Figure 2).

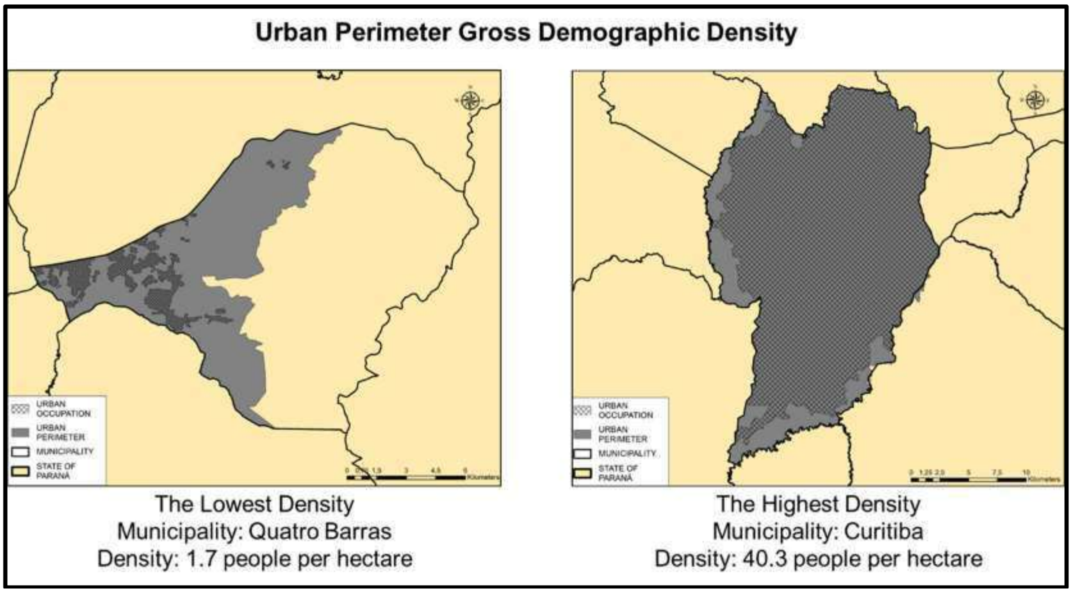

Figure 2 – The lowest and the highest gross demographic densities of Parana urban perimeters
Source: SEDU/PARANACIDADE Interativo, 2018

Table 1 shows the high number of Parana municipalities with densities lower than 15 people per hectare: 242, corresponding to 62.4% of the 388 here considered. The lowest densities predominate in almost all population range sizes, except for the highest, where densities higher than 20 people per hectare prevail. It is possible to assure that, in Parana, the urban development model tends to be of low urban land occupation densities, regardless population size.

Table 1: Number of urban perimeters classified by gross demographic density and population sizes

URBAN POPULATION	GROSS DEMOGRAPHIC DENSITY			TOTAL
	0-14	15-20	>20	
141,958 – 1,751,907	3	0	5	8
68,441 – 141,957	10	4	1	15
31,962 – 68,440	8	5	3	16
16,103 – 31,961	31	5	2	38
7,172 – 16,102	42	21	15	78
4,152 – 7,171	44	17	19	80
2,438 – 4,151	49	16	12	77
524 – 2,437	55	14	7	76
TOTAL	**242**	**82**	**64**	**388**

Source: SEDU/PARANACIDADE Interativo, 2018

5.2 Occupation rate

Urban perimeter occupation rates in Parana show high levels of diversity, being classified into 5 ranges: i) very low - between 8% and 25%; ii) low - between 26% and 50%; iii) regular - between 51% and 75%; iv) high - between 76% and 90%; and v) very high - above 90%.

Table 2 shows that most of urban perimeters in Parana (285) have occupation rates between 26% and 75%, averaging 57.5%. Despite being here considered as a regular rate, there are still 42.5%of non-occupied areas within urban perimeters, in average, which indicates an urban perimeter oversize trend vs. effective demand for new urbanized land.

In general, occupation rate extremes (the lowest and the highest ranges) are concentrated in municipalities with less than 16,000 inhabitants. In these municipalities, where continued, strong demand for new urban land can be reasonably expected to be negligible, the urban perimeter seems to be treated as an unimportant control tool as shown both by its oversize or its undersize (where occupation rate reaches far more than 100%).

Table 2: Number of urban perimeters classified by occupation rate and population sizes

URBAN POPULATION	OCCUPATION RATE					TOTAL
	8 – 25%	26 – 50%	51 – 75%	76 – 90%	> 90%	
141,958 – 1,751,907	0	1	4	2	1	8
68,441 – 141,957	1	8	6	0	0	15
31,962 – 68,440	1	6	7	2	0	16
16,103 – 31,961	4	20	11	3	0	38
7,172 – 16,102	2	22	37	13	4	78
4,152 – 7,171	1	19	35	16	9	80
2,438 – 4,151	2	26	30	17	2	77
524 – 2,437	9	22	31	12	2	76
TOTAL	**20**	**124**	**161**	**65**	**18**	**388**

Source: SEDU/PARANACIDADE Interativo, 2018

Figure 3 demonstrates Parana urban perimeters with the lowest and the highest occupation rates which, in both cases, are inadequate. The urban perimeter of Presidente Castelo Branco Municipality is only 6% occupied, far below Parana state average (57.5%). Even though the real estate market dynamics does not justify such small occupation rate, it can be seen from Figure 3 that there is an urban occupation in the north of urban perimeter, indicating a trend to sprawl into rural areas.

On the other, in Floresta Municipality, the urban occupation maladjustment is characterized by its 158% occupation rate. Here, urban perimeter undersize can be seen as its disregard as an urban control tool.

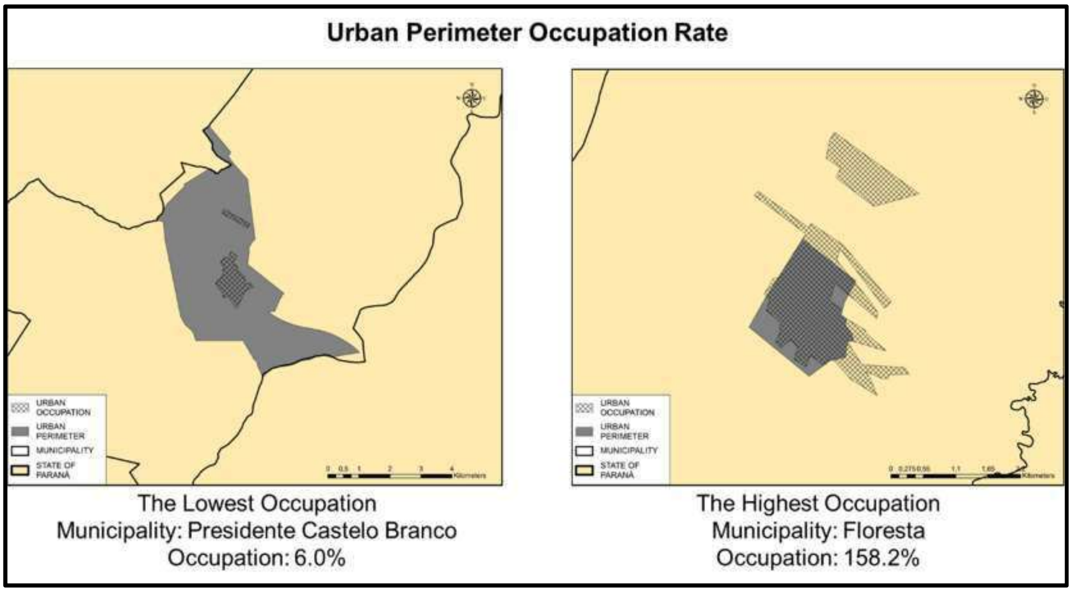

Figure 3: The lowest and the highest occupation rates of Parana urban perimeters
Source: SEDU/PARANACIDADE Interativo, 2018

5.3 Displacement of urban perimeter centroid from city center

Displacement of urban perimeter centroids from city centers were classified into 5 categories: i) very near - between 0 and 0.38 kilometers; ii) near - between 0.39 and 0.89 kilometers; iii) slightly distant - between 0.90 and 2.03 kilometers; iv) distant - between 2.04 and 3.80 kilometers; and v) very distant - between 3.81 and 10.22 kilometers.

Larger municipalities tend to have the greater distances between urban perimeter centroid and city center. Conversely, smaller municipalities usually have the smaller ones (Table 3). Nevertheless, geographical factors that gave rise to some city centers or foster their increase, in Parana, such as maritime foreland and seaside groundwater basin, river borders, conurbation areas, international boundaries, lead to significant displacements.

As examples, it can be mentioned the municipalities of Pontal do Parana (20,920 inhabitants) with 10,221.11 meters of displacement (located along the seacoast); Colombo (212,967 inhabitants) with 6,696.23 meters of displacement (conurbation with Curitiba, the capital state); Paranagua (140,469 inhabitants) with 5,953.16 meters of displacement (located along Paranagua bay); and Foz do Iguaçu (256,088 inhabitants) with 5,531.03 meters (located on an international boundary). In such cases, horizontal urban expansion, within the urban perimeter, tend to make more difficult people's access to urban infrastructure, facilities and services, concentrated in the city center, and therefore cities less sustainable.

Table 3: Number of urban perimeters classified by displacement of urban perimeter centroid from city center and population sizes

URBAN POPULATION	DISPLACEMENT FROM THE CITY CENTER (KM)					TOTAL
	0 – 0.38	0.39 – 0.89	0.90 – 2.03	2.04 – 3.80	3.81 – 10.22	
141,958 – 1,751,907	1	2	1	0	4	8
68,441 – 141,957	4	3	6	2	0	15
31,962 – 68,440	8	4	4	0	0	16
16,103 – 31,961	11	15	6	6	0	38
7,172 – 16,102	31	37	8	2	0	78
4,152 – 7,171	42	27	8	3	0	80
2,438 – 4,151	44	28	4	0	1	77
524 – 2,437	55	12	5	3	1	76
TOTAL	**196**	**128**	**42**	**16**	**6**	**388**

Source: SEDU/PARANACIDADE Interativo, 2018

On the other hand, some municipalities with population over 50,000 inhabitants have very near or near displacement distance values, such as: i) Cianorte (69,958 inhabitants) with 95.70 meters of displacement (isolated city); ii) Paranavai (81,590 inhabitants) with 437.31 meters of displacement (isolated city); iii) Toledo (119,313 inhabitants) with 559.62 meters of displacement (isolated city); and Ponta Grossa (311,611 inhabitants) with 618.18 meters of displacement (regional center). In such cases, urban expansion tends to be fairly well balanced concerning people's access to central urban infrastructure, facilities and services from several regions of the city, optimizing daily city commuting. Figure 4 illustrates two municipalities that belong each to the extreme ranges of urban perimeters centroid displacement in relation to the city center.

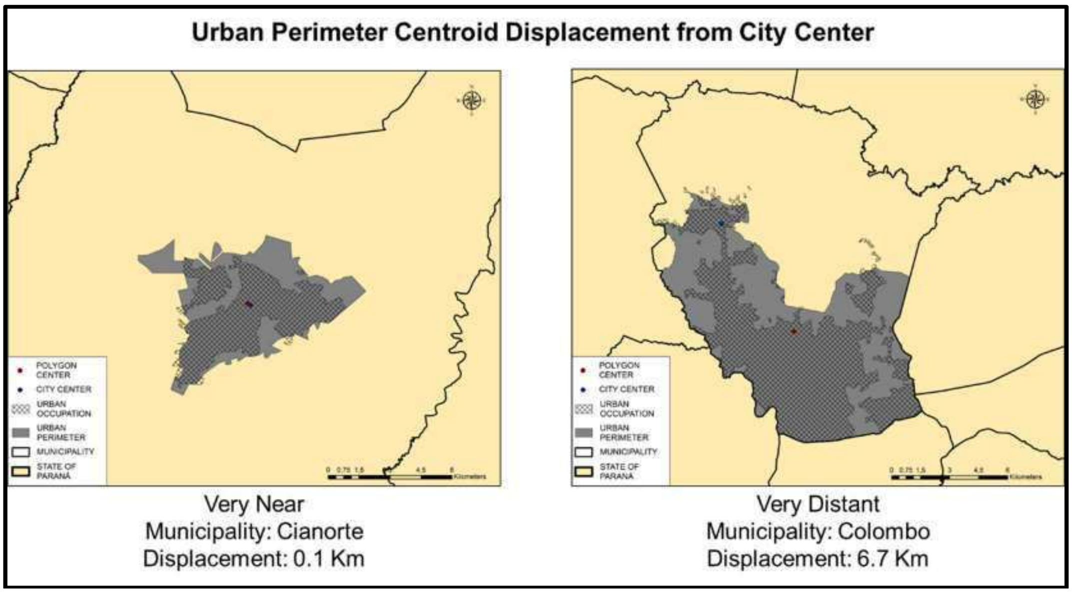

Figure 4: Parana municipalities of the first and fifth range of urban perimeter centroid displacement from city center
Source: SEDU/PARANACIDADE Interativo, 2018

5.4 Urban perimeter shape irregularity degree

Urban perimeter shape irregularity degree aims to identify the level of urban perimeter compactness. If compacted, its shape tends to a circumference; otherwise, the urban perimeter has an irregular form. The proportion of street network extension in relation to urban perimeter area tends to be high, and, consequently, increasing commuting distances and times. The results were classified into 5 ranges: i) regular - between 0 and 0.20; ii) very slightly irregular - between 0.21 and 0.31; iii) slightly irregular - between 0.32 and 0.41; iv) irregular - between 0.41 and 0.52; and v) very irregular - between 0.53 and 0.77.

Table 4 shows that municipalities within the largest population range size have irregular or very irregular urban perimeters, even though it is observed unexpectedly small municipalities classified in this very same category. Most part of the smaller municipalities are equally placed within the other four irregularity range sizes.

Table 4: Number of urban perimeters classified by irregularity shape degree and population sizes

URBAN POPULTATION	**DEGREE OF SHAPE IRREGULARITY**					**TOTAL**
	0 – 0.20	**0.21 – 0.31**	**0.32 – 0.41**	**0.42 – 0.52**	**0.53 – 0.77**	
141,958 – 1,751,907	0	0	0	5	3	8
68,441 – 141,957	0	2	5	4	4	15
31,962 – 68,440	2	2	5	3	4	16
16,103 – 31,961	3	4	12	13	6	38
7,172 – 16,102	5	15	26	21	11	78
4,152 – 7,171	13	12	25	24	6	80
2,438 – 4,151	10	26	21	13	7	77
524 – 2,437	11	21	24	14	6	76
TOTAL	**44**	**82**	**118**	**97**	**47**	**388**

Source: SEDU/PARANACIDADE Interativo, 2018

Urban perimeter irregularity degree may be explained by several factors. Notwithstanding, two prevail: i) federal or state roads (as in Ponta Grossa, Araucaria, Sao Jose dos Pinhais, Carambei municipalities); and ii) land surface irregularity (as in Cerro Azul, Tunas do Parana, Almirante Tamandare municipalities).

Figure 9 illustrates the two Parana urban perimeter extreme irregularity degrees. The most irregular one is Cerro Azul urban perimeter, which adjusts both to land surface irregularity and a federal road. These two aspects lead to the linear shape of Cerro Azul urban land occupation, in north-south direction, limiting street network connections, and the federal road plays the role to link the different regions of the city.

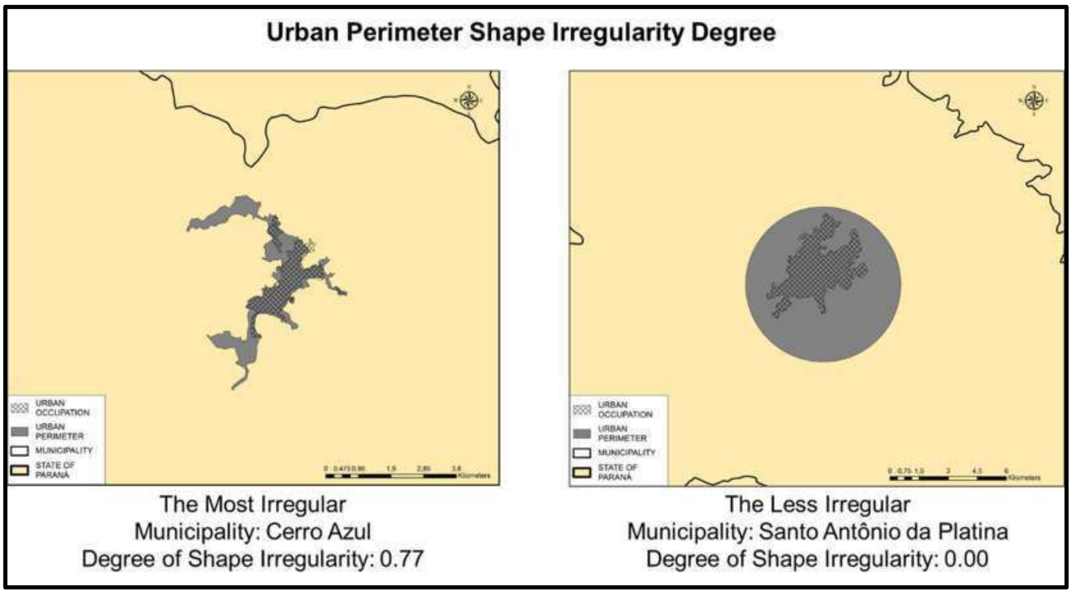

Figure 5: The most very irregular and the most regular Parana urban perimeter shapes
Source: SEDU/PARANACIDADE Interativo, 2018

The urban perimeter of Santo Antonio da Platina Municipality is the opposite case: its shape is a perfect circumference, which, in theory, represents perfect geometric regularity (its shape irregularity degree is zero). However, when comparing the urban perimeter area to the actual occupied area, it is observed that there is no relationship between them, which suggests that this urban perimeter's shape (and oversize) seems to be a pure abstraction, totally disconnected from municipality's reality.

6. Conclusion

Brazilian legislation assigns to urban perimeters, through a specific law, the task of delimiting urban settlements, urban expansion areas and specific urbanization areas, following the Comprehensive Plan guidelines. According to IBGE, urban perimeter is the most used urban planning tool in Brazil. Of the 399 Parana municipalities, 388 have, legally, urban perimeter.

Nevertheless, its effectiveness for arranging and controlling urban occupation may be put into question. This paper evaluates this questioning through 4 spatial metrics: i) gross demographic density; ii) occupation rate; iii) displacement of its centroid from city center; and iv) shape irregularity degree.

The results showed that most of Parana urban perimeters have very low gross demographic density levels, with less than 15 people per hectare. In addition, there is none among Parana municipalities whose urban perimeter gross demographic density exceeds 50 people per hectare, as an evidence of an extensive urban land occupation model, which tends to increase urban costs.

The low urban perimeter gross demographic densities are related, generally, to urban perimeter oversize compared to its actual urban occupied area. In average, Parana urban perimeters are occupied by slightly more than 50%. Considering that Comprehensive Plan, including the urban perimeter, should be updated, at most, every 10 years, the urban perimeter polygons can be considered large enough to comprise urban growth during this period.

Urban perimeter oversize puts at risk urban occupation control, since it contributes to less dense and more fragmented urban occupation. In addition, it also hampers its occupation arrangement as shown both by urban perimeter centroid displacement from city center and shape irregularity degree.

In general, larger municipalities present greater distances between urban perimeter centroid and city center. Furthermore, those municipalities that comprise conurbation areas, located along international boundaries, seacoast or bays show significant distances as well. In such cases, urban growth within urban perimeter tends to intensify these distances, increasing urban commuting in number and in extent to access urban infrastructure, facilities and services concentrated in the city center.

The evaluation of urban perimeter polygon shapes also shows that the smaller municipalities concentrate most of regular or very slightly irregular polygons, which tend to a circumference. Most of Parana urban perimeter polygons are slightly irregular or irregular, due mainly to surface land irregularity and urban growth along federal or state roads. The urban perimeter irregular shape, if followed by urban occupation, tends to limit urban connections and to increase distances between the various city regions.

Parana municipalities urban occupation pattern, based on both low demographic density and low spatial concentration levels, reduces municipal management performance towards urban infrastructure, facilities and services offer, add to local government poor technical and financial capacities. Increasing distances to overcome in order to attend citizen's demands, rises public and private urban costs, and make cities progressively more and more unsustainable.

It is possible to assert that, in Parana, the annulment of urban perimeter as an urban technical tool may be due to legislators and public managers' political clientelism and to local administration staff institutional weakness. Besides that, this may also be an outcome of Brazilian culture, especially in countryside cities, that associates urban quality of life to horizontal and widespread occupation, based on large parcels and single-family housing, aiming to replicate countryside lifestyle into urban areas. Without changing this paradigm, any urban technical tool aiming to control urban sprawl tends to be annulled.

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Development of recommendations on the planning structure and street design in the cities with cold climate

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Abstract

Urban settlements located in cold regions have their own specific features related to climatic conditions. Winter, which can last for several months a year, affects the daily life of the population. Precipitation in the form of snow, low air temperature, short daylight hours, strong wind, ice – all these climatic features accompany the activities of people in cities with such climates and form their habits. Thus, these features compel urban planners to seek solutions that meet the needs of people living in cold climates. In Russia, the climate, namely, the presence of a long and cold winter, strong wind and insolation insufficiency, is almost never taken into account when designing or improving territories. As a result, streets are unsuitable for a comfortable city life in winter.

In this paper, the problem of imperfection of Russian city-planning standards in the field of space management and planting is considered. The purpose of this paper is to analyze the Russian and foreign standards for city design in cold climates. The report contains the results of an analysis of Russian regulatory documents in the field of street design; the results of a comparison of these documents with documents from Finland, Canada, and the USA; a list of recommendations for adding new and improving existing aspects of street design in Russian regulatory documents.

1. Introduction

Creating an urban environment in which it would be comfortable to be outside at any time of the year is an important, yet challenging task. This is especially true for cities located in areas with cold climates. The more time people spend in the open air, the better it influences their mental health (Beyer, Szabo and Nattinger, 2016). Active street life helps residents build new social ties, while the city economy thrives on taxes collected from small businesses and rising real estate prices (Lee, 2014). Moreover, regular physical activity, including walks, positively affects health, reducing the risk of developing a number of diseases. Winter is accompanied by heavy snowfalls, short daylight hours and long periods with temperatures below 0 degrees Celsius. Severe climate in such periods can significantly limit outdoor activity and affect the availability of the urban environment. People spend most of their lives indoors, which makes streets lifeless. In addition, urban transport is limited to the use of motor traction, and a large amount of snow creates numerous problems in ensuring pedestrian motion safety and road maintenance. On the other hand, a prolonged winter in cold regions provides a number of opportunities for organizing leisure activities, for example, holding winter festivals, developing winter sports or other activities related to snow. These benefits can be used in cities of subarctic areas to offer residents a special category of entertainment not typical for cities in temperate regions.

Nevertheless, in the northern latitudes it is quite difficult to make it comfortable to stay outside – in winter people can spend 70-95% of their time indoors (Pressman and Zepic, 1986). In this regard, it is important to make efforts to improve the aspects of urban planning and space management which will make it comfortable for people to stay outdoors even in winter, namely, to walk, organize leisure, communicate, and visit various facilities. It is necessary to effectively use knowledge on the urban climate in the field of street design and improvement.

In Russia, street design and improvement is regulated by federal and local guidelines which were developed back in the 1960s and were called Building Norms and Rules (Russian “SNiP”). Updated revisions of SNiP were called Codes of Rules (Russian “SP”), however, their content remained practically unchanged. Analysis of existing Russian city planning standards showed that they cover improvement superficially; some of the aspects considered are not related to each other and do not provide an integrated approach to space management; many rules and recommendations do not take into account the climatic characteristics of the area. At the same time, more than 60% of the territory of Russia is in the permafrost region, and the average annual air temperature in the country is -5.5 °C. For example, in the eastern part of the Sakha Republic (subarctic climate zone), in Chokurdakh, the temperature is below 0 degrees for more than half of the year. At 93.1% of Russia's area, average temperature of the coldest month of the year is below −10 °C, and at 82% of Russia's area average temperature of the coldest month of the year is below −15 °C. In many cities, average temperature in winter is not lower than −20 °C, for example in Belgorod (−5.9 °C), Veliky Novgorod (−7.7 °C), Vologda (−9.7 °C), Kirov (−11.9 °C), Orenburg (−10.9 °C), Smolensk (−5.9 °C). Thus, improvement of many Russian cities needs to take into account the peculiarities of the cold climate.

The main purpose of this work is to compare Russian and foreign guidelines and regulations on space management and improvement in cities. Comparative analysis will identify gaps in Russian regulations and, in future, help develop specific amendments to city planning legislation based on relevant experience of other countries with a similar climate.

2. Scientific background for urban planning and improvement in cold climates

International scientific community has paid attention to urban design issues considering natural and climatic conditions since the 1980s. For example, N. Pressman and X. Zepic in their work "Planning in Cold Climates: A Critical Overview of Canadian Settlement Patterns and Policies" attempt to identify a range of problems related to the winter season in the urban environment (1986). The main goal of the work was to develop strategic approaches that would be able to minimize the consequences of the winter season for people and urban life in Canada. Professor I. Eliasson in her article "The use of climate knowledge in urban planning" came to the conclusion that, in spite of the availability of information on the local climate for urban planning, in most cases this data is not organized and actually stays uninvolved in city planning (2000).

In the 21st century, thanks to the spread of the Internet, the number of available publications on problems of urban planning in areas with cold climates increased. Studies began to be published on cities and countries that had previously paid no attention to climatic characteristics in urban planning. For example, the article "Climate-Sensitive Urban Design in Cold Climate Zone: The City of Erzurum, Turkey" presents the results of a study of adaptability of urban environment components in the Turkish city of Erzurum (street orientation, typology of building, planting, improvement, etc.) to cold climate conditions. According to the results of the study, the author states a set of decisions and recommendations that, if they are taken into account in city planning processes, can affect the adaptability of streets to the winter season (Dursun, 2015). In addition to expanding the geography of research objects on this topic, research works emerge on specific elements of urban environment and their adaptation to the cold climate. In "Urban Drainage In Specific Climates," C. Maksimovic analyzes and classifies the problems of design and operation of drainage systems in a cold climate in the case of Scandinavia (2000). Among modern studies on problems of urban planning in cold regions, we can mention the work of Saeed Ebrahimabadi on considering climatic factors in urban design (2015). Essi Oikarinen's analysis of concepts in the approach to climate-aware urban planning and design in the northern climate is also noteworthy (2014). Peter Bosselmann, Edward Arens, Klaus Dunker & Robert Wright studied the impact of the current layout of Toronto on the manifestation of weather factors (1995). Patrick J. Coleman in "Pedestrian mobility in winter" explored the problem of pedestrian activity in the winter period and considered a number of approaches and solutions for stimulating walking in the cold season (2001).

In Russia, the problem of climate-aware urban improvement has not been studied, in contrast to construction issues in cold climates, as evidenced by a small number of studies on this topic. For example, A. Klochko, PhD, in "The Impact of Climate Change on Architectural Urban Design and Regulation" focuses on the need for further analysis and revision of building norms and standards, taking into account the climate in Moscow (2013). Another work that can be mentioned here is "Specifics of Design and Construction of Low-Rise Buildings in the Arctic," where Professor Yu. Varfolomeev compiles a list of changes recommended for inclusion in SP 42.1330.2016 in order to improve current legislation in the sphere of urban planning (2014). His conclusions are based on the results of a 30-year study of construction and operation of low-rise buildings in the Arctic zone of Russia.

Despite the fact that scientific interest in the problem of urban planning in cold climates continues to grow, available research is rarely used directly in urban design and improvement. Scientific research in this area is not given due attention. City authorities often face a number of limitations: lack of knowledge and tools, political peculiarities, other priorities in planning practice, economic situation. An analysis of the research background on this issue showed that most publications are aimed at structuring knowledge in the field of urban planning in view of climatic characteristics in order to apply this knowledge in future practice. In other words, setting the principles and rules for urban design in cold regions should serve as the basis for improving official standards and introducing new solutions in the field of planning and improvement.

3. International experience in urban planning in cold climates

The climate in some regions of Canada, USA, Finland, and Russia is similar. In these countries there are many cities with long and cold winters, plenty of snow and wind. In Russia these are Murmansk, Yakutsk, Syktyvkar, in the USA these are cities of Alaska, such as Anchorage and Juneau, in Canada – Edmonton and Fort St. John, in Finland – Helsinki and Oulu. The list is not limited to these cities only. In any of the countries under consideration there are settlements with an average winter temperature from 0 down to −15 °C, with extreme cold, and heavy snowfall. Thus, it is permissible to consider the experience of the USA, Canada and Finland when developing recommendations for improvement of Russian standards. Borrowing experience will make it possible to adapt proven practices and simplify the development of guidelines for Russia.

3.1 Regulations for improvement in cold climates in the USA, Canada, and Finland

Emma Sanborn in her work “Integrating Climate Sensitive Design Principles in Municipal Processes: A Case Study of Edmonton’s Winter Patios” views the development of climate-aware urban planning in the context of Canada (2017). Starting from the 2000s, the focus of urban planning has begun to shift towards climatic characteristics, ecology and cultural diversity. Improvement of the urban environment has become an important aspect of city planning policy at the local level. Various guidelines and recommendations focused on the problem of designing an environment for cities with cold climates have begun to appear. For example, a set of recommendations for improvement to be used in the design of urban areas has been developed for the city of Edmonton. The document covers a wide range of aspects: the location of buildings, the layout of the street grid, the design of facades, creation of public spaces, arrangement of public transport stops, planting. Despite the fact that the document is not an official guide, the recommendations contained in it can be used to resolve various issues in the field of urban planning.

For the city of Fort St. John, a set of recommendations for designing the urban environment has also been developed. The document describes such aspects as the use of materials and colors, planting, improvement of public areas, parking planning. For the cities of Thunder Bay and Vancouver, similar guidelines have been developed, the use of which is recommended when designing an urban environment where the climatic characteristics are of high priority. As can be seen from the above analysis of sources, in Canada there is vast experience in studying the problems of improvement in cold climates, as well as in developing special regulations.

The experience of the USA in climate-aware design and improvement is well reflected in the documents regulating the city-planning activity in Anchorage, Alaska. For example, in the regulations for street improvement and landscape design, attention is paid to greenery planting: plant species should be selected taking into account the characteristics of the climate in the region; evergreen plants that can relieve the winter landscape and offer protection from the wind are recommended for use; in winter it is recommended to use fences protecting trees and shrubs during mechanized cleaning of the site; when planning the territories, planners have to provide zones for storing snow during winter cleaning; in doing this, it is necessary to find a compromise between the convenience of movement for pedestrians and cars and the need to store snow; also, planners are required to provide for possible winter activities that can be organized in popular areas of the city – their size should allow for making a ski track or building an ice rink. As the USA has only a small number of areas with a harsh climate, this country has less experience in developing climate-aware standards and guidelines than Canada.

In Helsinki, Finland, street improvement is regulated by an official guideline. The document contains instructions on how to design, organize and maintain streets to ensure a high-quality urban environment. However, with regard to climate-aware improvement, it only states that outdoor furniture should be located so that the area around it can be mechanically cleaned. The remaining aspects are only covered superficially. Since regulations and official documents in Finland are written in Finnish, it prevented us from analyzing the experience of Finland in climate-aware design and improvement in detail.

Based on the results of the search for studies and standards for improvement in the 3 mentioned countries, it was decided to thoroughly study the experience of Canada and apply it in developing recommendations for enhancing Russian standards for design and improvement. It is in Canada that official and unofficial regulations for different cities are developed with detailed consideration of the basic aspects of improvement. In addition, the largest number of sources found are devoted to the problems and experience of Canada in the field of climate-aware design and improvement. The Canadian climate is characterized by cold winters and cool summers due to the geographic location of the country. In the north of the country, polar climate prevails. On the territory of Canada, there are cities located in subarctic zones with a relatively low average annual temperature and abundant precipitation in winter. For example, in Brandon, Winnipeg, Edmonton or Whitehorse, average monthly temperature in winter can drop down to −15 °C even in the southern part of the country, although you can as well expect temperatures of about −40 °C with strong ice-cold winds. Average annual temperature in some Canadian cities is the same as in many Russian cities.

3.2 Regulations for improvement in cold climates in Russia

According to Russian legislation, city planning regulations (SP and GOST), including ones on improvement, are divided into mandatory and voluntary. The mandatory regulations are mainly technical regulations that set minimum requirements necessary to protect the life and health of citizens, ensure environmental protection, fire safety, etc. In this work, we analyzed the regulations aimed at aspects of improvement and space management. In order to describe the situation more accurately, we divided the aspects found into two groups, depending on the mandatory or voluntary nature of the regulation in question. The mandatory standards for improvement which take the climate into account are listed in Table 1.

Regulatory document	**The statement of the aspect**
SP 34.13330.2012 "Automobile roads"	Climate zoning should be considered in roadway construction
SP 42.13330.2016 "Urban development. Urban and rural planning and development"	The planning pattern should be developed in view of natural and climatic conditions
	For areas north of 58°N, the dimensions of residential areas may be reduced but not more than by 30%
	Distance from pedestrian walkways to the nearest public transport stop should be reduced to 300 m or to 400 m depending on the climatic conditions
SP 52.13330.2016 "Daylighting and artificial lighting"	Lighting of the roadway of streets, roads and squares of urban settlements located in the northern climatic construction zone of the Asian part of Russia and north of 66°N in the European part of Russia should be designed based on the recommendations listed in the document

Table 1: Mandatory regulations for improvement taking into account climatic characteristics

The list must be supplemented with optional regulations, which are presented in Table 2.

Regulatory document	**The statement of the aspect**
SP 42.13330.2016 "Urban development. Urban and rural planning and development"	Public spaces should be provided in residential areas taking into account natural and climatic characteristics
	The density of residential and business buildings should depend on natural and climatic characteristics

Table 2: Non-mandatory regulations for improvement taking into account climatic characteristics

As can be seen in Table 1 and Table 2, there are very few aspects in federal legislation that emphasize special requirements for design in cold climates, and they mainly contain general guidelines without details. There is no systematic approach to the consideration of climatic characteristics in design and improvement either in mandatory or in voluntary regulations.

In addition to federal regulations that control city planning throughout the country, there are local regulations for individual regions or cities. Local regulations are necessary to clarify the federal ones and to cover the missing aspects. In order to identify aspects of climate-aware improvement in local regulations, several cities were selected that belong to the same climatic sub-area of Russia, have similar climatic characteristics, are capitals of their regions and have publicly available documents. The results of identifying such aspects are given in Table 3.

City	**Average winter temperature**	**Local regulatory document**	**A suitable aspect**
Syktyvkar	−12.8 °C	Local standards of city-planning design of Syktyvkar	The following aspects are taken into account in the design of small architectural forms (SAF): Correspondence of SAF materials and design to the climate and the purpose of the SAF
			Protection against frost and snow drift, ensuring water drainage
			Convenient maintenance, as well as mechanized and manual cleaning of the territory near the SAF and under the building
			Cleaning of the territory in winter
Yakutsk	−36.7 °C	City improvement rules for Yakutsk	To protect pedestrians and protruding glass shop windows from snow and icicles falling from the edge of the roof, it is recommended to install special protective nets at the level of the second floor. To prevent icicle formation, the use of an electrical circuit along the outer perimeter of the roof is recommended.
			Cleaning in winter
Murmansk	−9.3 °C	City territory improvement rules for Murmansk	As unfavorable climatic factors affect different parts of the city, protective green areas are formed
Vorkuta	−18.8 °C	City territory improvement rules for Vorkuta	Removal of snow and ice during winter cleaning; snow storage; snow disposal; clearing of icicles
Irkutsk	−16 °C	City territory improvement rules for Irkutsk	Materials for advertising boards should be used in view of climatic characteristics
			Specifics of territory cleaning in winter: cleaning technology, frequency of cleaning, snow storage

Table 3: Results of the analysis of local standards for improvement and space management

As can be seen in Table 3, local regulations complement the overall list of aspects that take into account the climatic factor. Nevertheless, all the listed aspects are mentioned superficially, no recommendations for compliance are given. In order to specify the shortcomings and gaps in the Russian regulations, it is necessary to compare them to foreign documents.

4. Comparison of Russian and international regulations for improvement

In order to determine what aspects of design and improvement in Russian regulatory documents need to be enhanced, it is necessary to highlight the existing aspects in federal and local documents. Such aspects are presented in Figure 1.

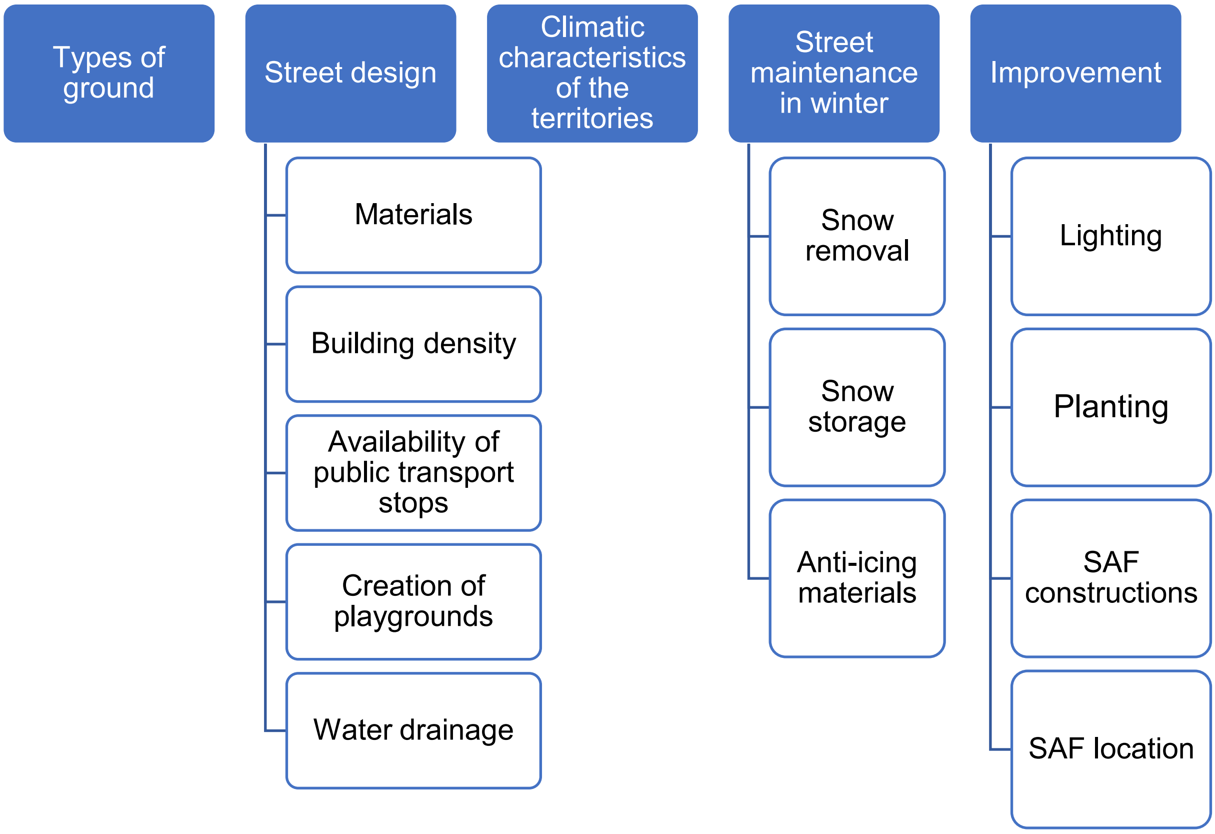

Figure 1: Aspects of improvement and design covered by Russian regulations

Most of the design and improvement aspects listed in Figure 1 need to be enhanced. The aspect of street maintenance and cleaning in winter is covered in most detail, including rules for cleaning frequency, places for storing snow, protection from ice and slippage, cleaning technologies, requirements for mechanized cleaning, protection of pedestrians from falling icicles. For this aspect, a recommendation can bed borrowed from the Anchorage improvement regulations, where it is recommended to fence off greenery in winter in order to prevent it from being damaged during mechanized snow removal. In general, the aspect of cleaning and maintaining streets in winter is covered in detail in the Russian regulations, but the recommended technologies are outdated compared to those used in other countries.

The aspect of street improvement is covered superficially in the Russian regulations, so they can be enhanced by borrowing a number of recommendations from international regulations, namely: Edmonton Winter Design Guidelines; Fort St. John Winter City Design Guidelines; Vancouver Street Restoration Manual; Thunder Bay Urban Design and Landscape Guidelines; Anchorage Design Criteria Manual. The following recommendations can be used to enhance the design and improvement practice:

1. Planting. Recommendations for the use of certain plant species that are suitable for cold climates, including evergreen plants; using greenery to protect streets from the wind; protecting plants from damage during mechanized cleaning.
2. Design of sidewalks. When designing sidewalks, it is important to provide for snow removal in winter. Sidewalks need to be wide enough for mechanized cleaning. In addition, buffer zones should be provided for temporary storage of snow, otherwise snow will accumulate on the sidewalk and reduce its walkability. In addition, it is recommended to use surface materials for roads and sidewalks that are easy to clean from ice and resistant to reagents. Innovative technologies should be used in the field of urban environment design, for example, heated sidewalks can prevent the accumulation of snow and ice.

3. Designing intersections and pedestrian crossings. It is recommended to ensure good visibility of signs and traffic lights at the intersections, so that they are always noticeable in periods of short daylight. It is recommended that the phases of the red traffic signal be shortened so that pedestrians do not have to stand in the cold air for a long time. The roadway in the pedestrian crossing zone must be narrowed to provide pedestrians with the shortest possible trajectory of movement. Elevated pedestrian crossings should be used to avoid the accumulation of snow and water on them.
4. Lighting. In conditions of short daylight hours, it is recommended to use good lighting of sidewalks, motorways, bicycle lanes, public transport stops, pedestrian crossings. At the same time, it is important to develop such a lighting system that electricity is used efficiently and the maximum amount of light is delivered in periods of poor visibility. In winter, additional lighting can be used for trees and facades as part of city decoration.
5. Public spaces. It is recommended to install screens for wind protection, gas heaters and other heating structures in order to make it comfortable to be outdoors. Public spaces, such as parks, should be multifunctional and provide an opportunity to organize winter activities in them.
6. Outdoor furniture. It is important to install outdoor furniture from materials with low heat emission, so that it is comfortable to sit on the furniture at any temperature. It is recommended to place seats and leisure facilities in such a way that the wind blows in the back. In addition, surfaces should preferably be deigned in such a way that accumulated snow is easy to scrape off. Outdoor furniture should not prevent snow removal, so its location is important. It is necessary to provide places for seating with temporary roofs or canopies so that people can stay outdoors during snowfalls. Movable outdoor furniture is suitable, so that people can move it and always be under the sun or stay protected from the wind.
7. Navigation. Urban navigation should be as informative as possible, namely, important directions and an approximate time to the destination should be displayed. It is important to provide an option for changing the content of the signs, so that new directions can be added in winter. By default, signs should be well visible in the dark and during snowfalls, and have such a form that they don't accumulate snow on their surface.
8. Public transport stops. Providing stop shelters with panels displaying transport arrival time will make waiting more comfortable for passengers. In extremely cold regions it is recommended to make enclosed shelters to protect passengers from cold temperatures and wind.
9. Seasonal activity. Winter provides an opportunity to organize seasonal activities, such as festivals and sports events, which will ensure active street life throughout the year.
10. Drainage systems and water removal. In periods of warming after negative temperatures, a large amount of water emerges, which must be removed in a timely manner from streets, sidewalks, roofs and public spaces.
11. Street art. Placing permanent and temporary art objects stimulates traveling around the city and spending time outdoors even in winter.
12. Building. It is recommended to plan the building process in such a way that the distances between residential houses and social objects are minimal. At the same time, the location of buildings should consider the wind chart and insolation. Streets should be protected from the wind and illuminated by the sun as much as possible.

5. Conclusion

In this work, we have managed to analyze the Russian experience and the experience of the USA, Canada, and Finland in improvement and space management. Regulations, official and unofficial guidelines, research works and reports have been studied. A comparative analysis of Russian and foreign regulations has made it possible to identify aspects and directions in improvement that are not currently taken into account in Russia, or require further elaboration and specification. As a result, a list of 12 directions with brief characteristics of each direction has been compiled. At the next stage we plan to work out solutions, technologies, regulations, and rules: a guideline will be drawn up with specific recommendations on street design, space management and improvement. The resulting guideline can be used as a comprehensive manual for architects and planners in Russia and other countries. Based on the recommendations included in it, amendments to official federal and local city planning regulations will be developed.

Acknowledgment

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A Resilient Coastal Mega City, A Resilient People: Flooding as a Climate Change Threat in Lagos, Nigeria

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ABSTRACT

With an estimated population of about 11.2 million Lagos popularly referred to as 'Èkó' or 'Lasgidi', is a coastal city vulnerable to recurrent flooding which has progressively modified the shoreline but the residents and city's resilience to recurrent flooding is incomprehensible. With increasing urbanisation, population growth, urbanisation of poverty and daily influx of people from other States of the Federation, various settlements have evolved along the wetlands without supportive infrastructures thus, making neighbourhoods highly vulnerable to flooding. The paper examines residents' vulnerability and resilience to flooding, the coping and mitigating strategies and policies that have been adopted by residents and the State. For a resilient city and a resilient people the paper proposes resilience thinking and adaptive governance through flood mitigation education and awareness programs that eradicates or minimizes refuse or debris dumping in storm-water channels.

INTRODUCTION

Nigerian cities, in low lying terrains like Lagos, are prone to coastal, river or urban flooding. Urban flooding occurs where little or no provision has been made for surface drainage, or where existing drainage has been blocked with municipal waste, refuses and eroded soil sediments (Folorunsho and Awosika, 2001). Urban flooding is a serious disaster in the world, which not only causes serious damage, disturbs normal life and working conditions, but also pollutes the city and causes sanitary problems (Chen, 2004).

Lagos, a vibrant commercial capital is a megacity occupying two main islands in the Atlantic Ocean, separated by creeks and mangrove swamps. Lagos experiences coastal and urban area flooding, high tidal levels, ocean waves, and storm surges. Inadequate infrastructures to contain the run-off, peoples' attitudes and non-compliance to physical planning measures all constitute barriers to proper flood control. The major causes of flooding in these areas include excessive and recurrent rainfall, overflow of water bodies, encroachment of building on flood-plain, poor/faulty/non-functional drainage network and indiscriminate dumping of waste into water channels leading to drainage blockage. Lagosians continue to be vulnerable to flooding and their resilience in addressing the flooding challenges remains unparalleled.

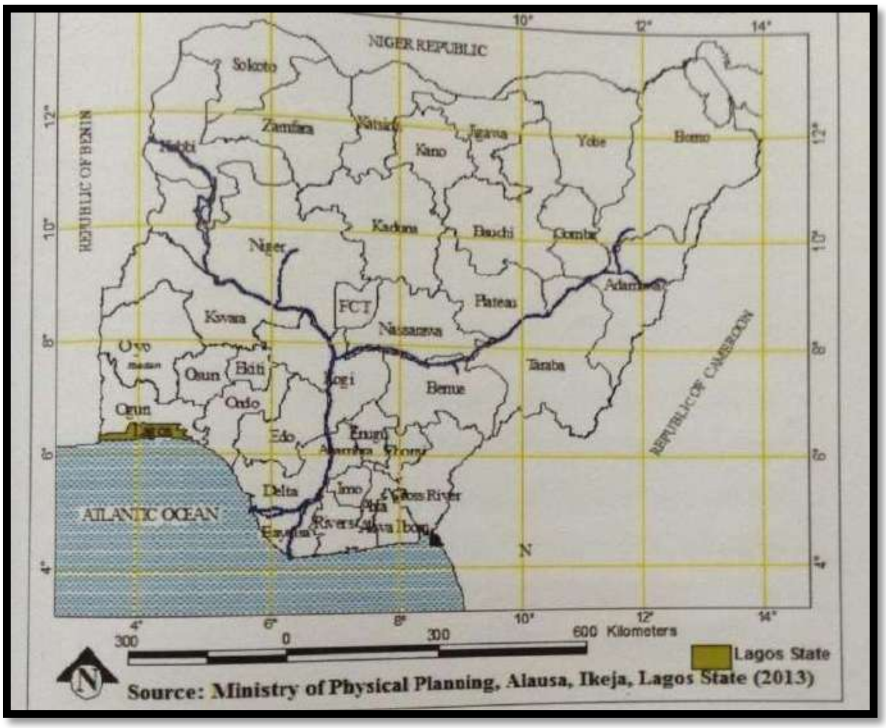
Resilience means "ability to adapt to and through a difficult situation. Resilience is a term that is often used to mean 'bouncing back from a terrible event' or 'having strength to cope', or 'being determined to see things through to the end" (Mowbray, 2011:2). Resilience refers to the process of overcoming the negative effects of risk exposure, coping successfully with traumatic experiences, and avoiding the negative trajectories associated with risks (Fergus and Zimmerman, 2005). Resilience and Resilience thinking enables the system, individual, people, community, city or economy to adapt and embrace shocks arising from a catastrophe though innovative resolutions.

The paper examines residents' vulnerability and resilience to flooding, the policies that have been adopted by residents and the State to cope with flooding. For a resilient city and a resilient people, paper adopts the resilience framework and proposes resilience thinking and adaptive governance (through flood mitigation education and awareness programs well as integration of geo-spatial and remote sensing techniques towards appropriate flood modeling, simulation and forecasting) as an approach to minimize the devastating impact of flooding.

STUDY AREA

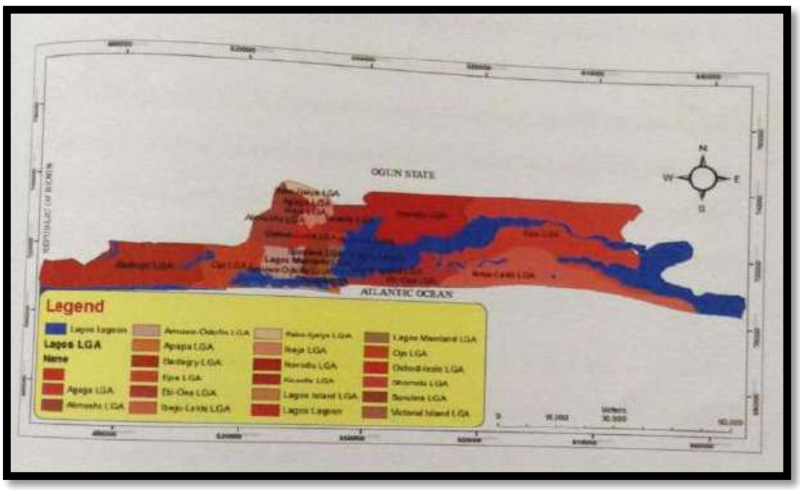
Lagos megacity occupies two main islands in the Atlantic Ocean, separated by creeks. Its land area is 153,340 hectares, with 209 km^2 (some 19.6 per cent of its landmass) covered by water and mangrove swamps (Filani, 2012). The seat of Nigeria's government until 1986, Lagos (Figure 1) remains the nation's commercial capital, contributing more to its economic growth than any other city. With an estimated population of 16 million, Lagos is the most populous conurbation in Nigeria with a population density of about 5,000 persons/km2, making it one of the most densely populated cities in Africa (Filani, 2012).

Figure 1: Lagos State in Nigeria context



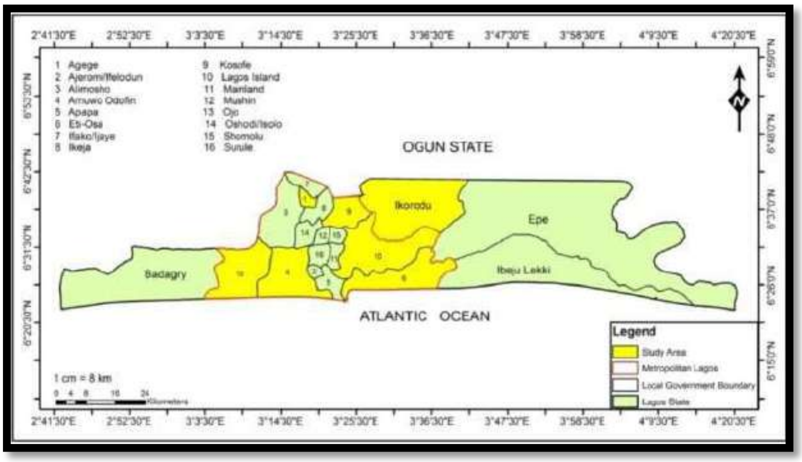
Source: Ministry of Physical Planning, Alusa, Ikeja, Lagos State, 2013.

Lagos State has 20 Local Government Areas (LGA) (Figure 2), out of which 16 make-up the metropolis. The Local Governments considered in this study include Ojo, Kosofe, Eti-Osa, Lagos Island, Amuwo-Odofin, Ikorodu, Ajeromi-Ifelodun and Agege (Figure 3).



Source: Information Unit, Lagos State, 2014

Figure 3: Local Government Areas under study within Lagos State Context



Source: Authors, 2015

METHODOLOGY

The study utilized both secondary and primary data. The secondary data regarding coping and mitigating policies and its implementation were obtained from the Lagos State Ministry of Environment- Lagos State Waste Management Authority (LAWMA), Office of Drainage Services; and Lagos State Emergency Management Agency (LASEMA). Primary data was collected using informal interviews and structured questionnaires administered in 2014/2015 on 150 residents through purposive sampling to elicit information regarding frequency of flood occurrence and residents coping mechanisms.

RESILIENCE FRAMEWORK

Resilience is the "the ability of a system to absorb disturbances and still retain its basic function and structure" (Walker and Salt, 2006:.1) and "the capacity to change in order to maintain the same identity" (Folke et al., 2010). Resilience is about survival and adaptability. Resilience is "the ability of a system to maintain its structure and patterns of behavior in the face of disturbance" (Holling, 1986:296). Resilience "is the ability to persist and the ability to adapt" (Adger, 2003:1).

Resilience originated in the 1970s in the field of ecology from the research of C.S. Holling (Pisano, 2012). Resilience is defined as "a measure of the persistence of systems and of their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables" (Holling, 1973:14). The concept of resilience in relation to social–

ecological systems incorporates the idea of adaptation, learning and self-organization in addition to the general ability to persist disturbance (Folke, 2006). "Resilience is the capacity of a system be it an individual, a forest, a city or an economy, to deal with change and continue to develop. It is about the capacity to use shocks and disturbances like a financial crisis or climate change to spur renewal and innovative thinking. Resilience thinking embraces learning, diversity… and humans and nature are strongly coupled to the point that they should be conceived as one social-ecological system" (Moberg and Simonsen, 2014:3).

The resilience perspective shifts policies from those that aspire to control change in systems assumed to be stable, to managing the capacity of social–ecological systems to cope with, adapt to, and shape change (Berkes et al., 2003, Smit and Wandel, 2006).
Resilience in the ecological literature reflects different aspects of stability that focuses on efficiency, constancy or persistence, change and unpredictability (Gunderson et al, 2002). He notes "the differences between these two aspects of stability – essentially between a focus on maintaining efficiency of function (engineering resilience) versus a focus on maintaining existence of function (ecological resilience) – are so fundamental that they can become alternative paradigms whose devotees reflect traditions of a discipline or of an attitude more than a reality of nature …"(Gunderson et al, 2002:1).

Resilience Thinking

Resilience thinking on the other hand "is about generating increased knowledge of how we can strengthen the capacity to deal with the stresses caused by climate change and other aspects of global change. It is about finding ways to deal with unexpected events and crises and identifying sustainable ways for humans to live within the Earth's boundaries" (Moberg and Simonsen, 2014:3). "Resilience thinking provides a framework for viewing a social-ecological system as one system operating over many linked scales of time and space [notwithstanding that] its focus is on how the system changes and copes with disturbance" (Walker and Salt, 2006:38). Resilience thinking addresses the dynamics and development of complex social–ecological systems (SES) (Folke et al., 2005)). Three aspects are central: "resilience, adaptability, and transformability" (Pisano, 2012:12). For resilient world the values of diversity, ecological variability, modularity, acknowledging slow variables, tight feedbacks, social capital, innovation, overlap in governance, ecosystem services (Walker and Salt, 2006). Table 1 shows the facets of resilience.

Table 1: Three Facets of Resilience

Resilience concepts	**Characteristics**	**Focus on**	**Context**
Engineering resilience	Return time, efficiency	Recovery, constancy	Vicinity of a stable equilibrium
Ecological resilience	Buffer capacity, withstand shock, maintain function	Persistence, robustness	Multiple equilibria, stability landscapes
Social–ecological resilience	Interplay disturbance and reorganization, sustaining and developing	Adaptive capacity transformability, learning, innovation	Integrated system feedback, cross-scale dynamic interactions

Source: Folke (2006)

Pisano (2012:9) focuses on social-ecological resilience as the best suited for considering governance issues and conceptualises resilience characteristics through the definition of social-ecological resilience that, draws from Carpenter et al (2001) as the:

- Amount of disturbance a system can absorb and still remain within the same state or domain of attraction;
- Degree to which the system is capable of self-organization;
- Ability to build and increase the capacity for learning and adaptation.

Social–ecological resilience is about people and nature as interdependent systems. This is true for local communities and their surrounding ecosystems, but the great acceleration of human activities on earth now also makes it an issue at global scales (Steffen et al, 2007), making it difficult and even irrational to continue to separate the ecological and social and to try to explain them independently, even for analytical purposes (Folke et al, 2010).

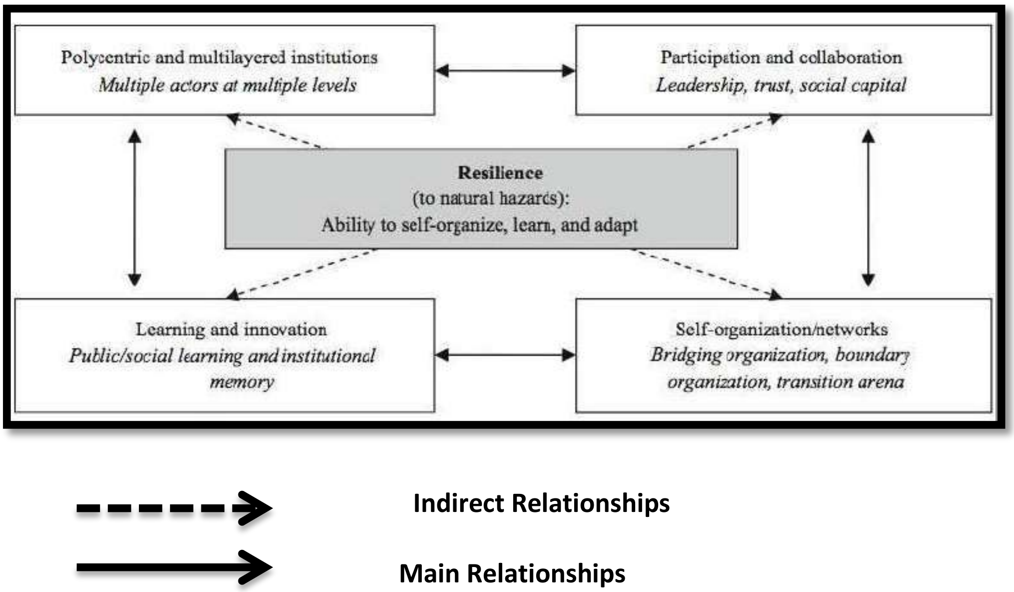
Adaptive Governance

The Stockholm Resilience Centre considers adaptive governance as “an evolving research framework for analysing the social, institutional, economical and ecological foundations of multilevel governance modes that are successful in building resilience for the vast challenges posed by global change, and coupled complex adaptive Socio-Ecological Systems” (Pisano, 2012: 25). Adaptive governance deals with the complex issues that socio-ecological systems are confronted with (Pisano, 2012). Adaptive governance is best understood as an approach that unites those environmental and natural resource management approaches that share some or all of the following principles: polycentric and multi-layered institutions, participation and collaboration, self-organization and networks, and learning and innovation (Djalante, Holley and Thomalla, 2011). Four interactive crucial aspects for adaptive governance are suggested by Folke et al (2005) namely: (1) to build knowledge and understanding of resource and ecosystem dynamics; (2) to feed ecological knowledge into adaptive management practices; (3) to support flexible institutions and multilevel governance systems; and,(4) to deal with external perturbations, uncertainty, and surprise. Figure 4 shows an illustrative representation of the links between the crucial characteristics of adaptive governance that will help in building and governing resilience (Pisano, 2012).

Folke et al. (2005) recommends four interactive crucial aspects for adaptive governance:

- Build knowledge and understanding of resource and ecosystem dynamics
- Feed ecological knowledge into adaptive management practices
- Support flexible institutions and multilevel governance systems
- Deal with external perturbations, uncertainty, and surprise

Figure 4: Interlinkages between key characteristics of adaptive governance in relation to building resilience



Source: Djalante, Holley and Thomalla (2011).

RESIDENTS PROFILE

The residents profile is shown in Table 2. About 52.7% and 47.3% of respondents were men and women respectively. 62.6% of respondents were above 40 years old while about 37.4% of respondents were above 40 years old. In regards to marital status 37.3% were single, while 50%, 6% and 6.7% of the respondents were married, divorced and separated respectively. 12.7% of respondents had no education while 34.7%, 28.6% and 24% of respondents had primary, secondary and tertiary education respectively. About 60% of respondents earned less than ₦40000 (US$111) per month while 30% earned between ₦ 41000 and N80000 per month (US$114-US$222) and 10% earned above ₦ 80000 (US$222) per month. 21.3% of respondents have stayed in the study area since birth, 27.3% between 1-5 years, 22.7% between 6-10 years, 11.3% between 11-15 years and 17.3% have stayed in the study area for above 15 years. Some of the factors which attracted respondents to the flood prone areas include low rent (28.7%), low rent and proximity to work (13.3%), low rent and market availability (9.3%), availability of cheap land (14.7%), nearness to work place (11.3%), and family ties (12.7%). All the respondents in the areas visited attested to have experienced flooding before.

Table 2: Respondents socio-economic profile

Sex	**Number**	**%**
Male	79	52.7
Female	71	47.3
Total	**150**	**100**
Age	**Number**	**%**
less than 20 years	26	17.3
21-40 years	68	45.3
41-60 years	40	26.7
Above 60 years	16	10.7
Total	**150**	**100**
Marital status	**Number**	**%**
Single	56	37.3
Married	75	50
Divorced	9	6
Separated	10	6.7
Total	**150**	**100**

Level of Education	**Number**	**%**
No formal education	19	12.7
Primary	52	34.7
Secondary	43	28.6
Tertiary	36	24
Total	**150**	**100**
Monthly Income in Naira (₦0	**Number**	**%**
Less than₦ 20,000	45	30
₦ 20,000 - ₦ 40,000	45	30
₦ 41,000 - ₦ 60,000	26	17.3
₦ 61,000 - ₦ 80,000	19	12.7
Above ₦ 80,000	15	10
Total	**150**	**100**
Duration of Residency	**Number**	**%**
Since Birth	32	21.3
1- 5years	41	27.3
6-10years	34	22.7
11- 15years	17	11.3
above 15years	26	17.3
Total	150	100

In 2018 the exchange rate is $1=360

RESIDENTS VULNERABILITY TO FLOODING

Lagos State is susceptible to recurrent yearly flooding due to its spatial location, topography, urbanization of poverty and crowding. The incidence of flooding is indicated in Table 3.

Table 3: Flood incidence in Lagos State from 2000 to 2014

Year	**Affected locations**	**Rainfall began**	**Duration in days**	**No of deaths**	**Number of displaced persons**	**Main cause**	**Comments**
2000	Most parts of the metropolis	22/5/2000	1		None	Rainfall	Socio-economic activities paralyzed, road blocked
2000	Lagos City	20/5/2000	2	10	None	Rainfall	The flooding was up to a metre (yard) deep

Table 3: Flood incidence in Lagos State from 2000 to 2014

Year	Affected locations	Rainfall began	Duration in days	No of deaths	Number of displaced persons	Main cause	Comments
							in several low-lying areas of the city, tens of thousands of homes all over the city were inundated with water.
2002	Lagos	7/24/2002	3	2	None	Rainfall	A mother and baby drowned
2004	Lagos City	6/17/2004	2	0	None	Rainfall	Ten hours rain floods large areas of Lagos City hyped by locked drains caused by dumping refuse
2007	Lagos area- Ikorodu, Kosofe	8/1/2007	15	6	5000	Rainfall	Ogun river flooding; 4,000 homeless in Lagos. 200 buildings destroyed 6 people dead
2009	Lagos Mainland – Apapa axis	30/6/2009	2		None	Rainfall	
2010	Lagos business districts, Island	7/7/2010	1		1760	Rainfall	Most streets in the city's key business district were swallowed up in flood. Motorists forced out of business.
2010	Lagos mainland and Island	14/6/2010	1		None	Rainfall	Roads were flooded. Canoes constructed to ferry people across 'the river'.
2011	Lagos	10/7/2011	2	Over 25	5393 households	Rainfall	5,393 households were affected in 31 districts/streets. Estimated output loss of ₦100 billion
2012	Lagos mainland and Island	27/06/2012	3	7	None	Rainfall	Houses submerged, one collapsed in Bariga. Community linking bridges washed off; pupils trapped; roads and bridges were submerged by the flood, and many properties were swept away
2013	Lagos Island and Mainland	10/4/2013	1		None	Rainfall	Commuters were stranded as downpour causes flooding, gridlock in Lagos
2013	Lagos Island	9/08/2013	1		None	Tidal waves	Homes were flooded
2014	Lagos Island and Mainland	20/4/2014			None	Rainfall	Roads and Drainages were submerged
2014	Lagos Island and Mainland	10/07/2014	1		None	Rainfall	Roads and Drainages were submerged; movement was impeded.

Source: Informal Research culled from various Newspaper sources in Nigeria (Vanguard, The Punch, Business Day, Daily Champion, Daily Times, Global Flood Register).

The major causes of flooding in the study locations include:

- Flat topography
- Excessive and recurrent rainfall
- Overflow of water bodies
- Encroachment of building on flood-plain
- Absence of building setbacks and construction of houses on drainage or water ways (Photo 1)
- Opening of a dam (Oyan dam) in neighbouring Ogun State
- Poor/faulty/non-functional drainage network (Photo 2) and,
- Indiscriminate dumping of waste into water channels leading to drainage blockage

Most of these factors seemingly are human triggered apart from the topography. In low lying areas like Amuwo- Odofin, Ajegunle, Owode and Ojo, residents said flooding occurs anytime there is a heavy rainfall for several hours.

Photo 1: Inadequate setback of houses

Source: Authors 2015

Photo 2: Clogged drainage between houses

Source: Authors 2015

Incomplete canal dredging and inadequate infrastructures to contain the run-off constitute barriers to proper flood control measures. For example, in Ajegunle, a canal was dredged in 2010 after the flood with the expectation that it would be concretized but up till not completed. Residents complained that flooding effect have heightened after the dredging than it was before the dredging (Photo 3). The unfinished dredged canal accumulates stagnant water and remains a breeding ground for mosquitoes and flies. Residents notes the Lagos State Waste Management Authority (LAWMA) comes around once in a while to spray the water to avoid/minimize flies infestation.

Photo 3: Abandoned dredged canal

Source: Authors 2015

Peoples' attitudes, non-compliance to physical planning measures and high rate of influx of people into the city of Lagos has led to indiscriminate development and construction of different forms of unsustainable and unstable shelter/housing that fail to comply with planning regulations and standards of housing development. These developments impede free flow of water and run-off during and after rainfall thus leading to flooding. Floods have devastated many parts of Lagos leading to loss of several lives and property and the displacement of many people.

RESIDENTS RESILIENCE

The immediate response to flooding by the residents varies. About 23.3% of respondents want to leave the area (flee from area), 22.7% of respondents fill the roads with sand using sandbags, putting wood shavings on roads; 22.7% of respondents use buckets to dispose flood water from their houses; 16.7% of respondents want to relocate temporarily; and 37.3% of the respondents have done nothing during the flooding incidences.

However, over the years, residents of these areas have adopted various coping strategies. These include:

- Clearing and de-silting of drainage,
- Building of embankments and raising of building frontages,
- Use of boats for movement during flooding,
- Building high walls to prevent floodwater from entering the houses, construction of trenches around houses,
- Arrangement of planks and tyres on sandbags to aid movement to their shops/buildings

However, in the low cost housing in Amuwo-Odofin residents who do not live on the ground floor worry less about flooding. With dysfunctional governance structure residents' adaptability is notable in the various methods used to contain flooding (Photos 4-7). The residents self organize to make their community flood resistance by using no or low cost materials like planks or used tyres to construct embankments and keep the community moving.

Photo 4: Sandbags and planks

Source: Authors 2015

Photo 5: Temporary bridges

Source: Authors 2015

Photo 6: Bridge made with planks

Source: Authors 2015

Photo 7: Planks placed on tyres for movement

Source: Authors 2015

Majority of these coping strategies are rudimentary, unsustainable, temporary and inefficient. Government Agencies like Office of Drainage Services, LASEMA and LAWMA have attempted some intervention according to the respondents.

POLICY RESPONSE

Office of Drainage Services

To combat the occurrence and re-occurrence of flooding in Lagos State, the Government through the Office of Drainage service embarked on the dredging of the silted streams and drainage channels in Lagos. In the year 2008, a total of 676,603.55 metric tons of silt were evacuated from existing collector drains and canals and carted away to maintain the hydraulic efficiency of the drains as designed. This is to improve their carrying capacities and enhance the efficiency of the channels to effectively drain storm-water run-offs. The first drainage master plan (Lagos Mainland drainage master plan) was designed and concluded in 1974 in a bid to control urban flooding and inundations (Drainage Department, Lagos State Ministry of Environment, 2014).

Subsequently, drainage master plans for other areas were concluded in 1992 and 1998 respectively. The 1992 master plans were the Apapa Storm water drainage master plan and Lagos Island Storm water drainage master plan. The identified works were divided into two namely Priority 1 works and Priority 2 but only priority 1 works have been implemented to date. The last master plan was Greater Lagos Drainage master plan and it was concluded in 1998.

In Lagos State, between 2007 and 2011 a total of 169 drainages were dredged, while 124 of the waterways were lined with concrete and about 45 channels were also dredged between 2007 and 2011, and proposed to be lined before 2015.

Lagos State Environmental Management Agency (LASEMA)

LASEMA strategies cover 5 main aspects:

- Flood Prevention: The LEMC (Local Emergency Management Committee) was established in 2014 under the Lagos State Environmental Management Agency. The committee consists of 774 local members from all the wards in the State. The members are from all agencies related to the environment, Community Based Organizations, and representatives of communities. The committee was established in accordance with priority 3 of the Disaster Risk Reduction Convention in Kobe, Japan. The goal of the committee is to ensure reduction of risk at local level through knowledge, innovation and education. These three elements would then build the culture of safety and resilience in Lagos Community.

- Flood Preparedness: Identification of flood vulnerable communities through risk mapping and hazard vulnerability mapping. Other agencies working on the environment are also identified for collaborative efforts for example the Nigerian Metrological Agency (NIMET), Lagos State Environmental Management Agency (LAWMA), Lagos State Environmental Protection Agency (LASEPA), Department of Metrological Services, Emergency Flood Abatement Department, an Office of Drainage Services in the Ministry of Environment, and Ministry of Physical Planning and Urban Development (MPPUD).
- Flood Mitigation: This involves the use of early warning systems to sensitize and educate vulnerable communities on how to prepare, respond to and recover from the impact of the disaster; monitoring and enforcement of environmental laws like the Lagos State building code and Lagos State emergency plans.
- Flood Response: Stock piling of necessary equipment to combat flood and ensure easy response, and building of relief camps for rehabilitation for affected persons. Presently, Lagos state has two existing relief camps in Lagos East- Agbowa, Lagos West- Igbodo and an on-going construction in Lagos central-Lekki. For example, the 1760 Internally Displaced Persons during the 2010 flooding were resettled temporarily at these relief camps.
- Flood Recovery: Obtaining the demography and characteristics of the people to ascertain and predict flood victims (so as to prepare relief materials and number of people that would be displaced.

Lagos State Waste Management Authority (LAWMA)

Spatial growth is not the only product of population expansion, but also, waste generation, particularly, municipal solid waste that is impossible to avoid. About 10,000 tons of solid waste is generated each day in Lagos, with GPC of 0.65kg/person/day. The rate at which municipal solid waste is being generated hinders the capabilities, financial and technical, of LAWMA to sanitarily manage waste. Solid waste is left uncollected and dumped indiscriminately in water bodies, air-spaces of buildings, open lands, road verges and public drains. Littered waste becomes permanent feature of urban landscape.

DISCUSSION

Flooding challenges due to the encroachment of buildings on flood-plains, poor/faulty/non-functional and inadequate drainage network; and indiscriminate dumping of waste into water channels have resulted into displacement of people, loss of livelihoods, loss of productive hours, pollution of drinking water, destruction of farm lands, housing and infrastructures, water borne diseases, and death as seen in this study.

Urban sprawl and urbanization of poverty continue to cause overcrowding, and poor quality of housing in Lagos as evidenced in the study locations. Inadequate urban planning, poor infrastructures or lack thereof, poor enforcement existing planning regulation and non-compliance by people continue to cause havoc especially during flooding incidence. With the ever increasing urban population in Lagos, encroachments of wetlands and building of illegal structures, flooding will continue to reoccur unless people and governance structures transform.

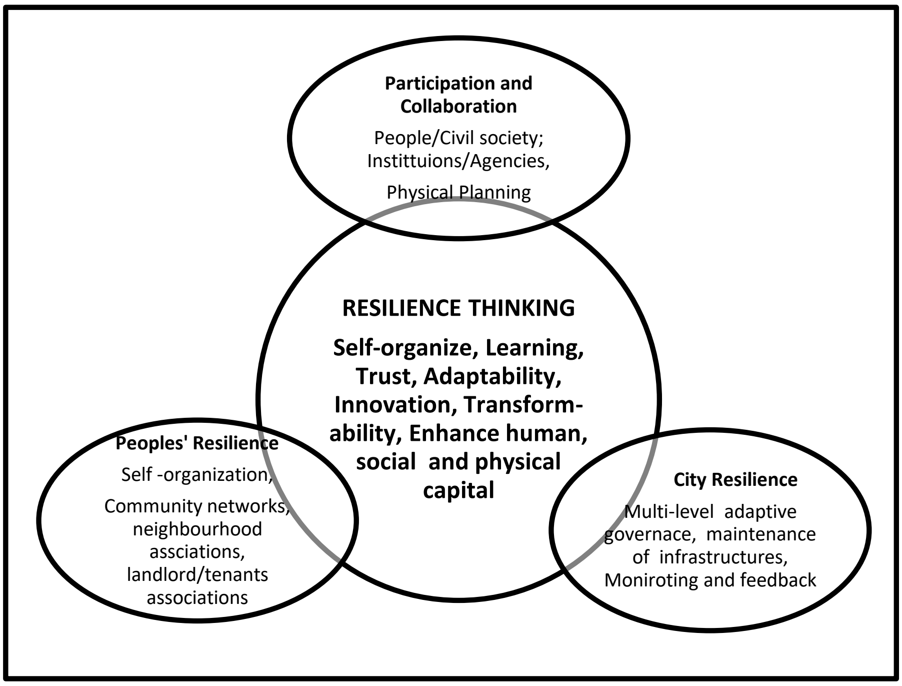
The people and city's resilience will continue to be tested in periods of flooding. Therefore adaptability measures that build resilience and transformability or transform-ability of residents and the governance regimes to self-organize and develop the capacity to learn and adapt is very critical.

Policy, programs, plans and projects by government agencies such as LASEMA, Lagos State Ministry of the Environment-Office of Drainage Services and LAWMA are laudable but have fallen short of people's expectations. Projects are not completed due to bureaucracy, funding inertia or lack of funds. Canal dredging and de-silting of drainages in areas like Ajegunle, Owode, Ojo, Agege, Amuwo Odofin, Lagos Island, Eti-osa were not completed, thus increasing the vulnerability of the people to more flooding disasters. Respondents noted the 'silent' inactivity of The Ministry of Physical Planning and Urban Development.

WAY FORWARD

Resilience thinking is about the capacity to learn, adapt, self-organize, and transform-ability. WEF (2018) notes the failure of urban planning, failure of regional or global governance and increasing urbanization are among the interconnected risks of climate change. Thus, planners have a major role in facilitating resilience thinking and developing tools together with the community (civil society) and policy makers to build resilience especially to avert flooding or any other environmental disaster (Figure 5).

Figure 5: Building Socio-Ecological Resilience in Flood Incidence



Source: Authors Conceptualisaton, 2015

Appropriate feedback and monitoring is also very critical to building resilience and achieving adaptive governance.

Planners

Physical (Community) Planners must ensure the:

- Facilitating participation and collaboration among civil society and policy makers
- Revision and enforcement of planning regulations, building codes, development control measures, zoning by-laws and change of use laws
- Revision and enforcement of Lagos building codes and non-compliance will lead to demolition of structures blocking the flow of drains and canals
- Improved sanitation and proper waste disposal measures
- Flood mitigation education and awareness
- Advice on building materials to be used in flood prone areas and
- Inform citizens about flood prone areas in the city
- Integration of geo-spatial and remote sensing techniques towards appropriate flood modeling, simulation and forecasting

Residents

People would always be at the centre of socio-ecological resilience. Residents should be properly informed and educated in the areas of:

- Utilizing good quality building materials,
- Proper waste disposal methods,
- Refrain from dumping waste indiscriminately or along water channels or in drains/gutter,
- Flood control and the devastating consequences
- Education is key to resilience thinking

Government

Multilevel governance is fundamental to resilience thinking and building resilience. Thus, the State Government through appropriate agencies (private, public, CBOs or NGOs) should:

- Develop awareness mechanisms as to the risk of flooding in communities
- Develop monitoring structures
- Set up effective information and warning systems
- Ensure enforcement and compliance of all environmental laws
- Ensure a budget reform for efficient performance
- Provision and maintenance of infrastructures
- Dredging and de-silting of blocked canals and drainages
- Review periodically flood adaptation and mitigation policies and programs

CONCLUSION

The communities in the study Local Government areas show resilience by the different measures adopted and adapted deal with flooding. These communities have persisted to reoccurring flooding. The utilization of planks/wood and used tyres (wheels) as pathways; and the construction of bridges to facilitate movement of people and goods indicate the extent of adaptability and transform-ability of the residents. For a resilient city and a resilient people, physical/community planners should begin to build resilience (socio-ecological resilience) and incorporate resilience thinking and adaptive governance into plan making, planning policy and practice especially in flood or any emergency and disaster situations.

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Challenges and lessons learned after Supertyphoon Haiyan in Tacloban City, Philippines

Paragas, Gerald, PANGASINAN, Philippines

ABSTRACT:

Touted as the world's strongest typhoon on record to make landfall, Haiyan slammed the central Philippines on 8 November 2013 with maximum sustained winds reaching 315 kph (170 knots) with gusts up to 379 kph (205 knots) just before landfall. The Category 5 (based on Saffir-Simpson hurricane scale) super typhoon, known in the Philippines as Yolanda, caused over 6,300 casualties, displaced over 4 million people and destroyed or damaged over one million houses due to high wind speed and storm surges. In total, 171 municipalities in 14 provinces across five regions of the country were affected by the storm. Tacloban, being the Eastern Visayas region's largest urban area and one of hardly hit areas, sustained the worst with damages estimated at Php 7 billion and recorded a death toll of almost 2,700 (Office of Civil Defense, 2014). The scale and nature of the impact of Haiyan created one of the worst humanitarian crises the Philippines has ever faced. To fulfil the overwhelming task for coordination, the cluster system was applied at the City Hall, with perceived parallel coordination efforts from regional and national governments, and international organizations.

In the aftermath of the supertyphoon, the City Government created a task force called *Task Force Tindog Tacloban*to 'coordinate the needs of the public and optimize the communication between the national government and the different international organizations with the local government' (CDRRMC Resolution No. 05, Series of 2015). Then later, the local government, with support from United Nations Human Settlements Program (UN-Habitat) and key agencies, began to conduct a purposive recovery and rehabilitation planning process which led to the creation of Tacloban Recovery and Rehabilitation Plan.

Sharing author's survivor accounts and actual involvement in recovery and rehabilitation efforts, with crucial information from partners in national government and non-government organizations, this study shall describe the experience of the Tacloban City Government, its challenges to include surge of foreign humanitarian workers, successes and lessons learned as the City transitioned from humanitarian response, to recovery and development phases after the disaster. The report will also examine the institutional systems which were set up to coordinate emergency response and recovery and rehabilitation in Tacloban, and reflect on the main achievements and lessons from emergency response to recovery to resilience and sustainable development. Over four years after the mega-disaster, the case of coastal Tacloban remains relevant today, showing the impacts of climate change to urban areas, and providing context to discussions on Philippine polices and international interventions related to disaster risk reduction and climate change adaptation.

THE DEVELOPMENT of JUWANA SETTLEMENT as a NORTHERN JAVA COASTAL CITY in INDONESIA HAS THE POTENSIAL TO SUPPORT GLOBAL MARITIME AXIS

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Keywords (3-5): *settlement development, coastal city, global maritime axis*

1. THE BACKGROUND

Juwana was a subdistrict town in Java north coastline of Indonesia became a trajectory of post lane (*Daendels*) from Anyer to Panarukan. Juwana was a coastline area and low plain passed by a largest river of Pati district namely Gonggo river. Society on the coastline of Gonggo river as a preliminary society developed Juwana as a town by applying dualistic concept cosmology and expressed in shape of residence, shape of worship building. Besides, concept of religious dualistically cosmology in determination of site of building toward the position of The Creator. Two aspects of dualistic were reflected on spatial form of outside space, spatiality, and shape of its building.

In its development of Dutch colonization, Juwana became Trade Hub a bit hectic and a significant port in Java island. Trade transaction of foreigners buying earth crops, including opium transaction. Therefore Juwana was North lane very significant, as a place for assembling-up ships, and industrial center of brass handicraft, batik, and cigarrette.

Society living in Juwana from generation to generation was a fishery society and milkfish producer whose their yields dominated milkfish market in Indonesia. Besides Juwana area has specific traits namely; a settlement of the beginning existed on the bank of river and coastline, formed liniary settlement. As time went by the Chinese merchants visited Juwana and established settlements with radial forms, there was open space in the midst as orientation center. Juwana developed with the establised axis of Daendels street penetrating liniary settlement, growing to be a town with a building in the architecture of colonialization of the Dutch, *Indisch*, the Chinese and the Java becoming characters of Juwana town.

This town experienced changes and development with the usage of settlement by fishermen, merchants, and handicraftsmen. Information from numerous sources, in the beginning of the fifteenth century the coastline cities in Java island underwent the rapid progress and its peak was at 16th century, due to trade advance of inter-continent.

Condition today Juwana undergoes decline in the businesses of handicrafts, traditional fishermen, and the building-up of ship. This is due to the lack of facilities and facilities of town supporting the town including facilities and diminution in an environmentally significant quality, as well as its usage of news tools for seeking the fish named *cantrang* effecting less favorably on traditional fishermen.

2. PROBLEMS

Problems are how Juwana as a Java North coastline town which location is strategic and potential with power resources and in the past time was trade hub affords to support World Maritime World as initiated by President of Republic of Indonesia, Joko Widodo.

3. THE USED METHODS

Research done qualitatively interpretative with a natural approach in the study of the phenomena at hand for comprehension and interpretation (Norman Denzin, Yvonne Lincoln, 2002:176). A data search with strategy method of *grounded theory research* with an observation, interview on informants pertinent to research objects. Data compared to notes and writing pertinent to problems. Then analized to obtain the accurate findings.

4. DATA IN THE FIELD

Juwana as a subdistrict town with Pati as a district capital city are both located in a lane which was a trait separating Java island with Muria island in the north (it is the present Jepara town), both are trade towns.

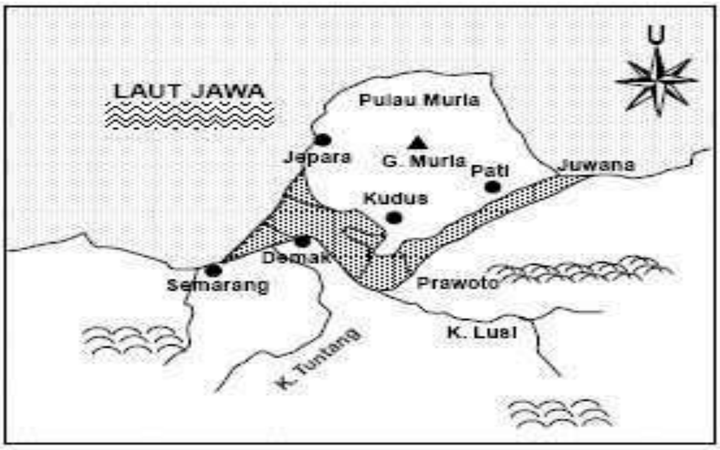

Figure 1. Juwana'sposition on Muria island
(Source: wongpati.com, accessed on April 2017)

Figure 2. Juwana position in Unification of Mataram
(Source: Kasunanan Surakarta, 2017)

Figure 3. Gonggo river as icon Juwana with the past time's fishermen
(Source: (https://www.kabarkotapati.com/2014/03/koleksi-foto-kuno-pati.html)

4.1 The Colonial Epoch

From the map and historical criteria at hand Juwana since in the Mataram epoch was a significant port hub and reckoned due to eographical site and potencies they hold. Juwana of the colonial epoch was a trade hub a bit hectic. Likewise about port hub dominated by the Dutch usually there was building of fortress as a place for supervising the pace of loading in the port and guarding toward the rebel as it was in Juwana. Juwana in addition was famous as the building-up place for ship as well as brass handicraft industrial center. Also it was a district region. In the administrative period of Governor General Daendels there was a built-up road of post or well known as *Gorte Postweg*, as a great road piece made from Anyer to Panarukan. In the Dutch administration, Juwana was a center of Kawedanan city (*District*). Started on January 1902 up to present, its status became Subdistrict, a part of Pati district. City's profile stretched from South-East to North-West, perpendicular to Gonggo river.

Juwana was a Java coastline area used by Mataram kingdom as a port for selling earth crops and the entry of overseas merchants mainly deriving from the China. Its linear settlement pattern followsed Gonggo river flow and changes to enter into the rural area to form radial pattern with squares as event center. In the 16^{th} century, Juwana is an important port town in Java island. The foreigners bought the earth crop and sold to other places. Opium was one of witnesses how Juwana became a North coasatline lane that was important. *Henri-Louis Charles Te Mechelen*, head of inspector for Regi Opium & Residency Asistant of Juwana in 1882, reckoned that one of twenty Javanese persons had been inhalers of opium during the epoch.

Figure 4. Building of Dutch epoch was function-tranferred into Administrative Office
(Source: Private Document, 2018)

4.2 The Today's Juwana

Juwana, geographically is domiciled 12 kms from Pati district capital city and 87 kms from the capital city of Central Java, Semarang. Juwana is adjacent to Java sea and also passed with Pantura road (Pantura is Java North Coast). Majority of population in Juwana was Javanese and minority was Chinese ethnic dwelling in the area of city center. Juwana as a fisherman city with inhabitants work hectiness starts from about 04.00 in the morning, road of Juwana city starts to be alive, hundreds of mothers and fathers working in the fish landing quay are seemingly busy with bicycle heading to their work places. In the morning at 07.00 o'clock like in the other small cities, Juwana starts to experience hectic hours where hundreds or even thousands of workers from the outside and the inside of Juwana crowds on the roads and it was added with childrens at busy time there in Juwana except Sunday. In the midday, the atmosphere of Juwana city is also busy. In the afternoon at 16.00, streets are again crowded with workers already leaving from the work places. Whilst in the afternoon & evening, the bustle is concentrated on squares and area of Juwana market.

The latest development of Juwana is most of shop-residences as office and mini market shops like Indomart, Alfamart, as well as great number of state banks or either private banks spreads. Besides, Juwana also has ample cooperatives such as; Cooperative of Muria and Cooperative of Pangestu which are both as great cooperatives headquartered in Juwana. This marks an economical cycle and financial cycle in Juwana a bit well. Juwana together with Pati, Jepara, and Kudus categorized into area of integrated economy potency named then as WANARAKUTI (Juwana, Jepara, Kudus and Pati).

Juwana itself has a big role for Pat district. Juwana is an industrial centers for a brass handicraft, furniture handicraft, ship-building, batik handicraft industry, and as district's fishery center with a fish auction place, and cultural center in Pati district. Ample customs, tradition, cultures in Juwana still sustainable up to present and Juwana deserves as "cultural city" from Pati district, street facilities in Juwana itself lacks of sufficiency such as narrows streets in the city, a bit dirty streets and less available sidewalks.

Juwana has ports in Bajomulyo and Pajeksan-Kudukeras, both ports are located on the area of Gonggo river every day, hundreds of ships parks on the bank of river. Gonggo river is a "grace" and also "disaster" for Juwana city. The grace is that due to this river, Jakarta residents are successful to be fisherman. Juwana is exception from fishermen. Fishermen in Juwana mostly have rich houses, cars, and luxurious stuffs. This is seen from fishermen deriving from area of Bendar and Bajomulyo. "Disaster" of Juwana river is about almost every year Juwana undergoes flood mainly in the area of Bumirejo & Doropayung due to overwater of Juwana river unable to accomodate the water.

Figure 5. Situation of Juwana Fisherman's settlement
(Source: Private Document, 2018)

Settlement Spatiality Pattern of Kampong Nelayan Tambak Bendar Bajomulyo Juwana can be identitifed to have a character of fisherman's settlement in the aspect of spaceness (unique) as well as factors taking influence in order to restrict and es tablish reliance (*determine factors*) on spatial pattern. It is seemingly visible that components of space shapers (*spatial space and urban space*) relates to social culture, economy and fisherman's settlement physics having significance on growth of fisherman's settlement also on Juwana city. Through a spatiality pattern significance as a response on dependence/reliance factors will be produced by a parameter going to determine considerative steps, pattern shapers or spatial perspective thus it can be identified so far about the possibility of spatiality problem troubleshooting able to do in fisherman settlement development and Juwana city overall.

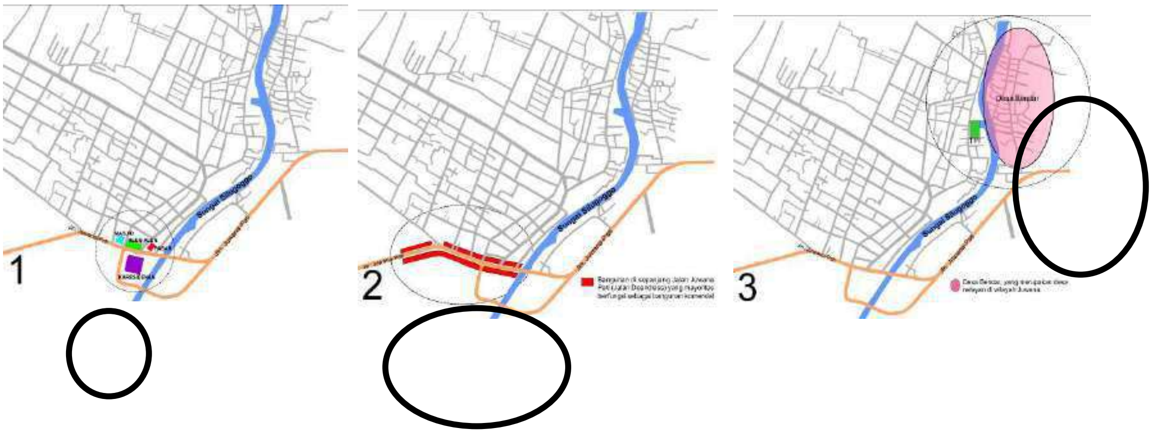

Figure 6. Juwana Room pattern Map with River
(Source: Private Document, 2018)

Pattern of Space 1: Subdistrict Office with City Squares as Juwana city activity
Pattern of Space 2: Commercial center forming the axist on the road of Daendels (PANTURA)
Pattern of Space 3: Location of Bendar village as Fisherman settlement village unique along the Gonggo river. A mosque (green color) as society's activity center

Research event done in steps of formulating research design, conducting comparation and existing region identity, determining variables and measurement parameters, probation and analysis. It is concluded that fisherman settlement spatiality pattern of Bendar village was formed from nature condition as basic form and develops in the frame of economical activity as determinative factors for setting the space in spatial scale or urban structurized in the basic level (*core*), transition and di fusion (separated level). There is access determining mode/mobility from social aspect or economical aspect (*backward-forward linkage*) with *leading sector* of fish capture activity, public space availability has significant meaning in spatiality pattern marked with the importance of quay existence and Fish Auction Place as *core area*. Thus social alteration aspect very relates to society economy increase that cause on city spatiality detail. Therefore it is necessary to have planning integration by placing determinant factor such as ecological humanism which influences on sustainability of fisherman settlement quality increase.

Figure 7. Juwana Beach Area
(Source: Private Document, 2018)

5. DATA STRUCTURE AND ANALYSIS

What's on the mind when thinking about Juwana town ? A fisherman town, a town of folks friendly, successfull and many more....

Juwana is a town on Java north coastline with an area width of about 5.593 ha (55,93 km²). Juwana town is the second largest in the Pati. Geographically, Juwana is adjacent with Java sea, on the north adjacent directly to subdistrict of Batangan, near the South adjacent directly to Jakenan subdistrict and Pati subdistrict, and near the West adjacent to Wedarijaksa subdistrict.

A number of Juwana subdistrict's population was 104.901 inhabitants (District Document; 2017). Majority of Juwana subdistrict has employment as fishermen. Since in Juwana there is fishery port located in a village of Bajomulyo. This fishery port is District's Fishery Port abbreviated or called as PPD, however this port's quality is assumed o equal with *Nusantara* Fishery Port or National Fishery Port. It is a fact from facilities available at around port such as: fish auction place, gasoline filling place, docking work place, ice factory and salt plant. The objective is as a fish ship-support media at sailing time. In this port there are fishery ships from numerous sizes and different types in terms of capture devices s*tarted from purse seine*, *long line*, fish trawling, *bagan apung* and *bagan tetap*.

Juwana fishermen are hard and dilligent in work, due to dilligence of this Juwana fishermen thus almost all inhabitants live prosperously. It can be seen from houses of inhabitants. Juwana can be equalized to big cities at hand in Indonesia.

Village of Bendar, is one of villages in Juwana assumed as most prosperous village. If you visit Bendar village, then you will feel as if being in the elite houses of businessmen and apparatus. You will forget that Bendar is solely a fishery village. How is possible with majority of employment as fisherman, almost all inhabitants of Bendar have luxurious houses with vehicles and motors with assumption that they have more than one. However Bendar is still Bendar and Juwana is still Juwana. Even though it can be said as most prosperous town of fishermen, Juwana inhabitants is still low profile and humble.

This success can be obtained since they use capture device called as *cantrang (purse seine).* That device can capture marine yields up to the bottom of it. Fish capture are at about Java Sea waters. Fish capture area in about Java Sea and Makasar strait is a most proper for ships with capture devices. Since that area has no coral but mud and is still rich of fishery resources. Therefore the condition can put opportunities for fishermen to gain capture yields in maximum. They with big ship can be the in the midst of sea for about 2-3 months. This makes discrepancy toward traditional fish capture which its fish yield is just so.

A governmental policy, in this case it is a Minister of Marine and Fishery as the authority in terms of prohibition of trawling or *cantrang* device receives protests and blasphemy. A policy issued by Minister Susi Pudjiastuti makes ample fishermen into bankruptcy.

A head of association of Lamongan's fish trawl or Pukat Tari Lamongan, affirmed that ample fishermen are jobless since a ban to use capture device of trawl, *payang* and *cantrang* up to the effective date in December 2017. Minister of Marine and Fishermen announced that extension of cantrang usage in six districts like Rembang, Pati, Juwana, and Lamongan with the condition.

Faculty of Law, University of Indonesia (FHUI) held *Focus Group Discussion* (FGD) “Decreasing the Vulnerability of Indonesia’s Fishing Communities: Countering the Threats of Illegal & Unsustainable Fishing” on Friday (3/11/2017) presented a field report of Newton

Fund in Bitung and Dobo by three researchers named Prof. Melda Kamil Ariadno, Ph.D., Prof. Adrianus Meliala, Ph.D and Muhammad Bilahmar before the audience, with outcome; these fishermen conducts traditional capture and aware the importance of keeping-up nature resources in the waters. Society do the warning, and threatening if finding big ship using *trawl, by reason of destroying the marine habitat.*

Figure 8. A meeting of President and accompanied by Minister of Fishery and Marine Susi Pudjiastuti with Association of Indonesian Fishermen 08 May 2018 (Source: Association of Indonesian Fishermen, 2018)

With pro and contra about capture device named *cantrang* it its kind in the field, finally the president Mrs, Joko Widodo (Jokowi) said, Government keeps attempting to suggest fishermen in their green-minded effort of the fishing capture. According to him, effort of Minister of Marine and Fishery, Susi Pudjiastuti forbiding the usage of fishing capture named cantrang is a nature in terms of marine ecosystem is not wrecked thus capture yields of fishermen can be ample.

Jokowi also asks fishermens' understanding that the ban of cantrang has no mean at all to block fishermen doing fishing. Transition of leaving from cantrang usage to devices recommended by KKP shall be done by Indonesian fishermen for the prevention of marine ecosystem destruction.

Besides, another potency held by Juwana is ship production or ship building-up with Marbau wood already famous all around the Indonesian waters. Experts making this ship is Juwana native inhabitants and Bajo ethnic from South Sulawesi. Both are fishing societ. This industry is local genus rarely found in the other places since the needs of experts in capability and special skills.

In order this industry can develop thus Minister of Liaison places order of 100 transport ships in capacity of 35 gross tonnage later to use as logistic transport ships in East Indonesia.

Figure 9. Process of Ship Building-up in Juwana as One of Indonesia's Maritime Axis Establishment (Source: Private Document, 2018)

Figure 10. Prototype of Juwana Traditional House
(Source: Private Document, 2018)

6. SUMMARY

Juwana having marine resources and coastline as well as human resources grants important suppport for Juwana economy in specific and Indonesia in general, as well as holding the interest in the national and in the global since holding a rich nature biodiversity. For the power resource is harmony it takes as follows;

1. Integrated approach for planning and management of coastline zone,
2. It is necessary for availability in information and accurate data for the sake of proper management,
3. Transparency is needed in power resource allocaition,
4. Cooperation is needed between PEMDA (DIstrict Administration) and local societies in resources management.

Juwana can be a prototype for Java North coastline own able to support the establishement of world maritime axis in order to form economy network, culture, and life of all Indonesian societies integrated with numerousi recource potencies.

Resources they have are: ship building-up, fisherman port, milkfish/*tambak* fishery industry, food industry, and town spatial structure aready formed with Gonggo river as a bit large port mainstream for fish with ship-building-up potential to support Indonesia as world marineity axis.

7. THE FUTURE HOPE

Becoming Indonesia as World Marineity Axis is a vision to future relied on reality that in the region of Unity State of Republic of Indonesia, there are potencies of marine resources super indefinite in numbers. This was initiated by Joko Widodo President of Republic of Indonesia in his presidential early period. Thus coastline area becomes development attention necessary to focus on architectural rsearches in order to strengthen marine axis in Indonesia, particularly in Java island. Thus it takes as follows;

1. It is necessary for a sustainable development and marine and coastline resources management as well as human resources with target of "function management of ecology and social economy", and protection toward the production.

2. Capacity increase of local production commensurate with international standard sustainable development management toward coastline resources, marine and human being with work synergy between BAPPEDA (District Planning Institution), and Ministery of Marine and FIshery or KKP

3. It takes as follows: 1. *Art District*, 2. *Financial District*, 3. *MICE Activity*, 4.*Creative Industry District*, 5. *Food, SME* & *Traditional Comercial Center*, 6. *Education, 7. Fishery Center.* With existing completion, it is expected that Juwana can be main destination of PANTURA (*Pantai Utara Jawa* or Java North Beach). It shall be single destination and single management. Therefore it needs new Branding, one of most proper one can be seen from preliminary establishment of the town namely "World Marineity Axis"

Figure 11. Example of Juwana Brand Image
(Source: Private Document, 2018)

4. Presidential Regulation is necessary in the usage of fish capture net based on green environment. Thus no "pro and contra" activities in the fields.

5. From the four points above, it is hope that there will be Juwana prosperousness as world marineity axis held by Indonesia and have a positive impact on marineity Indonesia in the eyes of the International.

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What can we do beyond 2050? Long-term adaptation in Boston and New York

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Synopsis
This session uses case studies of coastal resilience plans in Boston and New York to discuss building long-term adaptive capacity, asking: What comes after the projected benchmark of 2050? What are resilience strategies for the long-long term?

Introduction

According to 100 Resilient Cities (100RC), a Rockefeller Foundation initiative funding the development of resilience strategies in cities around the world, urban resilience is “the capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks they experience.”[1]

100RC and many similar initiatives – among others, C40 and the International Council for Local Environmental Initiatives (ICLEI) – have adopted resilience as a steering principle. One of their central directives is organizing cities and communities to cope with the risks of climate change in an era of steadily more extreme superstorms such as Hurricane Sandy in New York (2012) and Typhoon Yolanda or Haiyan (2013). This process has, in turn, triggered a number of urban and regional-scale design competitions and visioning plans for how (especially coastal) cities should be planning long-term adaptation to sea level rise, storm surge, extreme heat, inland flooding, eroding infrastructure, and other climate / urban vulnerabilities.

Many of these plans use mid-century (2050) and end-of-century (2100) projections as benchmarks for risk projections, thus tethering design strategies to finite time periods and goals. In this paper, we will explore what happens when we look beyond these projections to even longer-term goals, imagining forms of resilience able to adapt to changing environmental, social, political, and economic circumstances far after 2100. How will precedents for resilience set by today’s design practices and coalition-building influence decisions made decades later? How can we build adaptive capacity for climate change and related stresses in the long-long term?

Long-term adaptation in Boston and New York

These questions form the backbone of the Dutch design and planning firm One Architecture & Urbanism (ONE), which has honed its expertise in large-scale resilience planning and infrastructure in the United States following its winning proposal for the 2014 Rebuild By Design competition: The BIG U. Since then, ONE has been at the forefront of a vanguard group of resilience planners, many in Boston and New York, using the framework of “flexible adaptation pathways” – an approach acknowledging the uncertainties of future climate conditions and the need for multi-layered, iterative responses in systems as complex as a city or urban watershed.

This approach has been largely informed by the New York City Panel on Climate Change (NPCC1) formed in 2007 by Mayor Bloomberg, which developed guidelines for risk

[1] http://www.100resilientcities.org/resources/#/-_Yz47ODU4NidpPTEocz5j/

management centering the ability of plans to evolve through time to meet changing risk projections, vulnerabilities, as well as physical, environmental, social, and economic circumstances. These guidelines, both in terms of risk projection and design standards (to cope with increasing heat, precipitation, heat level rise, and other stressors) surfaced in the form of reports by the Mayor's Office of Recovery and Resiliency (ORR) and many other city agencies, as well as the ongoing revisions to the City's OneNYC plan.

Through case study examples of flagship projects by ONE in both cities, the opportunities and challenges of long-term adaptation strategies can be illuminated. As a Dutch firm now working primarily in the United States, ONE bring a critical perspective toward water-centric design with an acute focus on process, precedent, and the importance of a robust implementation strategy intimately involving stakeholder interests. Prior to its American work, ONE also initiated a "Deltametropolis" design studio for the Dutch government's Ministry of Planning, and led the visioning process of Randstad 2030, a federal plan for the long-term development of the western region of the Netherlands, and has worked across a wide gamut of sociopolitical contexts from the highest levels of governance to the smallest-scale grassroots urban initiatives and community groups.

In cities like Boston and New York – both of whose urban coasts have been expanded through land reclamation – capitalist frameworks of governance and private interest remain invested in the expansion of shorefront development ignoring common-sense resilience strategies following even the harshest of storms. Today, nearly 12.3 percent of new residential units in New York (one in eight) is built in "a high risk flood zone, up from 10.7 percent in 2014 … last year, 2,362 flood-zone units were completed – nearly double the number delivered in 2014"[2].

This stark disconnect from the ages-old Dutch practice of "controlling nature" and its contemporary emergence as the McHargian philosophy of "designing with nature" has led us to pursue *resilient* design over the *sustainable.* Resilience presents designers, engineers, and policy leaders with a flexible toolkit rather than a goal or quota, and thorough integration with scientific considerations accommodating the certainty of large-scale ecological shifts in years to come. *Sustainability,* defined by Merriam-Webster as "a method of harvesting or using a resource so that the resource is not depleted or permanently damaged," plateaus efforts toward a flatline goal, most commonly associated with finite carbon sequestration, renewable resources, and emission caps. Resilience thinking, while including many of the same priorities, also accounts for unanticipated shifts in climate (SLR and meteorological) projections, the ever-changing context of environmental and social risks.

In the most basic terms, resilience is a narrative that embraces networked relationships (both physical and social) and known unknowns. As Ross Exo Adams elaborates in the article "Scaleless" for *Cultural Anthropology* (2018), resilience urbanism "blurs the boundary between bodies and infrastructure just as it blurs the distinction between the organization of space and the distribution of governance." In a similar vein, ONE has found resilience to be a helpful framework not just in the design context but also in terms of "project risks" and project management: it is a tool to navigate the complexities of governance and the competing interests

[2] https://www.nytimes.com/2018/07/06/realestate/luxury/new-buildings-rise-in-flood-zones.html

of stakeholders, and can be leveraged as a framework to structure collaborative relationships between public and private entities on long-term projects for which there are few priors.

In order to successfully advance resilience projects into implementation, ONE has adopted an ad hoc coordinator / integrator role between city agencies, private contractors (mostly in design and engineering), and public interest groups. In the several decades of this practice, ONE has come to view this highly collaborative planning role as central to any design process geared toward short-term implementation and long (-long) term goals. The consequences of this mediatory role have become clearest in ONE's projects in New York and Boston.

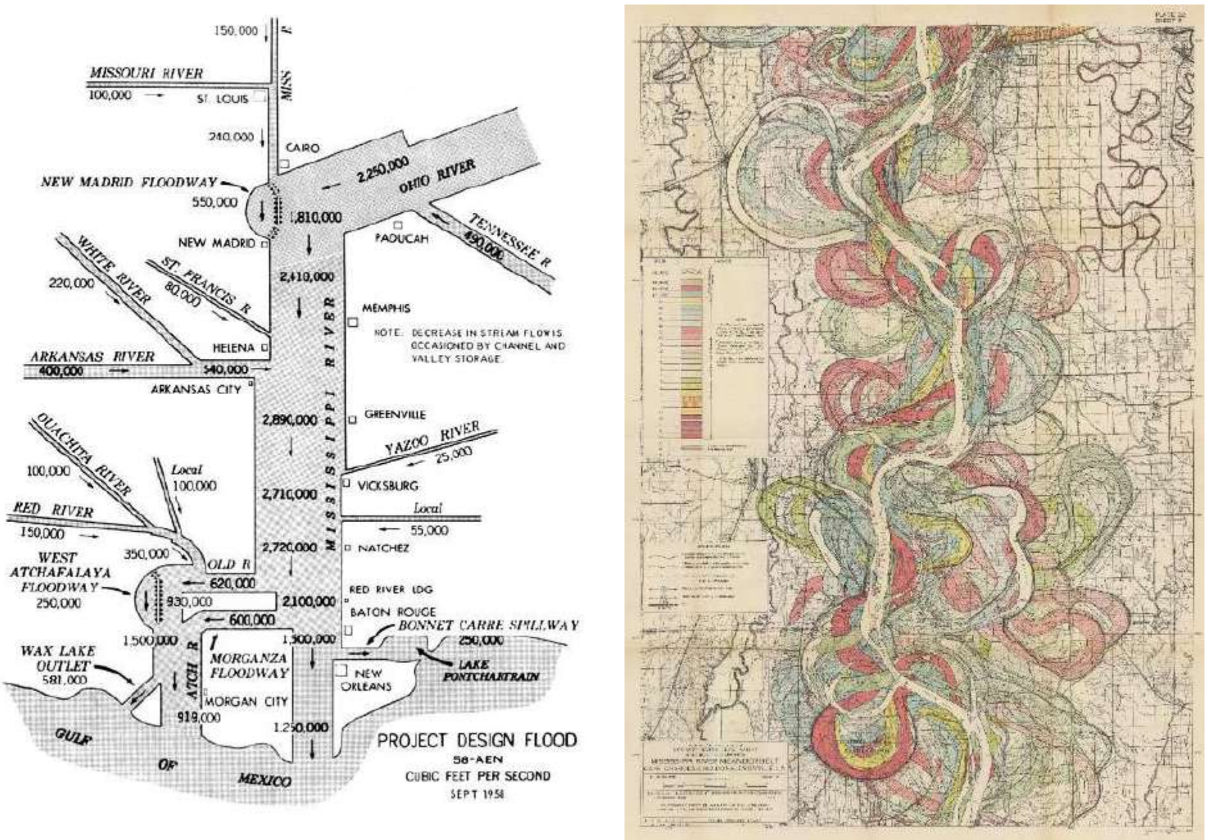

Fig. 1: Visualizing technocratic versus flexible, adaptive resilience thinking: USACE's Project Design Flood (1958) versus Harold Fisk's maps of the historic pathways of the Mississippi River throughout the formation of its delta (1944).

In its first iteration by NPCC1, "flexible adaptation pathways" can be read as a kind of design manifesto in addition to a scientific caveat, and its criteria read as design ideals: *(1) multidimensionality, (2) interdependency, (3) intertemporality, (4) holistic indicators and monitoring,* and *(5) societal processes and transformation.* In ONE's reading of this methodology, we see this as an addendum to the technocratic approaches of reactionary, post-disaster master planning and strict design timelines. In our experience, we have learned that resilience projects, even from a managerial standpoint, must adopt the same principles of flexibility, collaboration, intertemporality, and more of the points above: they must be able to evolve their identities in response to changing conditions, and not respond to the risks (environmental, social, political, urban) posed at a finite moment in time. Rather, they must anticipate and embrace uncertainty, allowing for multiple identities and services to coexist and evolve at the same time. A metaphor from geography might be the disparity between the Army Corps' 1950s-era water management mandates for the Mississippi River, dubbed Project Design Flood, versus the river's historic identity as a highly modular body of water, shifting over the landscape with changes in the pull of gravity. An example from landscape architecture might be the *jardin en mouvement* according to Gilles Clement: anticipating decay, change, and the inherent competition of a restricted number of plant species, allowing this to rule a garden rather than establishing restrictive design rules.

In 2016, the City of Boston opened up a proposal for the first phase of its new Climate Ready Boston initiative, an extension of its Imagine Boston 2030 master plan focused on climate adaptation and coastal resilience. Building on this initiative, the first geographically-specific report focused on the waterfront districts of East Boston and Charlestown. The team of contractors assembled consisted of Kleinfelder, Stoss Landscape Urbanism, One Architecture & Urbanism (ONE), and Woods Hole Group. These two neighborhoods were prioritized due to their relatively higher risk to coastal flooding, dense vulnerable populations, and narrow, well-defined flood pathways, making them optimal for short-term infrastructural interventions to cope with inundation.

In the five years since the conclusion of the Rebuild By Design competition, the ten design teams selected to move forward have advanced at variant speeds, but The BIG U has perhaps developed furthest of all in the shortest time span. In 2015, immediately following the competition's close-out, the BIG team secured $35 million in HUD funding to develop a first compartment of the plan, dubbed the East Side Coastal Resiliency (ESCR) Project. Soon after, a second compartment, the Lower Manhattan Coastal Resiliency (LMCR) Project received funding to advance into a speculative design and feasibility study incorporating the long-term impacts of flood protection systems on existing infrastructural systems and social context of Lower Manhattan, but has not yet moved forward into physical plans. After securing these projects, ONE has also become a central player in the development of the East Harlem Resiliency Study and a similar initiative in Breezy Point, Queens – one of the coastal communities hardest hit by Hurricane Sandy.

From their inception, ESCR and LMCR have illustrated the challenges faced by resilience plans whose continued life depends on the long-term health and strength of public-private partnerships and their ability to manage and prioritize competing interests between agencies without an established framework for collaboration. Liaising between the Mayor's Office of Recovery and Resiliency (ORR), the Department of Parks and Recreation (DPR), the Department of Planning, the Department of Transportation (DOT), and private utilities such as ConEdison, ONE has become a specialist in highly collaborative design processes.

Among the primary lessons learned from these various projects, we have recognized the following principles as integral to the long-term feasibility of resilience projects beyond the century-long checkpoints of risk projections: (1) Planning and design should function as an integrator: collaborative design processes and community engagement are key; (2) Creating dual top-down and bottom-up approaches to implementation, rooted in both technocratic and grassroots planning processes; (3) Looking beyond feasibility to factors such as funding streams, resource chains, carbon sinks, and multiple-benefit services that projects can tie into beyond 2100. It is important to hold both scales in mind at the same time: short-term solutions allowing cities to build public and private support around quick wins and more immediate risk solutions, while also creating a framework for a project's adaptability and phased implementation in the long-long term.

Countering the current paradoxical trend of redeveloping New York City's vulnerable waterfronts

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1. Introduction

The growing impact of changing environmental and economic conditions on a global level, generates an urgent requirement for cities to respond in a resilient way. Therefore, this research aims to gain insights on the physical transformation of vulnerable industrial waterfronts that deal with productive decline and climate change. This paper will illustrate current redevelopment methods that are implemented in (post-)industrial coastal areas in the metropole city of New York (Fig.1) and conduct a critical analysis regarding this paradoxical redevelopment by mega-projects that are favoring exclusive access for rich communities or mere leisure activities. The paper will use the redevelopment of Williamsburg, Brooklyn as an exemplary case of an already redeveloped waterfront where industry is relentlessly replaced by mere residential and recreational facilities. To counter this method of urban planning, the paper will test a novel research strategy at the intermediate scale on the vulnerable waterfront of the Coney Island Creek, more south in Brooklyn, which can be considered as a best example of urgently needed transformation of remaining industrial coastal areas in the city.

This paper questions the profit-based motifs of current real estate developers. How can coastal areas that are in direct threat of storms, rising sea-level and pollution function resiliently in the future, when they are rapidly developed in order to generate the highest possible profit-range?

Figure 1: New York City with its 930 kilometers of coastline and the Coney Island Creek area in the southernmost point of Brooklyn, NY. Source: map by Drs. Gitte Schreurs, aerial photo by Apple Maps.

2. Global awareness of a changing environmental and economic climate.

2.1 Environmental changes

New York City is one of many cities worldwide that is suffering under the consequences of growing environmental issues. Climate change is causing the seas to rise and storms to intensify around New York; inundations of more than two meters are expected to occur every five years by 2030. Changes in climate are generally measured by three parameters: the sea-level, the mean yearly temperature and the mean yearly precipitation.

When we look at these parameters, the numbers don't lie: trends in temperature, precipitation and sea levels have increased overall throughout the century. In New York City, mean annual temperature has increased 2.5°C and mean annual precipitation has increased 19.5cm (a change of 1.4% per decade) from 1900 to 2011. Year-to-year precipitation variability was greater from 1956 to 2011 than from 1900-1955. Sea-level in New York has risen 33.5cm since 1900. (NYPCC, 2013) Temperature, precipitation and sea level are expected to rise even further by 2020 and 2050. The New York City Panel for Climate Change has calculated the estimated increase for each parameter with low-, middle- and high-estimates (for best- and worst-case scenarios) (Fig.2).

Baseline Climate and Mean Annual Changes

Air temperature Baseline (1971 - 2000) 54°F	Low-estimate (10th percentile)	Middle range (25th to 75th percentile)	High-estimate (90th percentile)
2020s	+ 1.5°F	+ 2.0°F to + 3.0°F	+ 3.0°F
2050s	+ 3.0°F	+ 4.0°F to + 5.5°F	+ 6.5°F
Precipitation Baseline (1971 - 2000) 50.1 inches	**Low-estimate (10th percentile)**	**Middle range (25th to 75th percentile)**	**High-estimate (90th percentile)**
2020s	-1 percent	0 to + 10 percent	+ 10 percent
2050s	1 percent	+ 5 to + 10 percent	+ 15 percent
Sea level rise Baseline (2000-2004) 0 inches	**Low-estimate (10th percentile)**	**Middle range (25th to 75th percentile)**	**High-estimate (90th percentile)**
2020s	2 inches	4 to 8 inches	11 inches
2050s	7 inches	11 to 24 inches	31 inches

Based on 35 GCMs (24 for sea level rise) and two Representative Concentration Pathways. Baseline data are from the National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center (NCDC) United States Historical Climatology Network (USHCN), Version 2 (Menne et al., 2009). Shown are the 10th percentile, 25th percentile, 75th percentile, and 90th percentile 30-year mean values from model-based outcomes.Temperature values are rounded to the nearest 0.5°F, percipitation values are rounded to the nearest 5 percent, and sea level rise values rounded to the nearest inch.

Figure 2: Baseline Climate and Mean Annual Changes by the NYC Panel of Climate Change
Source: NPCC Climate Risk Information Report, 2013

Besides sea-level, temperature and precipitation, there is a fourth important parameter to illustrate the impact of climate change on the urban conditions: the occurrence of extreme weather events. In 2012, super storm Sandy had a devastating impact on New York City and was an eye-opener that the city needs proper risk management and resilient urban planning to answer to future extreme weather events. Even though a storm like Sandy is no direct outcome of climate change, the impact of a storm on the city increases significantly due to the changing environmental parameters. The extent and magnitude of coastal flooding during super storm Sandy increased due to the risen sea level in the New York City area. Also, unusually warm upper ocean temperatures made the hurricane gain additional strength (NYPCC, 2013). Numbers show that there has been a general increase in the overall strength of hurricanes in the North Atlantic since the 1980's (USGCRP, 2013). It is during extreme events like these that the risks and flaws in the current urban planning system are exposed. It is crucial for the future of the city that new coastal developments take into account the devastating consequences of these more regularly occurring events.

Though not only hurricanes are a direct threat to the waterfront of New York City, but also the regular coastal flooding. Rising sea-level increases the impact of coastal flooding and flash floods during heavy rainfall or storms. Several flood maps show the projected impact of floods on the urban fabric.

The New York City Department of City Planning has developed the Flood Hazard Mapper, providing a comprehensive overview of coastal flood hazards that threaten the city today (NYCgov). The mapper also shows how the flood hazards are likely to increase in the future as a consequence of climate change and aims to function as a tool for the making of resilient design decisions by property owners, companies, architects and planners.

FEMA (Federal Emergency Management Agency) has also developed Flood maps, showing projected flood zones for the future of New York City, taking into account sea-level rise from both ocean warming and ice sheet melt. They also factor in local conditions such as vertical land movement and regional climate variations. The maps represent the potential flood extent of the 100-year (1% annual chance) and 500-year (0.2% annual chance) flood areas in the 2020's and 2050's, based on the high-estimate of sea-level rise. This means an estimated sea-level rise of 28 centimeters by 2020 and 78,7 centimeters by 2050, in comparison to the sea-level of 2013 (Fig.3).

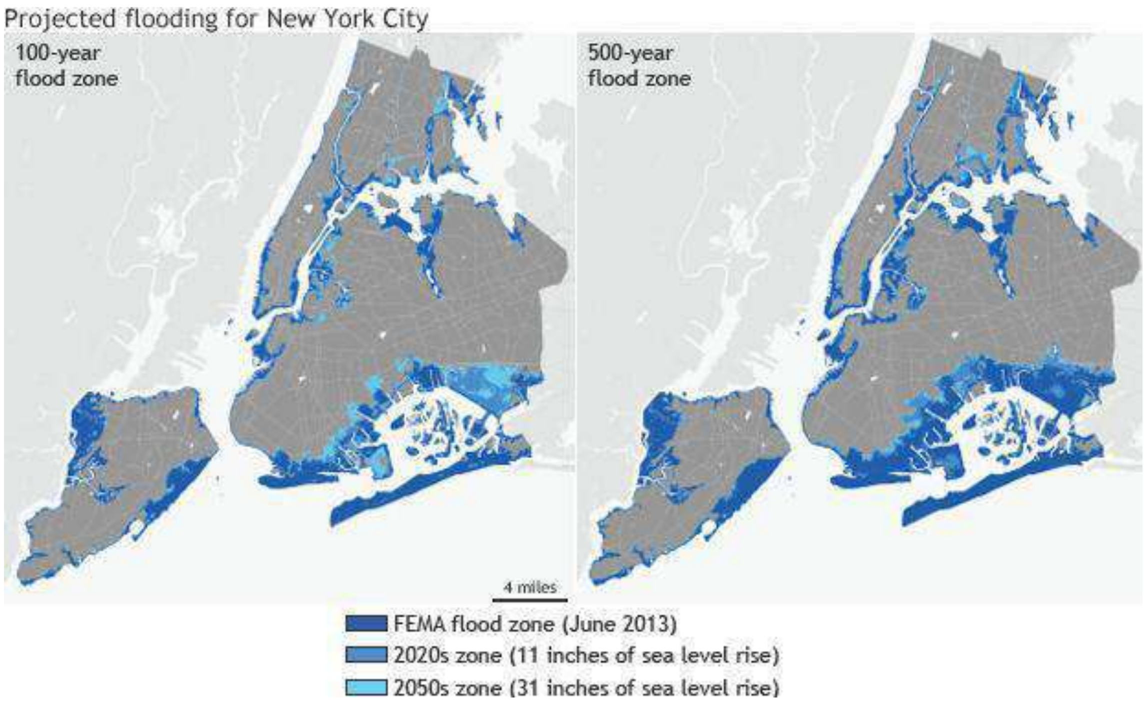

Figure 3: 100-year and 500-year inundation map of FEMA
Source: NPCC Climate Risk Information Report, 2013

After hurricane Katrina (2005) and super storm Sandy (2012), a general awareness for the dangers of climate change and its potential impact on the coastal urban fabric of New York has grown. Yet, we can see a clear paradox in today's city -and especially coastal-development. Despite the awareness for water threat: waterfront property values are rapidly rising, pushing all industrial activity out of the city. There has never been a higher demand for coastal residential development in New York City, while research on how to deal with climate change is still in full progress. The current mindset of city planners and local governments appears to be mainly set on problem-solving after a peak moment, instead of prevention.

2.2 Economic changes

New York City's 930 kilometers of coastline were once indispensable for the growth and prosperity of economy in the city. The city's waterfront has been subject to a vibrant history of industrial development. The first colonial settlements of the 17th century were mostly located at the waterfront. Because of the thriving agriculture that was rapidly developing at the water and the lack of paved roads, ships became the main transportation method between the islands that formed New York City. During the first industrial revolution at the end of the 18th century, industries replaced the agriculture at the waterfronts of New York because of this beneficial transportation by freight ships. At the start of the 19th century, the enormous amount of freight boats was accompanied by ferries to serve commuters between the different boroughs. Waterfronts seemed more important than ever for the economic wealth of the city.

However, when the New York Central Railroad was introduced in the 1850’s, a large part of freight transportation shifted to trains for they were faster than ships and had more possibilities of reaching other cities and states. After the completion of the Brooklyn and Verrazano Bridges, physically connecting the different islands of New York, trains and trucks became the most important sources of freight transportation. Industries adjusted to this shift and started facing the streets instead of the waterfront, entailing the decline of the waterfront’s importance. This inevitably resulted in graduate relocation of many industries to more inland sites. As a consequence of this relocation, New York City of today knows a large stretch of post-industrial waterfront landscapes with underused or even abandoned warehouses and docks.

Today, developers deal with the issue of how to reprogram or revive these locations. Different approaches are tested on the post-industrial coastal landscape. One of the new developments we can witness at coastal areas is the emergence of ‘modern industry’s’ that are partially reclaiming the old industrial sites, trying to sustain the economy in the city. Warehouses are converted into coworking spaces for young entrepreneurs or recreational facilities (parks, playgrounds, etc.) are implemented to provide waterfront access for the community. However well-intended, this change of initial industry to more modern facilities does not only have a positive social impact. Simultaneously with the exodus of larger industries from their prime waterfront locations, employment opportunities for low-educated workers disappear out of the city center. Affordable housing for low-income families and walk-to-work opportunities become non-existent because of the rapidly rising property and land value by gentrification at the coastline. The conversion to ‘modern industries’ inevitably contributes to an elite waterfront accessibility and rise in value of the neighboring properties.

What generates even a larger social and economic impact, is most of the post-industrial waterfronts today being rezoned or reprogrammed to fully non-industrial uses, eliminating all initial productive activities, favoring exclusive waterfront access for tourists and high-income residents.

3. The paradox of property value and resilient waterfront redevelopment

For the first time in the history of New York, the city shows a significant interest in the repurpose of urban coastal areas. Often, adaptation in New York City is implied by transformation of the productive or residential waterfront to natural flood zones with mere natural or recreational purposes (D’Hooghe, MIT CAU, 2014). These parks and piers are implemented by the city on many waterfronts in or within close proximity to Manhattan, to serve inhabitants and tourists by offering leisure activities and magnificent views over the city skyline. Ferries are recently initiated to connect the different boroughs and offer easy access from Manhattan to Brooklyn and Queens. These ferries, as rather minor interventions, generate a huge impact at the area of destination. Comparable to most cities globally, accessibility is key in New York. A direct ferry connection to the touristic and economically thriving Manhattan generates inevitable and rapid gentrification for the receiving end of the ferry line. Waterfront land is bought by large real estate project developers for hallucinatory prices. Existing constructions, dating from the industrial revolution in the 19th century, are ruthlessly demolished and replaced by high-rise, low-cost residential towers, overlooking the Manhattan skyline. To then be sold for millions of dollars to the wealthy few. One of the reference cases to illustrate this phenomenon is Williamsburg, in the north-west of Brooklyn.

3.1 Reference case: Williamsburg, Brooklyn, NY

Williamsburg is a neighborhood in Brooklyn, located east of Manhattan, with the East River as a separation between the two. Since the late 1990's, inland Williamsburg has already been undergoing a form of gentrification by the hipster and artist culture. However, its waterfront fully remained a thriving industrial area, with shipyards and heavy industries characterizing the Williamsburg coastline. The inland area was an easy target for gentrification as it has always been rather easily accessible by metro (L-line) and car (Williamsburg Bridge). Rents in Williamsburg significantly increase when the property is within close proximity of a metro entrance. However, the waterfront recently became more accessible as well for locals and tourists, by the newly initiated East River Ferry line, providing a direct connection to Manhattan and other point in Brooklyn.

During the industrial vitality of the 19th century, employment opportunities were created for many blue-collar workers. This resulted in the development of low-rent residential properties for immigrants and lower-income families, in close proximity to their workplace. However, during the industrial decline of the 20th century, Williamsburg dealt with large unemployment rates, increasing crime and residents relocating to different parts of the city. During the recent revitalization of the 21st century this changed drastically and rents are skyrocketing, pushing out all remaining low- and medium-income residents and families, welcoming an elite, white community. By demolishing the remaining industry that was still operative in the area, walk-to-work opportunities for lower-educated workmen become inexistent in the area.

Until 2005, the waterfront had a land-use of mere manufacturing and industry. Today however, a huge rezoning is initiated as interest for the Williamsburg waterfront has grown rapidly for its stunning views over the Manhattan skyline, improved accessibility and gentrification of the inland areas. Before the rezoning, the waterfront was characterized by active manufacturing, light industrial activity and smaller residential developments. After the rezoning of 2005, the land-use exists primarily out of residential new developments and the designation of old warehouses into expensive lofts. To guarantee a certain social mix in the area, the City Council of New York obliged real estate developers to provide one out of three new developments as affordable housing. However, by loopholes in the regulations, the developers forgo these incentives by creating lower rent apartments at less desired, more inland locations instead of implementing them in the new developments at the waterfront. This generates large-scale residential areas, merely affordable by the elite (Fig. 4).

Figure 4: The redevelopment of the Domino Sugar factory into high-priced apartments and parks
Source: Article in Archdaily: "Domino Sugar Factory Master Plan Development"

The redevelopment of the Williamsburg coastline happened over a very short time span, barely taking into account the environmental issues and economic opportunities that the area has. Inland Williamsburg is safeguarded from the flood zones according to FEMA. However, all of the properties at the Williamsburg waterfront are located within a flood evacuation zone and within the 100-year FEMA Flood inundation zone. During super storm Sandy, Williamsburg was spared from devastation because of low tide. Though power cut-offs, lowered accessibility for emergency services and obstructed escape routes after flooding can generate severe problems for residents living in high-rise towers within flood-zones.

Another major risk in these post-industrial areas during flooding is the pollution. Previous industrial activities have contaminated the soil of the post-industrial sites. The Williamsburg waterfront knows several polluted areas where asthma rates are significantly higher than in non-polluted areas (Fig.5). These areas are particularly risky during flooding, because the contamination in the soil will surface and be transported inland by the floodwater. The contaminated water can enter buildings and mix with sewage water.

Figure 5: Polluted sites in the Williamsburg/Newtown Creek area.
Source: Website greenpointers.com

The rapid redevelopment of the Williamsburg waterfront (and several other waterfronts) is in direct contradiction with the city's current studies on climate change and the aim for resilient development of New York. The speed of the real estate market and profit-based developments seems to outdo the importance of sustainable city-planning that is more than ever necessary for this metropole, surrounded by water.
This makes us question the city's intention for future development: do we want short-term, profit-based projects with rapid gentrification of very vulnerable coastal areas, or do we choose long-term resilient planning of the city's 930 kilometers of coastline?

4. Understanding actual needs and natural adaptation processes of the urban fabric

This research aims to counter this current tabula rasa approach of redeveloping a waterfront from scratch. It is impossible to tackle all post-industrial waterfront areas -with all their complexity- by only one general solution. Instead, this doctoral thesis seeks to provide answers, based on gaining critical insights regarding the daily operation of a specific waterfront and its unique characteristics such as territorial configuration, property structure, appropriation of collective areas, resilience to climate change and a changing economic situation. The hypothesis is that, by fully understanding the conditions of transformation and the everyday operation of a specific coastal area at the intermediate scale; a full understanding of its levels of resilience can be generated. This profound knowledge can then be reflected on similar coastal areas and function as design strategies for architects and urban planners, taking into account an area's full complexity, fragilities and opportunities. In this way, a resilient answer can be offered that enhances the current social and economic structure of the area, while dealing with the threats of climate change.

This research does not limit itself by analyzing the mere urban situation, neither only the architectural scale of the building itself. Instead, the focus lies at the intermediate scale; the scale of the streetscape, how the building relates to the streetscape and how the user can give meaning to them (Scheerlinck, 2010). The method of this research at the intermediate scale, is to analyze the area by the notion of six parameters, which are believed to cover the crucial aspects that are to be understood to enhance the changing urban conditions on economic and environmental levels.

The first parameter covers the *Activities* of the area, this means the analysis of daily, routine operations, as well as more occasional or time-related activities. Comparative analysis of the activities is conducted at several moments in time: during week and week-end days, before and after working hours, during mid-season and in holidays. The second parameter analyzes the *Morphology* of the area. This takes into account the type, style and land-use of the building, its amount of storeys, appearance of the façade and relation of the building to the streetscape. Parameter three shows how the water is related to the adjacent land: the analysis of the *Waterline*. Is the waterfront visibly of physically accessible from the land? How does this waterfront react during a flood or storm? What is the waterfront activity (if any) and does the shoreline exist out of a hard or soft edge? Next, the analysis of the *Infrastructure* and *Accessibility* is conducted. What kinds of infrastructure connects the area to the broader region and how does this impact the ongoing activities? What is the configuration of the streetscape and how are the individual buildings accessible and related to the sidewalk on pedestrian and vehicle level? Finally, an important aspect in order to fully understand an area, is the social structure. Therefore, the last parameter is the *Social participation.* What is the daily use of space by the direct users? How do they find it convenient and what are their annoyances?

4.1 Reference case: Coney Island Creek, Brooklyn, NY

Coney Island is an urban peninsula, located at the southernmost end of Brooklyn. Coney Island is famous for its amusement park and beach and generates a true exodus to escape the city on hot summer days (Koolhaas, 1978). However, as part of this intriguing urban peninsula where amusement, leisure and entertainment attract many tourists and investors; the Coney Island Creek is a subordinate area, lying in the shadow of this urban glamour. The area around the Creek struggles with a complex coexistence between industrial, recreational and residential waterfront conditions and constant threat of storms and urban floods (Fig.6).

Figure 6: The peninsula of Coney Island
Source: Aerial photo from Apple Maps, edited by Drs. Gitte Schreurs

All these vulnerabilities bring along political disinterest and make the local economy entirely dependent on private investments of small shop owners. The political abandonment and lack of individual capital of the small entrepreneurs leaves little space for alternative commercial and urban development processes to assure the resilience of this industrial waterfront.

The area of the Coney Island Creek is considered the best example of a vulnerable industrial waterfront, in urgent need of redevelopment to guarantee proper living standards and prevent severe decline. The aim is to implement and test the previously explained approach of parameter analysis on this area and therefore unveil the island's complex coexistence between industrial, recreational and residential waterfront conditions. The research wants to understand the vulnerabilities, but also the opportunities of the area, to later implement this knowledge during the development of resilient design strategies for this complex area.

In order to fully understand the area at the intermediate scale, the six parameters are analyzed at the scale of the building block. This method of research will be illustrated below by the example of one building block in the Coney Island Creek area, located between W15th and W16th street, north of Neptune Avenue. This method will later in the research be performed on all six types of building blocks that are to be found in the Coney Island Creek area in order to generate a consistent, comparative analysis of all parameters at the intermediate scale, representative for the entire area of the Creek.

- *Activities*: The building block is generally zoned as M1-2, light manufacturing. With the special overlay zoning CO, which allows for residential and industrial activities to take place in adjacent buildings. For each property, the official land-use, defined by ZoLa New York is mapped and compared to the actual land-use at the time of observation, in June 2018 (Fig. 7). However, in order to display the vibrant activities as correct as possible, all occurring activities are drawn on plan at different moments in time: on a weekday, a weekend day, during working hours and after working hours (Fig. 9). By fully understanding the daily operation and formal or informal activities within this building block, we can understand the actual need for novel spatial facilities and adaptations.

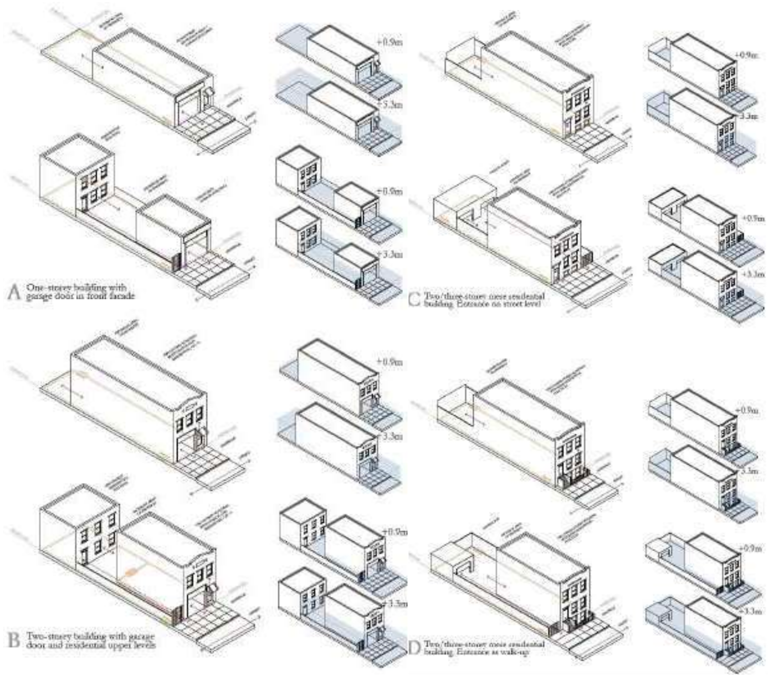

Figure 7 (left): Building block: Official land-use ZoLa NYC vs. actual land-use in June 2018
Source: Maps by Drs. Gitte Schreurs, based on information from ZoLa NYC and observations

Figure 8 (right): Typologies of buildings, located within this building block, by Drs. Gitte Schreurs

- *Morphology*: Analyzing the morphology, means analyzing the typology of the existing buildings, the relation between neighboring constructions and between the building and the streetscape. By analyzing this parameter, we can understand patterns of activities related to types of housing and how the typology of the building is used to benefit the activity. An example within this analyzed building block on Coney Island is typology type B: a two- or three-storey rowhouse, with a garage door on ground-level, providing the opportunity to open up the building and let the territory of the industrial working space extent onto the public sidewalk. Residential facilities can be found on the second (and third) floor of the building, preventing water damage to the house when floods occur (Fig.8). The façade in-between the garage door and the residence windows is used for commercial signages in benefit of the industrial activity on the ground floor. Knowledge on the informal use of indoor-outdoor space and ground floor - upper floor relationships of all building typologies can be used to design more sufficient buildings in similar spatial contexts in the future.

- *Waterline*: The waterline is crucial to investigate when we want to understand how to deal with land-water relationships in urban and architectural planning. In this building block analysis, we analyze two aspects of the waterline. For starters, when applicable, the physical relation between the water of the Creek and the land is drawn in map and section (sea-level vs. ground-floor level, hard or soft edge, natural or landscaped waterfront, etc.). Secondly, the impact of the 100-year and 500-year flood is illustrated per typology, specific for the area. In this example, for every typology is illustrated how a 0.9 meter flood level (1% annual chance) and a 3.3m flood level (0.2% annual chance) would impact the specific building type (Fig.8). This too is important to take into account when new constructions are designed.

- *Infrastructure*: The parameter of infrastructure is most important on the larger scale; the relation of the building block with the surrounding urban fabric. How well accessible is the area by motorized vehicles, public transportation, boats or by foot? How do these connections impact the activities in the area? The analyzed building block is very well-connected to the most important highway of New York City, the Belt Parkway, providing a beneficial accessibility for motorized vehicles. This characteristic triggers car-related entrepreneurs to settle in the area. The main types of land-use in this block -besides residential- are car repair services and parking facilities. Because of the less convenient public transportation, this area is less sought-after for residential purposes, allowing small-scale car-related businesses to remain located in a standard building block. However, if by renewed planning the public transportation would become more beneficial for this area, the land-value would most likely rise rapidly, pushing out all small-scale car-related activities, to replace the industrial activity with residential facilities, generating higher profits from rent.

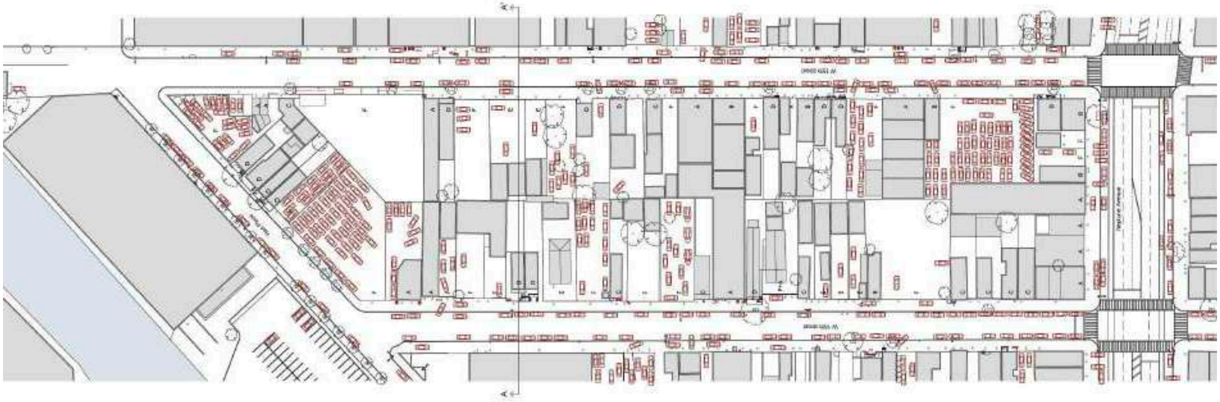

Figure 9: Building block: Activities in June 2018 on a weekday during working hours
Source: Map by Gitte Schreurs

- *Accessibility*: The analysis of the accessibility focuses on the scale of the building. A consistent mapping of all entrances (garage doors and regular doors) within the building block is conducted. The aim is to show the relation between the front door/garage door and the street. Does interior and exterior become one productive territory once the garage door is opened? What are the public/private relationships during informal appropriation of the sidewalk by industrial activities? Is there a direct relation between the sidewalk, the front entrance, the interior and the backyard? Understanding the accessibility of a building in combination with the activities taking place inside and outside can help us to grasp the need of public and private space of these companies or residences.

- *Social participation*: A final and very important parameter is the social participation. Many crucial aspects that contribute to fully understanding the operation of an area are not noticeable by mere spatial analysis. Therefore, for the building block analysis, a survey is taken from several workmen and inhabitants to generate crucial additional information about the daily operation of the area. The aim of the participation process is to understand the social structure of the companies, opinions about the working space or houses, the impact super storm sandy had on personal or property level and gather opinions about spatial and organizational elements they would personally like to change or add to the area.

These six parameters are the research method that resulted out of previously conducted research on this subject. However, they are still subject to change and can be altered as the PhD continues. For now, these six parameters are believed to cover the necessary knowledge to fully understand the aspects of an area at the intermediate scale to conduct the knowledge that is necessary to take into account when designing for this particular, or for similar, areas.

5. Conclusion

New York has 930 kilometers of coastline, of which each area has a very unique character, spatial layout, daily use and social structure. Today, a renewed interest for investing in these coastal areas, seems to generate redevelopments that happen at a fast speed because of profit-based real estate interest for waterfront residences. However, threats from the changing climate have never been more acute than they are today. Therefore, it seems rather paradoxical to develop these billion-dollar projects by a tabula rasa method while research on climate change is still in full progress and the economy is changing rapidly by new technologies. Planners seem to approach the city from a top-down method where demolition is the starting point and profit-based housing is the goal.

Instead, in order to generate a resilient metropole, that can withstand the challenges of the future and answer to today's needs, we must develop proper design and planning strategies. Not from the mere urban or architectural scale, not from the starting point of demolition, but starting from the actual need of the specific area. By analyzing the urban fabric at the intermediate scale, elements will surface that normally stay invisible for the general urban planner or the architect.

This research believes that resilient redevelopment is only possible by fully understanding the existing situation and the natural processes of spatial use and small-scale adaptation. Only then we can provide resilient future-proof planning and designing solutions for coastal areas that are as complex as these in New York City, and reflect this practice towards similar areas globally.

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PLANNING FOR COOLER STREETS; FUNCTIONS AND ELEMENTS FOR COOLER COASTAL CITIES. THE CASE OF GOLD COAST, AUSTRALIA.

Key Words

Urban Heat Island (UHI), Urban Cooling Strategies, Cooler Cities, Nerang Street, Australia, Masterplan, Solar Reflectance Index (SRI).

Synopsis

The paper presents the case of Nerang Street in Gold Coast, Australia as an example of integrating Urban Cooling Strategies into the design phase of a masterplan project. With adequate urban planning and design strategies, the aim is to reduce the Urban Heat Island (UHI) in coastal cities of Australia.

Introduction

It has been nearly four years now since diplomats in Paris agreed that the world community should commit together in the fight against global climate change. In addition to this event, summer heatwaves have drastically increased worldwide, becoming more frequent and risky, especially in Australia. Yearly extreme temperatures, are now becoming the number one natural risk to human lives in Australia (Nairn & Fawcett, 2013). Over 1000 people aged 65 years-old and above died mainly in urbanised areas due to extreme heat waves (McMichael et al. 2002). This phenomenon is called Urban Heat Island (UHI) and is a threat to today's cities (Figure 1). The effects of global climate change are palpable and urging to act now.

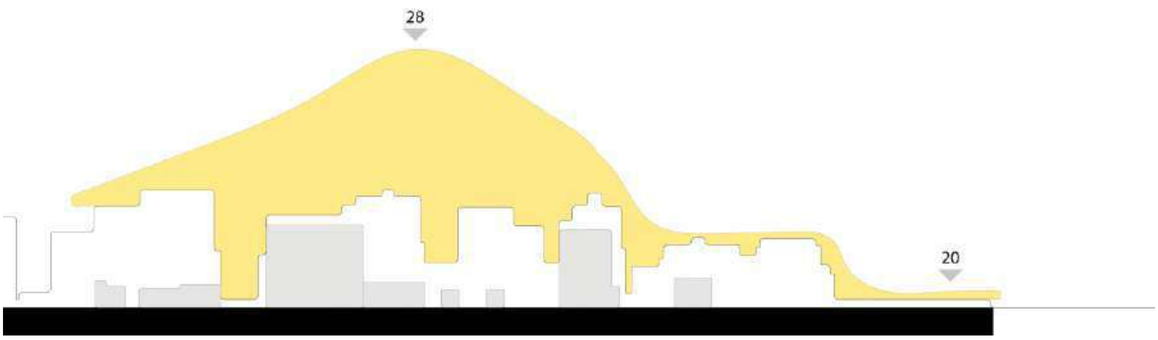

Figure 1 Generalised description of differential cooling rates between urban core and its surrounding. The difference in UHI is given by the difference in urban and rural temperatures.

Studies across the world's major cities demonstrate that, highly urbanised areas have a higher average temperature of 1°C to 12°C than less urbanised areas(EPA, 2014, Hopkins, G. 2014, Lehmann, S. 2014). The Australian Government has dedicated resources and new ways are being developed to reduce UHI in major Australian Cities (202020 Vision, Urban Forest Strategy – City of Melbourne, Pale pavement trial – City of Sydney Australia, Buildings that Breath – City of Brisbane and Urban Cooling Guide). Efforts are focused on moderating the intensity of UHI by changing the vegetation cover, previous surface areas and water availability (Coutts et al. 2009). Practical procedures developed for built environment professionals and cities to manage the effects of UHI in urban centres is a step towards recognizing the UHI phenomenon and mitigating its effects (CRC, 2007, 202020 Vision). However, across new projects, the changing character of streets and public spaces has seen extensive use of building materials causing low evapotranspiration, which triggers higher temperatures therefore creating UHI. Urban designers, Landscape architects and Architects have a major role to play to diminish the risk of UHI. New masterplans have to incorporate into the design process more elements that act as natural cooling mechanisms like vegetation cover, previous surface area and controlled stormwater management, (Stone and Rogers, 2001, Coutts et al. 2009). Every °C in temperature reduction through better design of cities matters. Study shows that 1°C temperature increase requires 1.5million kWh more cooling loads per year, thus generating 1000 tonnes in carbon dioxide emissions (Flinders University, 2015). Therefore reducing UHI will have social, economic and environmental effect on urban-dwellers of coastal cities in Australia.

The aim of this article is to demonstrate the importance of determining the UHI ratios in the early stages of masterplaning process. Nerang Street (700 metres segment from High Street to Marine Parade) in Gold Coast, Australia, is an example that has used desktop and site observation methods to determine UHI that informed the proposed interventions in the masterplan.

METHOD

Three methods were adopted to explore the UHI ratio in Nerang Street in order to generate the urban design tool.

The first method analyses the daily maximum temperature data for a 5-year period from three nearest bureau stations; Gold Coast seaway (2.2 km away from Nerang street), Heinze Dam (4.4 km) and Coolangatta (14.0 km). [1]The daily maximum temperatures from the three stations determines the monthly maximums for the 5-year span. The produced data is compared with the heat stress index table (Table 4), defines the amount of days where possible fatal consequences occur for the life of people aged 65 years-old (National Weather Service Heat Index, NOAA). Next, the monthly maximum from Gold Coast seaway station (being the nearest to Nerang street) is extracted from Heinze Dam station and then Coolangatta station. The mean of the difference between these meteorological stations determines the difference in temperature from Nerang St to its closest surrounding, thus providing the atmospheric UHI difference. In result, the comparison will determine whether Southport (where Nerang Street is located) is warmer or colder than its nearest surroundings. The study recognises that the method reflects the differences in areas rather than the specific street in consideration. For this reason, the second and third methods will provide a more insightful information on the UHI of Nerang Street.

The second method analysis sun-shading process on Nerang Street using *NearMap* and computer aided software (Appendix 1) during the hottest days in every year for the past 10 years. This study captures the areas with the longest sun exposure on the street. The length (d) of the exposed area is divided by the average walking speed (s) and this will determine the amount of time (t) it takes for a person to cross the area, thus, the amount of time a person is exposed to heat stress (t=d/s). Further, the paper observes and considers the amount of crossings regulated with traffic lights and the time required to cross the street.

[1] In absence of temperature data specifically related to Nerang Street, data from local meteorological stations produced by the Australian Bureau of Meteorology were used to demonstrate the difference in UHI between stations. The paper recognises that this data is not accurate to the microclimate existing in Nerang Street. Therefore two other methods where deployed to provide more insightful results.

Lastly, the paper analysis thermal emittance of surface materials of Nerang Street segment. By using the solar reflectance index (SRI) the paper determines the material contribution to UHI (EPA, 2014). Further, referring to 'heat stress index' table, the study determines the stress level a person perceives walking Nerang Street on a hot day. Lastly, urban cooling intervention matrix (CRC, 2007) examines the cooling strategies used by HASSELL's masterplan for Nerang Street.

RESULTS AND DISCUSSION

Comparing 5 year maximum daily temperatures between the nearest meteorological station to Nerang Street (Gold Coast Seaway, 2.4 km) and the closest surrounding station (Heinze Dam 4.4km and Coolangatta 14.0km) shows a contrast of yearly mean ranging from -0.7[2] to 1.0 degrees Celsius (Appendix 1). Respectively the yearly mean between Gold Coast Seaway station and Heinze Dam [3](Table 1) indicate that mainly the area of Southport (where Nerang Street is located) has experienced from 0.6 to 1 degree Celsius warmer temperatures. Results from comparing monthly maximum temperatures for a five-year period between Gold Coast Seaway station and Coolangatta provide a mean that support the fact that Southport experiences warmer temperatures (Table 2).

GCS-HD													
DIFFERENCE		SUMMER				WINTER				SUMMER			MEAN
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
2005	1.1	0.5	-1.2	0.9	0	-0.5	1.3	0.6	-0.8	-5	3.3	-0.6	-0.03333
2006	-2.9	2.6	3.9	-1.2	1.6	1.3	2.2	-1.1	0.7	0.6	-0.1	0	0.633333
2007	-0.6	3.2	-1.7	0.5	0.7	0.5	1	0.8	1.1	0.5	-1.2	3.1	0.658333
2008	1.9	1.6	1.7	1.7	1.6	1.8	1.5	2.9	-2.6	-1.8	2.9	-1	1.016667
2009	0.5	0.2	2.7	0.1	1.1	2.7	1.1	-2.1	-3.9	0.8	-5.2	-6.6	-0.71667
2010	0.2	-1.8	0.7	1.2	1.4	2.8	2.4	0.2	0.1	-0.2	0.5	0.6	0.675

Table 1: 5 Year Monthly Maximum Temperature Difference between Gold Coast Seaway Station and Heinze Dam Station (Years 2005-2010)

GCS-C													
DIFFERENCE	SUMMER				WINTER			SUMMER					MEAN
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
2013	0.8	1.4	-0.3	0.1	1.3	0.2	0.1	0.2	-1.3	0.8	0.5	1	0.4
2014	0.4	-0.2	1.3	-0.1	-0.3	1.3	1.9	1	-0.1	1.5	3	-0.2	0.791667
2015	4	0.7	1.8	0.5	-0.6	-0.3	-0.1	0.1	-0.7	-0.7	-0.1	0.9	0.458333
2016	1.9	2.4	1	0.9	1.5	0.4	-0.7	-0.8	-0.2	2.4	2.6	-0.7	0.891667
2017	0.4	0	-1.3	-1.3	0.6	0.2	0.1	0.7	-3.2	-0.5	0.8	0.1	-0.28333
2018	1.2	-0.4	2.9	-0.4	0.1	-0.2	0.7	0.7	0.9				0.611111

Table 2 5 Year Monthly Maximum Temperature Difference between Gold Coast Seaway Station and Coolangatta Station (Years 2013-2018)

Data demonstrates that Nerang Street in Southport, experiences yearly higher temperatures than the compared stations. Suggesting that people living and walking outdoors are prone to higher heat stress than the comparing areas.

The spatial variability of UHI in a specific area is controlled by shading cover and the surface characteristics, which determine the evapotranspiration ability of Nerang Street. The result from mapping the shading cover of Nerang Street for a 7 hour Sunrise-Sunset process (Appendix 2) of the hottest day from 2013 to Aug 2018 revel the areas exposed to heat stress in Nerang Street segment under investigation (Figure 2). Three areas present concern about increased UHI. The length of sun-

[2] Negative temperature means that during that year it was hotter in Southport where Nerang street is located than the comparing weather station.
[3] Heinze Dam closed in 2010. Data compared between Gold Coast Seaway and Heinze Dam are from 2005-2010.

exposed area 1 and 2 in figure 2 is about 120 m. Area 3 has a length of 110m of exposed surface (Figure 3). The average crossing time of Nerang Street segment under study for a 65 years old individual walking with a speed of 0.9 m/s (Webber, 2016) is around 12 minutes[4]. During this time, the individual is exposed to the effects of sun for more than 5 minutes. Given that human body temperature takes more to cool down and faster to heat up (Webber, 2016), revels that crossing the segment of Nerang Street can have serious health consequences for people aged over 65 on a hot day during 11 am to 4 pm.

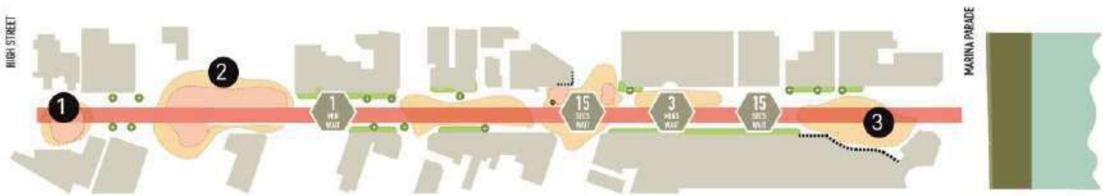

Figure 2: Heat exposure map of Nerang Street Segment under investigation

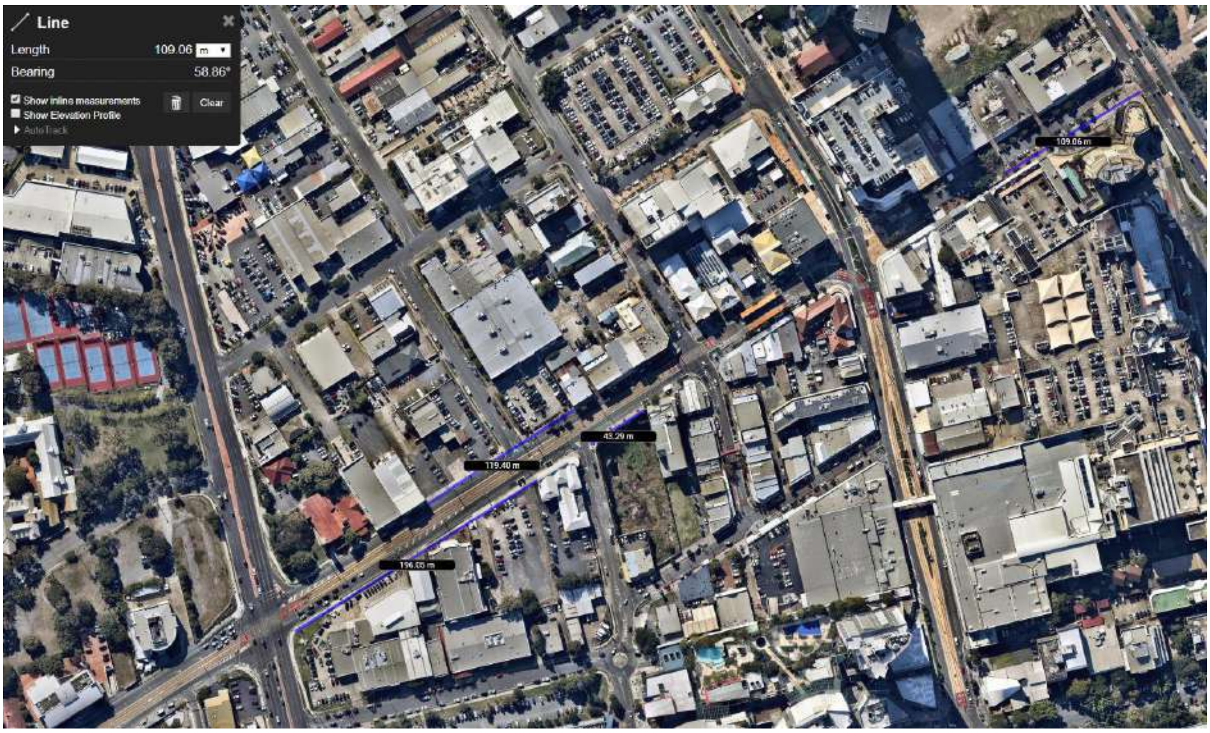

Figure 3: Length most sun-exposed Areas

Generally the surface material of area 1,2 and 3 (figure 2) is made out of coloured concrete (light rail tracks), 40mm asphalt black (carriageway), green verges and concrete at sidewalks (Figure 4).

[4] Referring to Webber (2016) the older the individual the slower is his speed. This study considers the speed of 0.9 m/s as appropriate for measuring the exposure of an individual to UHI while crossing the street from High Street to Marine Parade or vice-versa.

Considering the differences in albedo and SRI of materials, Babic S. (Babic et al., 2012) have demonstrated the surface of the street is in average 16.4 °C for asphalt and 11.0 °C for concrete hotter than air temperature. Indicating that the surface material contributes to a hotter air temperature in sunlight-exposed area.

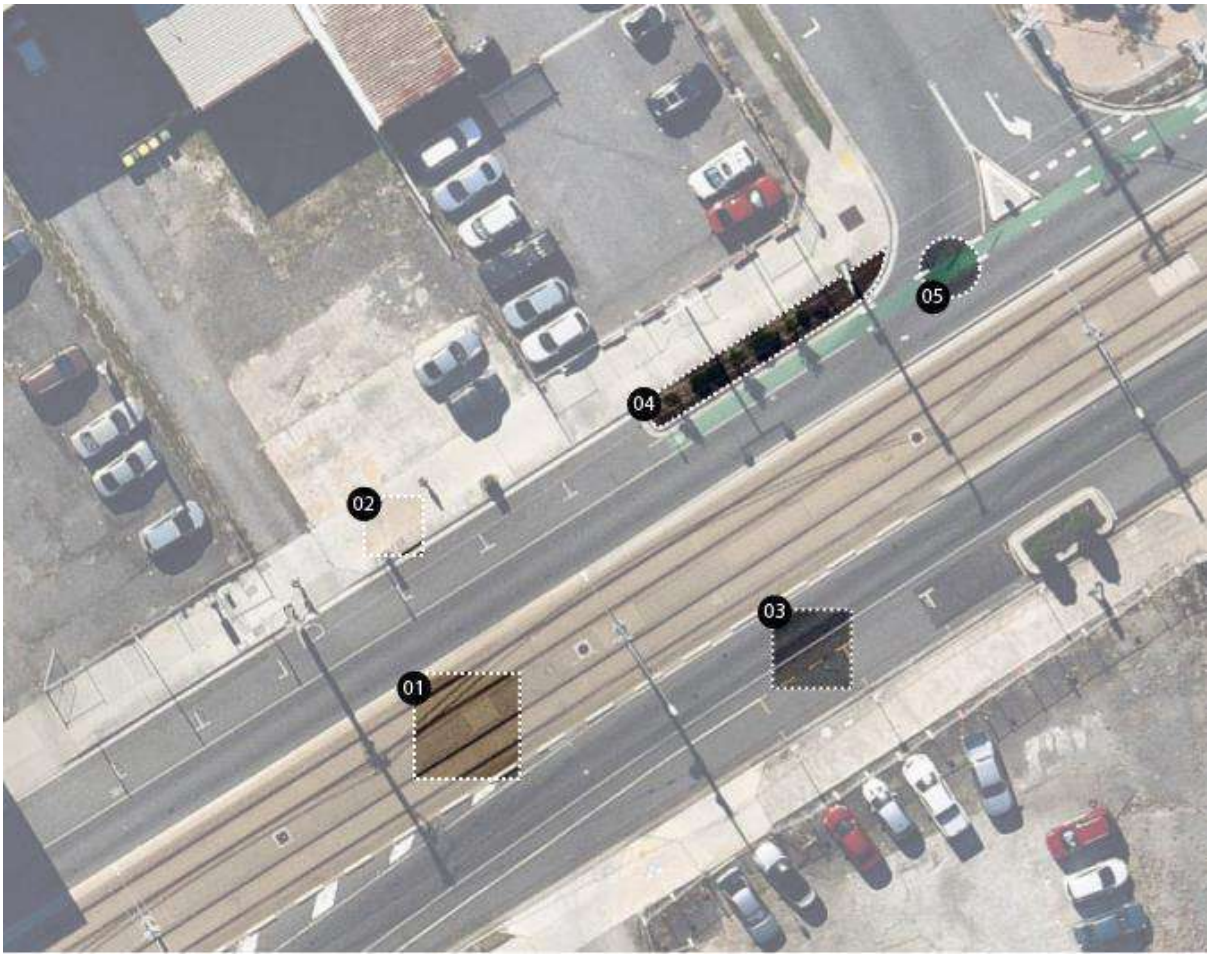

Figure 4: Material Inventory of Nerang Street Section 2 as per Figure 3

01. Colored Concrete; 02. Concrete; 03. 40mm Asphalt wearing course 04. Green Verge, grass 05.Colored Asphalt

Adding 1 °C[5] to the highest recorded temperature experienced in Nerang Street (December 2014, Table 3) results in an overall temperature of 38 °C. This temperature in a 50% humidity is considered dangerous for human life as per heat index table developed by the Australian Bureau of Meteorology (Table 4) and that immediate measures should be taken to prevent heatstroke.

[5] Is the minimum increase in heat that would have occurred in Nerang Street on the hottest day recorded given the surface characteristics of the street.

Gold Coast Seaway QLD (4.4 km away)												
Highest Daily	SUMMER			WINTER				SUMMER				
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2013	32.5	30.8	34.3	29	27.9	24	23.7	26.5	31.4	35.6	32	32
2014	33.3	32.1	32.2	32.6	27	25.8	24.9	25.5	28.4	31	32.3	36.9
2015	36.5	30.2	35.7	29.4	27.4	24.7	24.1	27.4	28.4	28.1	32.8	31.2
2016	33.6	34.1	31	29.8	28.4	26.9	28.9	24.9	27.2	30.1	32.8	33.3
2017	33.4	33	30.8	29.1	26.6	24.3	25.6	29	29.6	31.7	29	35.7
2018	34.4	31.8	35.1	31.1	27.7	24.7	25.2	27.2	26.9			

Table 3: Monthly Maximum Temperatures from 2013-2018 as measured from Gold Coast Seaway station, Australia

HEAT INDEX from TEMPERATURE & RELATIVE HUMIDITY READINGS

		TEMPERATURE (Degrees Celsius)																																
		18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
%	10	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	49	50	51
R	15	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	40	41	42	43	45	46	47	49	50	52	53	55
E	20	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	36	37	38	40	41	43	44	45	47	48	50	52	53	55	56	58
L	25	18	19	20	21	22	23	24	25	26	27	28	29	30	32	33	34	36	37	39	40	42	43	45	46	48	49	51	53	54	56	58	60	61
A	30	18	19	20	21	22	23	24	25	26	27	29	30	31	33	34	36	37	39	40	42	43	45	47	48	50	52	53	55	57	59	61	63	65
T	35	18	19	20	21	22	23	24	26	27	28	29	31	33	34	36	37	39	40	42	44	45	47	49	50	52	54	56	58	60	62	64	66	68
I	40	18	19	20	21	22	24	25	26	28	29	31	32	34	35	37	39	41	42	44	45	47	49	51	53	54	56	58	61	63	65	67	69	72
V	45	18	19	20	22	23	24	26	27	29	30	32	33	35	37	38	40	42	43	45	47	49	51	53	55	57	59	61	63	65	68	70	72	75
E	50	18	19	21	22	24	25	27	28	30	31	33	34	36	38	40	41	43	45	47	49	51	53	55	57	59	61	63	66	68	71	73	76	78
	55	19	20	22	23	24	26	27	29	31	32	34	36	37	39	41	43	45	46	48	50	52	55	57	59	61	64	66	68	71	74	76	79	82
H	60	19	21	22	24	25	27	28	30	32	33	35	37	38	40	42	44	46	48	50	52	54	57	59	61	64	66	68	71	74	76	79	82	85
U	65	20	21	23	24	26	27	29	31	32	34	36	38	40	42	43	45	47	50	52	54	56	58	61	63	66	68	71	74	77	79	82	85	89
M	70	20	22	23	25	27	28	30	32	33	35	37	39	41	43	45	47	49	51	53	56	58	60	63	65	68	71	73	76	79	82	85	89	92
I	75	21	23	24	26	27	29	31	33	34	36	38	40	42	44	46	48	50	53	55	57	60	62	65	68	70	73	76	79	82	85	89	92	95
D	80	22	23	25	26	28	30	32	33	35	37	39	41	43	45	47	50	52	54	57	59	62	64	67	70	73	75	79	82	85	88	92	95	99
I	85	22	24	25	27	29	31	32	34	36	38	40	42	44	46	49	51	53	56	58	61	63	66	69	72	75	78	81	84	88	91	95	98	102
T	90	23	24	26	28	30	31	33	35	37	39	41	43	45	48	50	52	55	57	60	63	65	68	71	74	77	80	84	87	90	94	98	102	106
Y	95	23	25	27	28	30	32	34	36	38	40	42	44	47	49	51	54	56	59	62	64	67	70	73	76	79	83	86	90	93	97	101	105	109
	100	24	26	27	29	31	33	35	37	39	41	43	45	48	50	53	55	58	60	63	66	69	72	75	78	82	85	89	92	96	100	104	108	112
		18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50

LEGEND

SAFE	MILD CAUTION	CAUTION	EXTREME CAUTION	DANGER	EXTREME DANGER	DEATH IMMINENT
No serious issues.	Frail Aged and children may exhibit discomfort	Discomfort Evident Fatigue Possible	Fatigue Likely Muscle Cramps & Heat Exhaustion Possible	Muscle Cramps & Heat Exhaustion Likely Heatstroke Possible	Heatstroke Likely Death Possible	Reduce exposure to under 2 minutes

Table 4:Heat Index Table: Australian Bureau of Meteorology 2009

As the natural landscape is replaced with impervious surfaces, runoff increases as water is rapidly removed through the stormwater network and infiltration is restricted – significantly reducing evaporation, which drives higher UHI (Hopkins, 2014). The results of the third analysis (Table 5) is a very dry urban landscape which means that more energy is partitioned into either heating the atmosphere or into heat storage driving higher night time UHI. Table 5 provides an understanding of the current situation of Nerang Street and in the same time the solution to improving the UHI conditions.

URBAN CONTEXT		SVF	COOL PAVING			COOL ENVELOPE		GREEN ENVELOPE		TREE CANOPY	EVAPORATIVE COOLING		SHADING STRUCTURES
			HIGH ALBEDO PAVING	HIGH EMITTANCE PAVING	PERMEABLE PAVING	HIGH ALBEDO ENVELOPE TREATMENTS	HIGH EMITTANCE ENVELOPE TREATMENTS	GREEN ROOF	GREEN WALL		SURFACE WATER AND EVAPORATIVE COOLING	MISTING FAN	
NERANG STREET	Plaza	Low	N	3	3	R-3	WR-3	3	3	1	D-3	HD-3	2
	Square	Medium	2	3	3	R-3	WR-3	3	3	3	D-3	HD-3	3
	Street	Low	N	3	3	R-3	WR-3	-	3	3	-	-	2
	Pedestrian mall	Low	N	3	3	R-3	WR-3	3	3	2	D-3	HD-3	3

D = Dry climate	W = Wall	Effectiveness
H = Humid climate	R = Roof	High = 3 Medium = 2 Low= 1 N = negative

Table 5: Urban Surface Context matrix adopted from CRC Urban Cooling Guide 2017

RE-IMAGINING NERANG STREET – CASE STUDY

Gold Coast is known for interactive streets with outdoor activities, public life and thermally comfortable environment. Gold Coast City Council and HASSELL Studio Brisbane have undertaken a transformative master plan for Nerang Street, fostering cooler streets, more welcoming and attractive to the people and investors. To achieve this, the master planning process has undergone a series of urban analysis on factors influencing UHI rates in Nerang Street, and adopted a Street Toolkit (Figure 4) as a response (Gold Coast City Council & HASSELL 2018).

The main factors governing the UHI generation and the amount of energy available for heat storage during day and night relate to the amount of shade and surface characteristics of the street. The urban cooling guideline (2017) provides with a set of strategies to help mitigate the UHI. These measures include water sensitive urban design, increased vegetation, high albedo and thermal emittance surfaces. HASSELL studio adopted the strategies and developed a toolkit (Figure 4) to approach the new masterplan of Nerang Street. In producing the masterplan (Figure 5) it is acknowledged that evapotranspiration rates and surface temperatures are not simply aligned with vegetation cover but rather with water availability (Deilami et al. 2016). Therefore, the masterplan considers integrating water feature along with new shading structures, permeable paving and increased vegetation cover to mitigate UHI.

In response to heat spots in segment 1,2 and 3 from figure 2 (Heat exposure map of Nerang Street Segment under investigation) the new masterplan changes the street design and through water sensitive urban design it introduces water feature that capture and reuse stormwater. Unvegetated areas are transformed into green oasis using local plants and vegetation, providing more shade and promoting safer streets for locals and visitors.

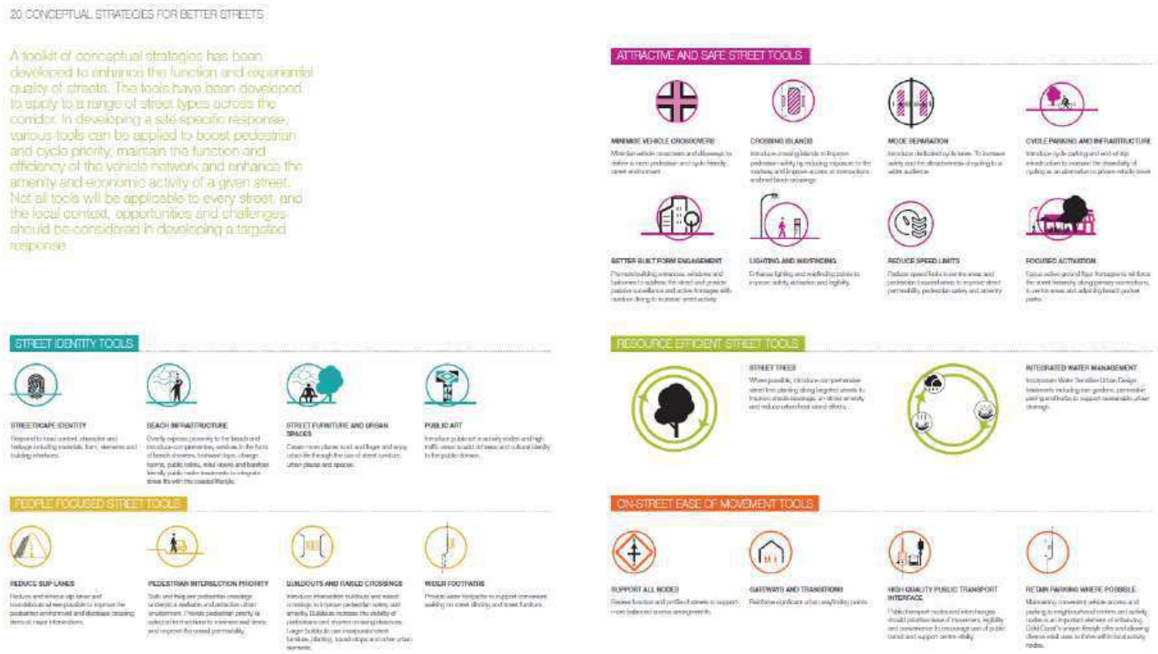

Figure 5: Better Streets Toolkit HASSELL

Figure 6: Nerang Street Concept Masterplan HASSELL

CONCLUSION

UHI is predominantly a phenomenon caused by urbanisation and characteristics of urban surface. Mitigating its risks requires mapping UHI and analysing surface characteristics at the early stages of masterplan. Desktop analysis of weather stations and shadings along with site observations are effective methods for urban planners and designers to foster a cooler city.

Temperature analysis revealed that Nerang Street experiences warmer temperatures than other compering areas. This suggests that there is potential for developing heat islands in parts of the street. Based on the produced data, on the hottest day of the 5-years in analysis, a 65-years old human walking Nerang Street could have experienced possible heatstroke with high life-threatening risk.

The paper recognises that the differences between meteorological stations are not an accurate estimation of UHI in Nerang Street in Southport. The analysed data reveals that in general the area is warmer then the two nearest weather stations. There are many factors influencing the changes in temperature between compared stations. Could be simple climacteric changes between the stations or may be the rapid urbanisation of Southport that drives relatively higher temperatures. Determining the factors influencing the differences in temperature between Gold Coast Seaway, Heinze Dam and Coolangatta stations requires another research.

Mapping and observations done in Nerang Street revealed 3 areas that are exposed to higher temperatures. The new masterplan for Nernag Street developed by HASSELL adopts cooling strategies and toolkits that mitigate UHI, by controlling heat retention of the street using water features, encouraging evaporation and transpiration, keeping previous surfaces cool, and increasing the vegetation capacity in the area. These factors are essential to minimise heat stress from extreme temperatures and manage the Urban Heat Island effect in urbanised areas.

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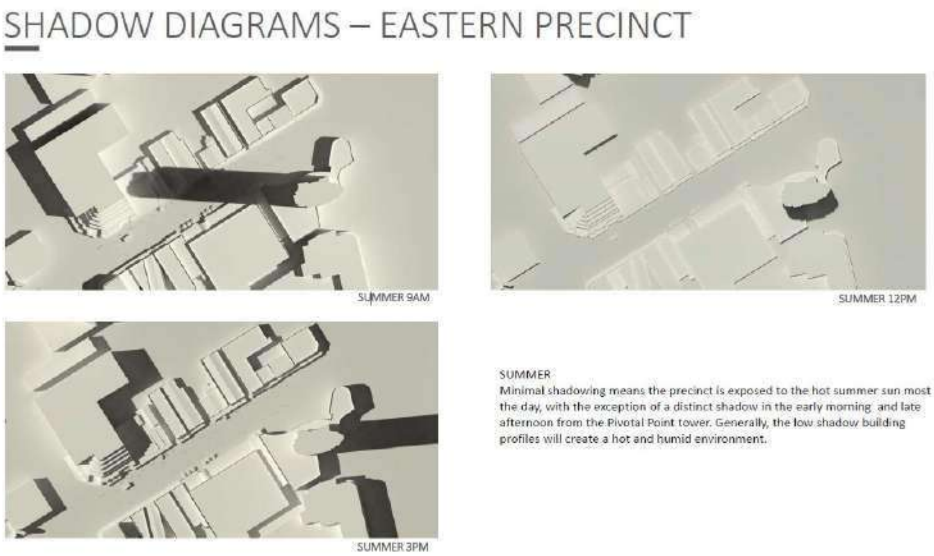
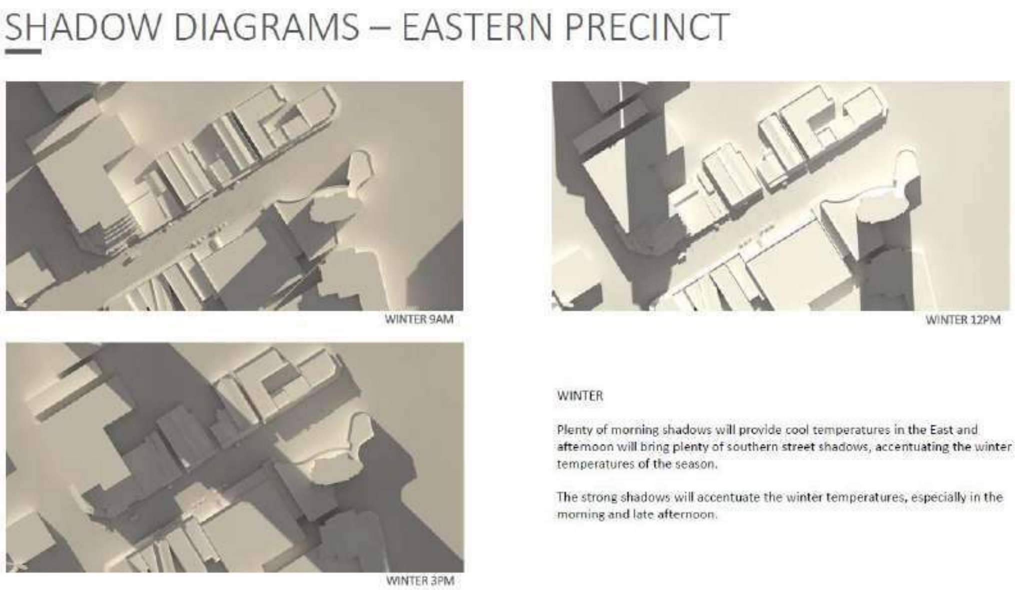
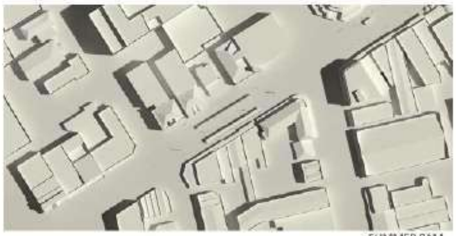
APPENDIX

APPENDIX – 1 – Computer generated shadows of Nerang Street during the warmest day of the year

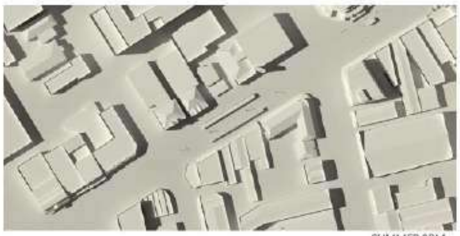




SHADOW DIAGRAMS – CENTRAL PRECINCT


SUMMER 9AM

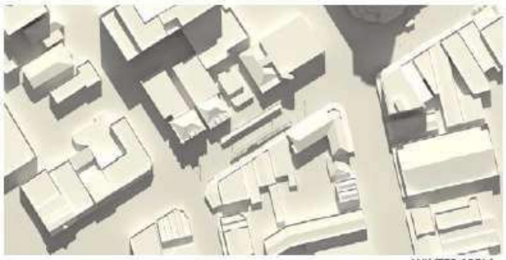

SUMMER 12PM


SUMMER 3PM

SUMMER
The central precinct is highly exposed to the summer sun, especially in the middle of the day with the afternoons providing some reprieve. Minimal shadowing during the day will create a hot and humid environment.

SHADOW DIAGRAMS – CENTRAL PRECINCT

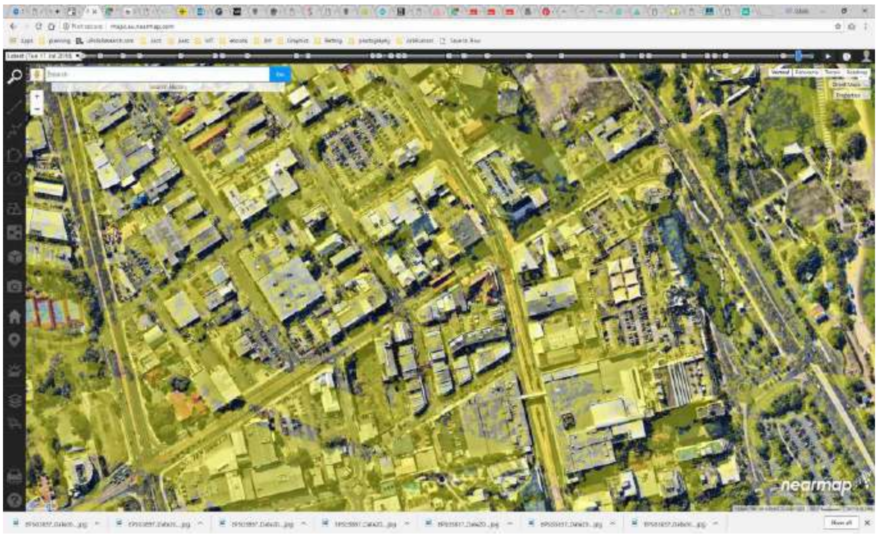

WINTER 9AM


WINTER 12PM


WINTER 3PM

WINTER
In the morning hours existing structures cast shadows in a north-west pattern, with higher buildings covering a large distance on the ground. The eastern side of the streetscape remains uncovered in the early afternoon, with most shadows returning in the afternoon, providing a cooler climate.

APPENDIX 2 – Near map analysis of shading during a Sun rise-to-sunset process in Nerang Street of the hottest day in December 2014 (36.9 °C)



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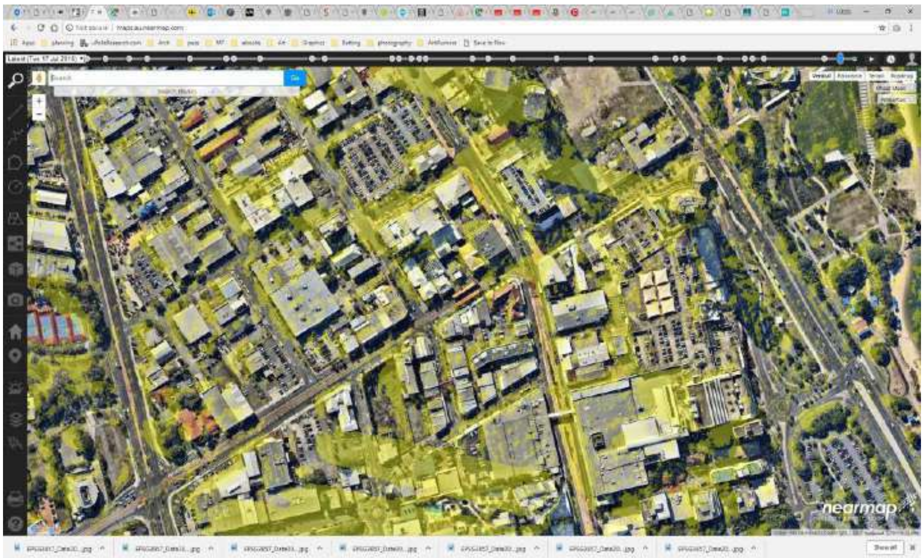

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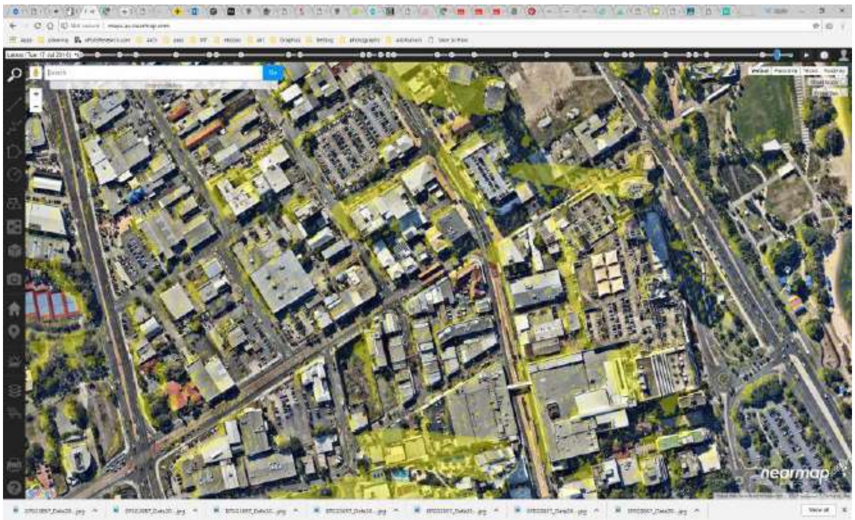

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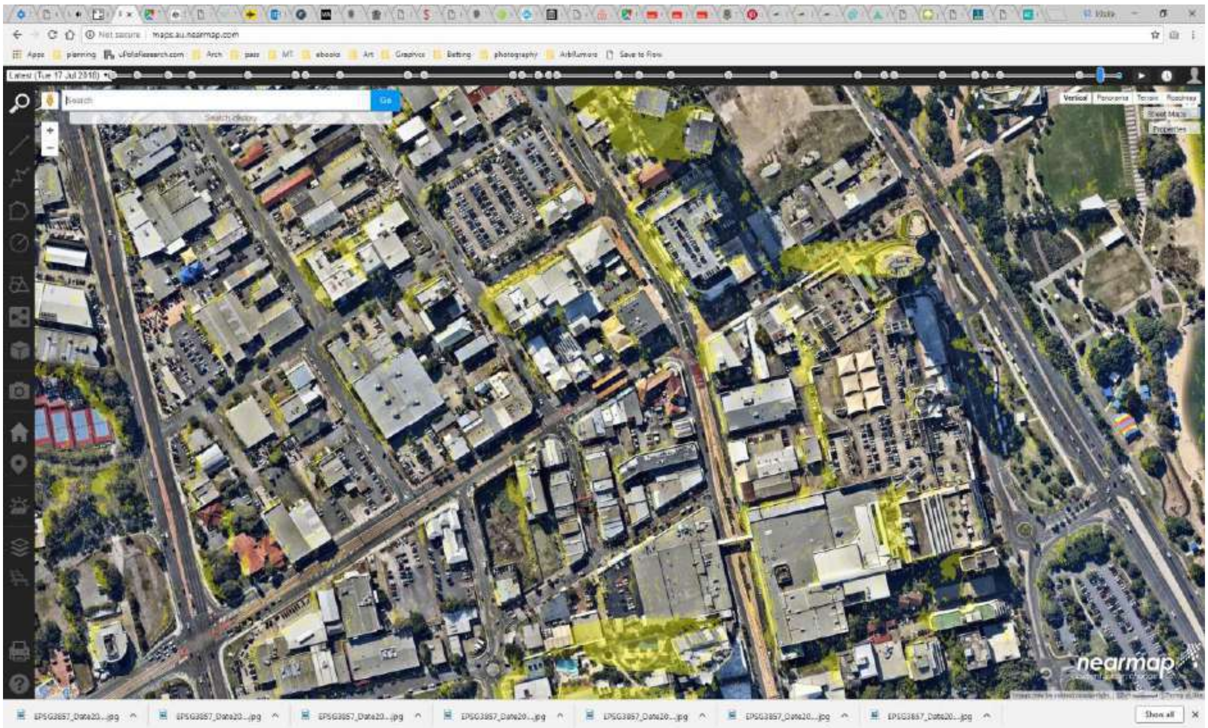

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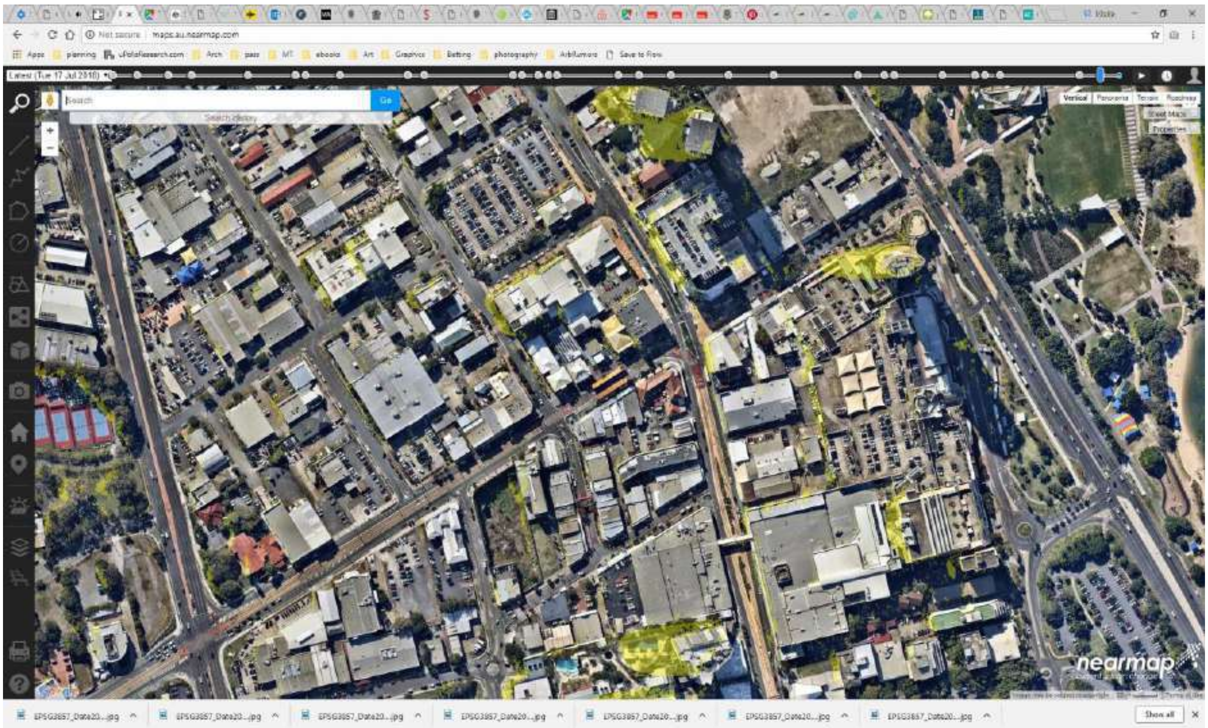

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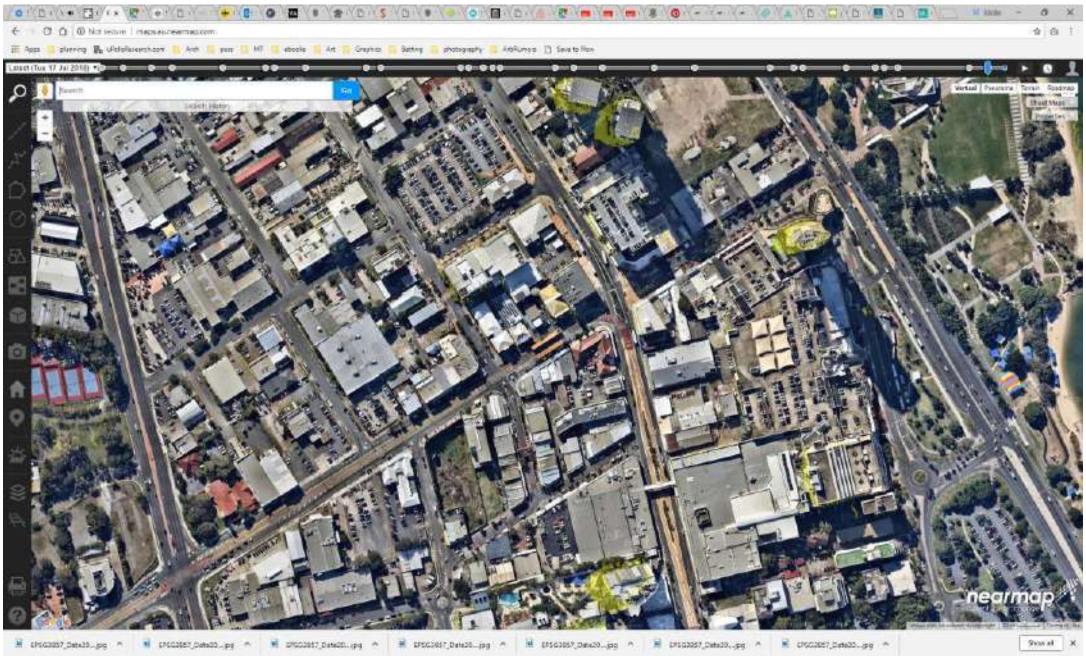

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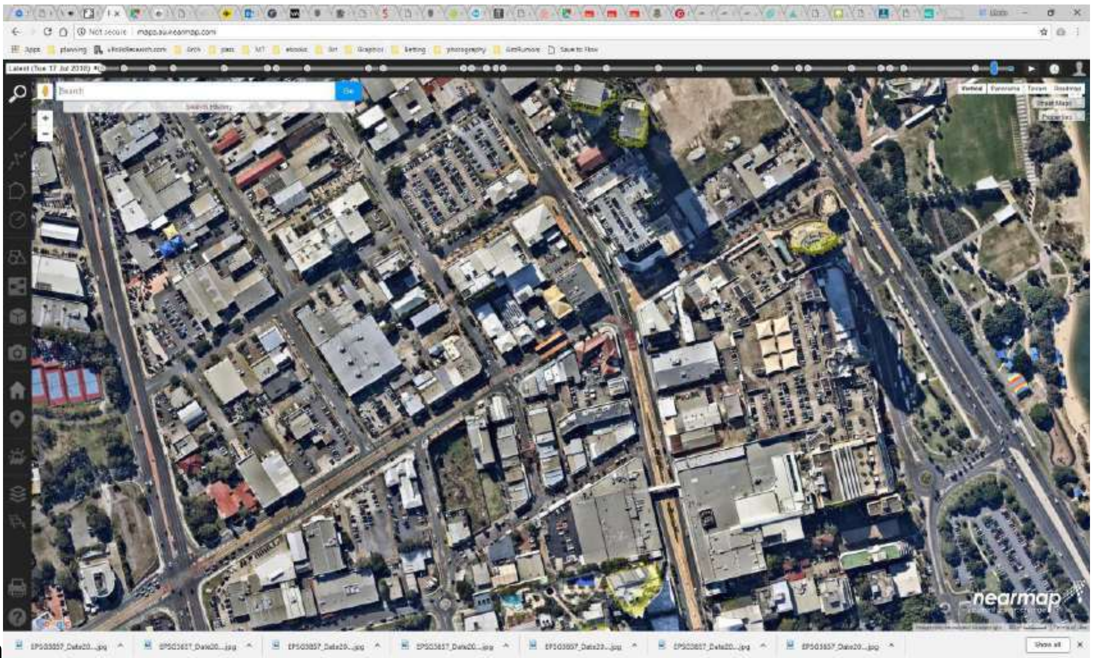
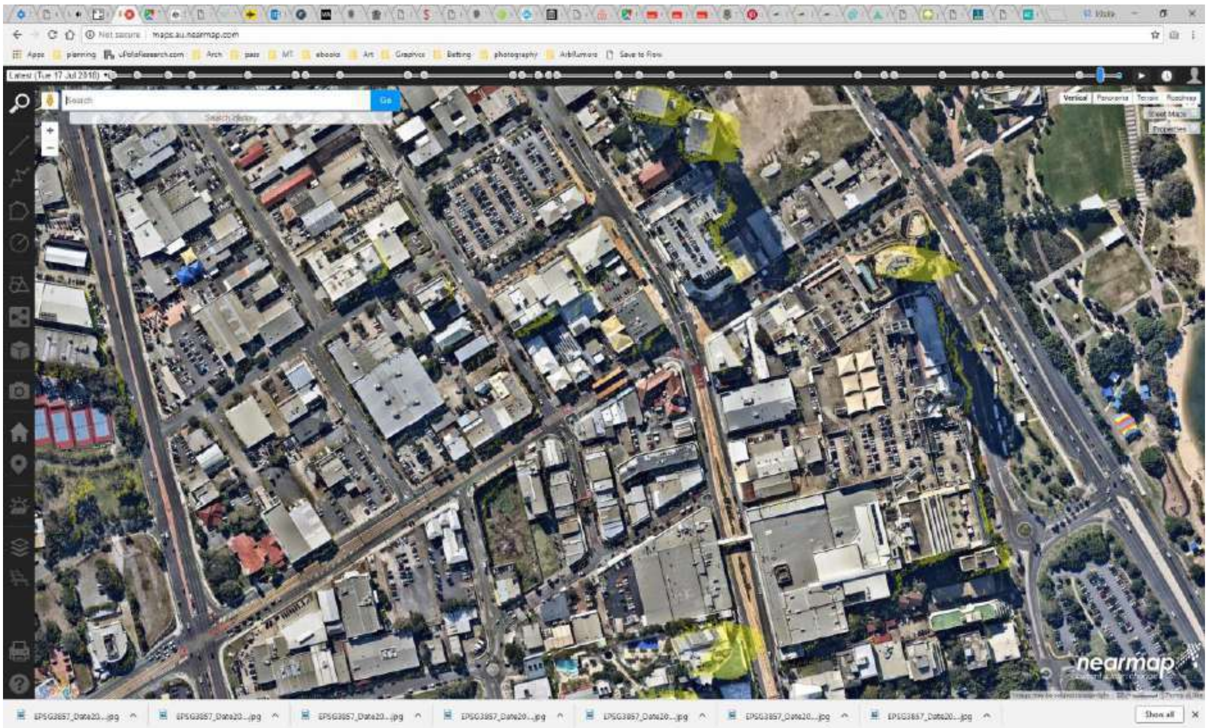
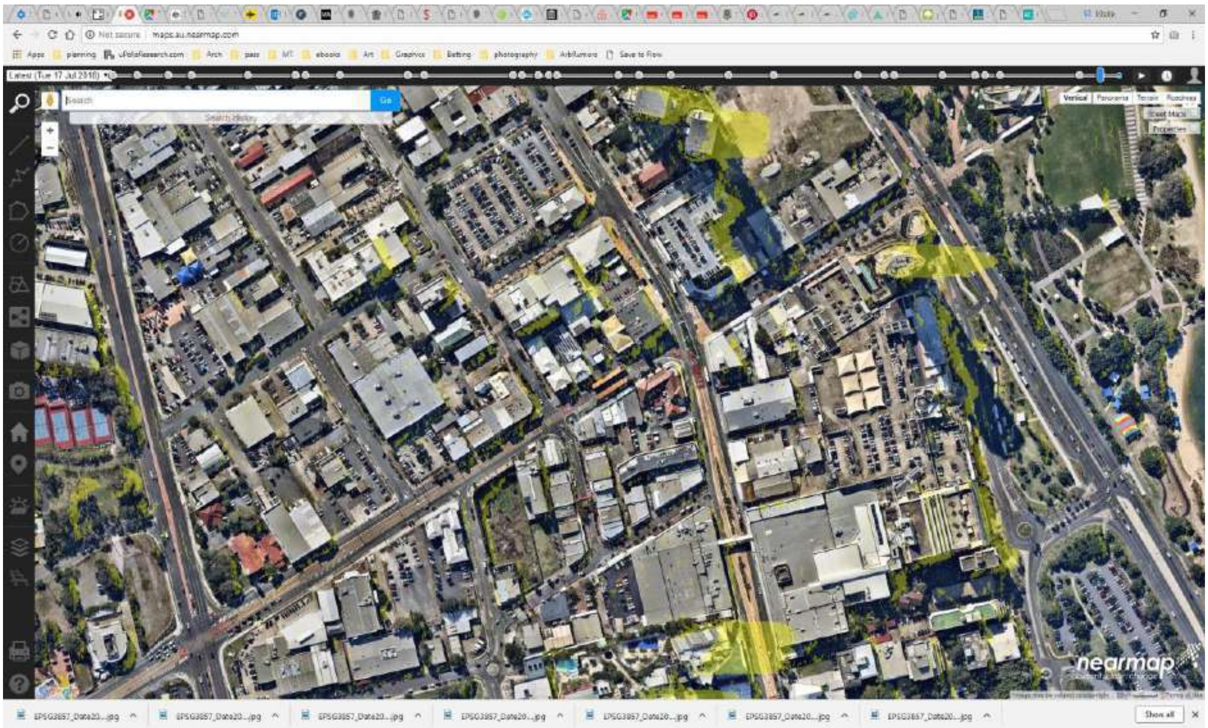
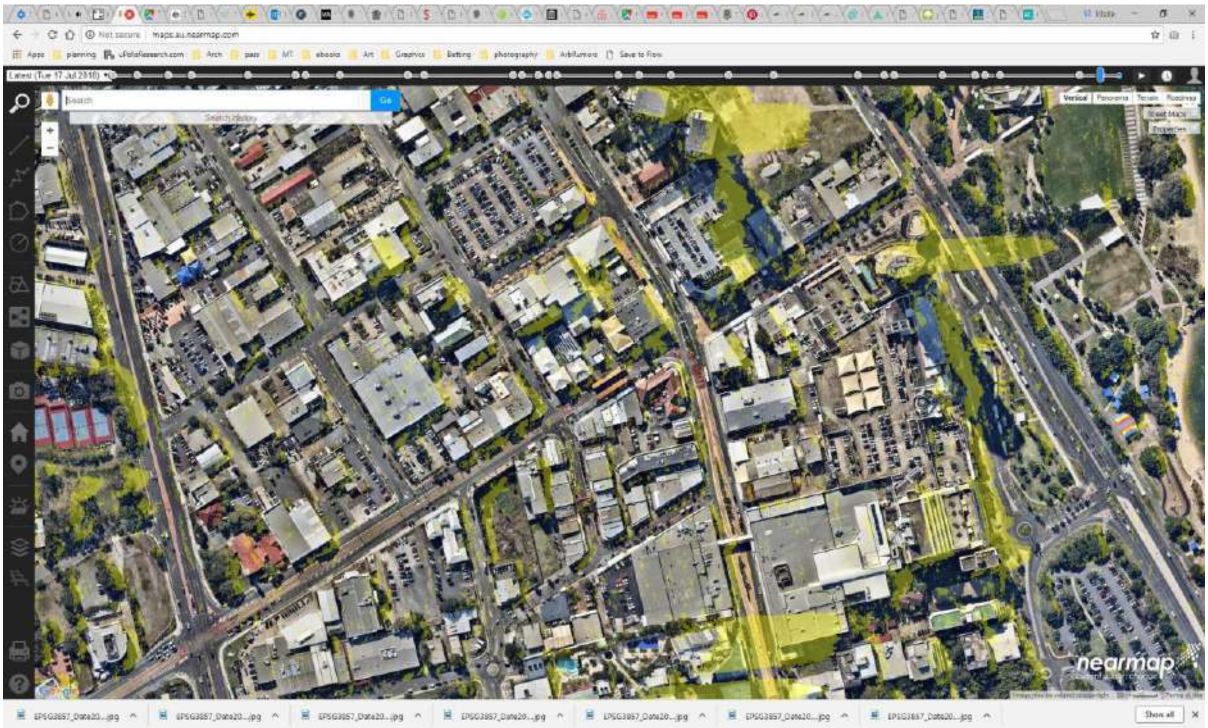


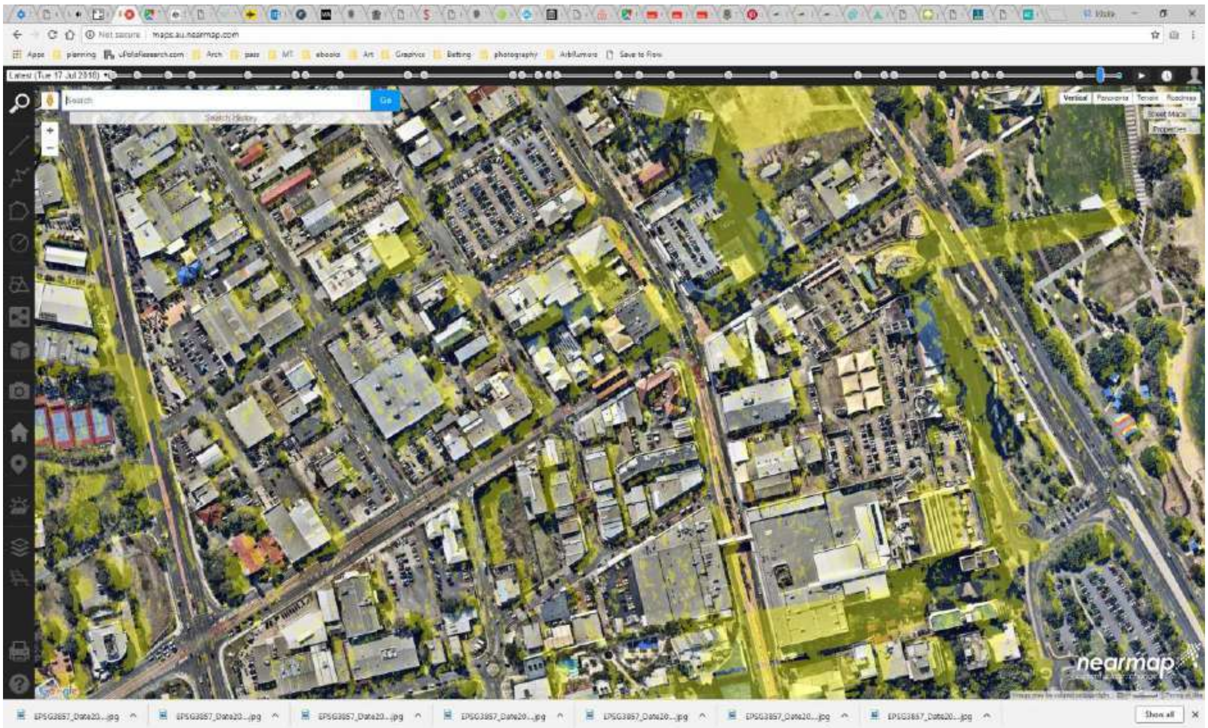
12:30am

13:30pm





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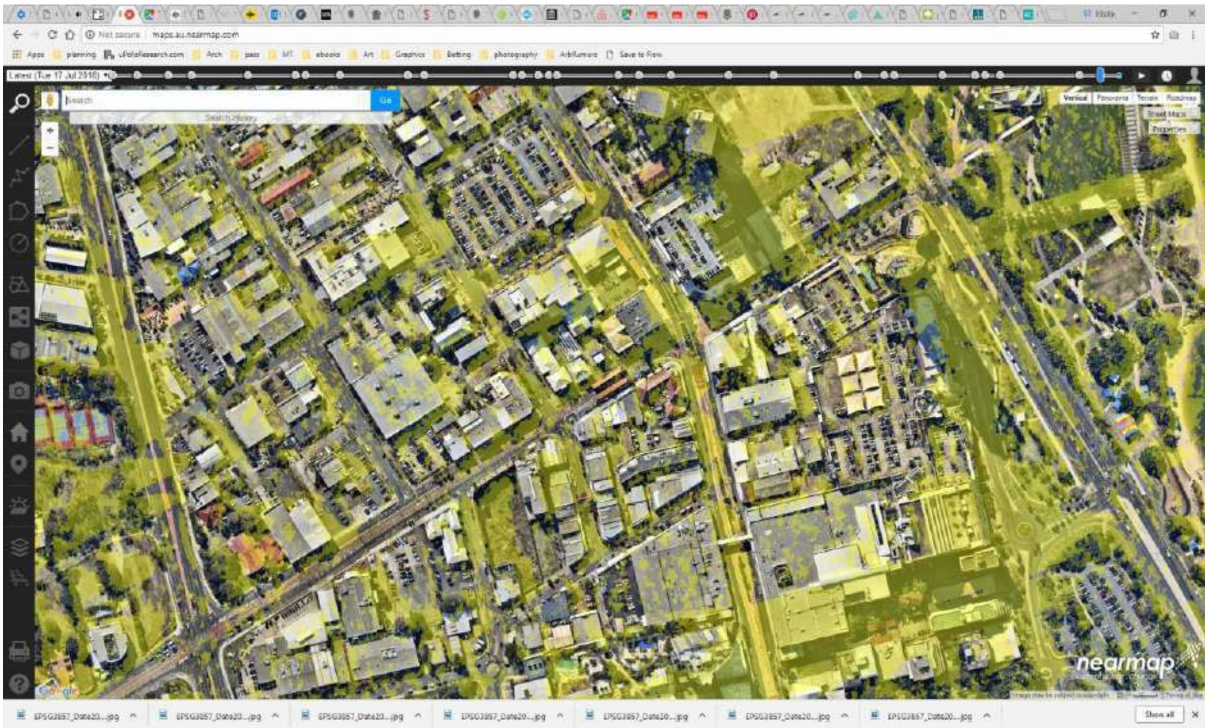
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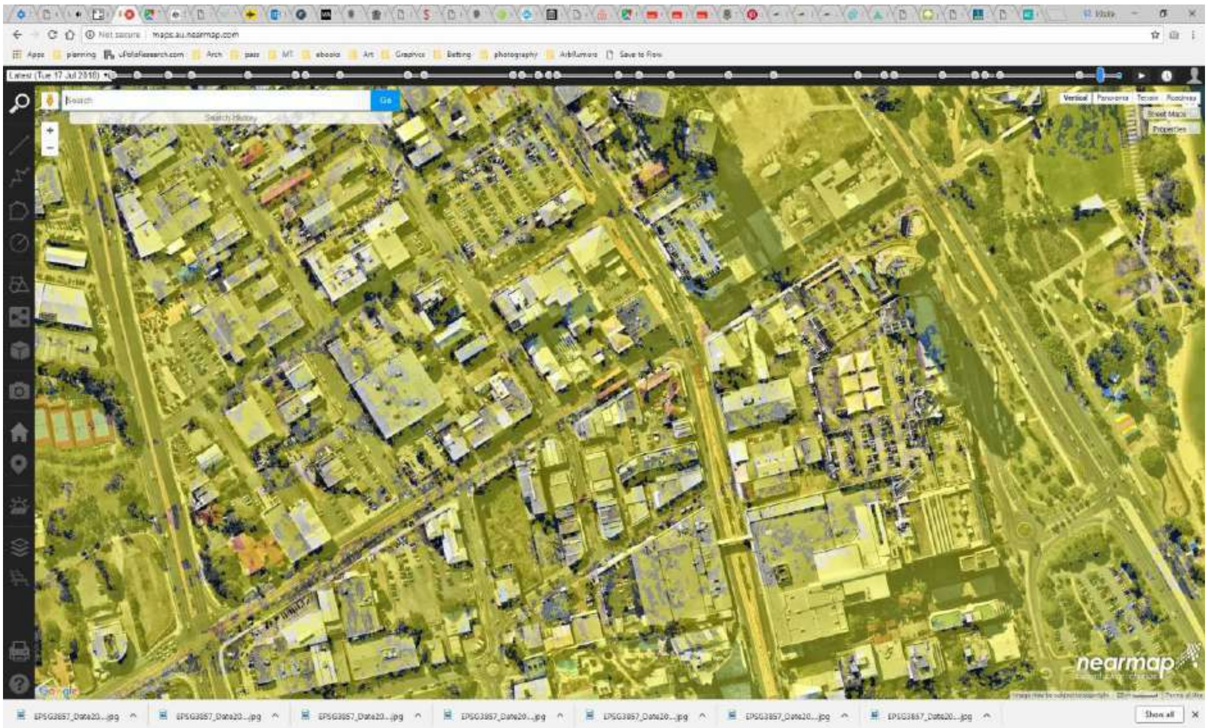

Climate change adaptation in Hong Kong from urban planning perspective: flood zoning as control mechanism

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ABSTRACT:

With rising sea level and higher intensity of typhoons under climate change, severe storm surge is anticipated and will induce more frequent and extensive coastal flooding in Hong Kong. Notwithstanding, official flooding blackspots were not locations of actual occurrence of major floods because the impact of storm surge was considered difficult to be addressed through land drainage system, resulting in a major loophole of flood adaptation in Hong Kong.

Conventional way of flood adaptation through engineering measures with past design standard could not catch up with the latest flood occurrence and magnitude. Upgrading of infrastructure would be costly, disruptive to local community and not be flexible and timely enough to respond to the growing flooding risk. Site formation level made by the reclamation geotechnical engineering works decades ago was also irreversible, necessitating the need for alternative management measures on flood risks. Flood adaptation from urban planning perspective is therefore pursued to complement and compensate for the design failure of engineering and structural measures.

As land use planning is governed by zoning control, flood zoning is proposed to be the research focus. The analysis would review the literature on flooding risks to Hong Kong and the influence of urban planning on flood adaptation policies. To enable in-depth analysis, a flood-prone community of Heng Fa Chuen and Chai Wan located at the south-eastern coast of the Victoria Harbour was selected for pilot testing of flood zoning. The flood risk exposure and vulnerability of this community were analysed. Through site visit, interviews and desk research, factors affecting effectiveness of flood zoning were discussed, leading to formulation of the flood zoning proposal. Flood zoning aimed to guide and regulate urban development by integrating flood risks with land use vulnerability classification and flood zone compatibility. Certain requirements on planning and building codes, urban design, monetary measures as well as public education through administrative, regulatory and statutory mechanisms were proposed. It was demonstrated that flood zoning could be an alternative and implementable tool for flood adaptation. The research outcome is evident-based and could be scalable to other parts of Hong Kong.

Track 3

CLIMATE-PROOF CITIES:
Planning for Weather, Water, Food and Energy

The contribution of urban underground space to climate-proof and resilient cities

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Synopsis
Climate proofing our cities is a double-edged sword in that it requires both climate mitigation and climate adaptation to be central to urban policy and planning. With the Paris climate agreement determining national agendas, cities are confronted with the need to prioritise decoupling from fossil sourced energy and replacing it with renewable forms. At the same time the climate is changing and requires cities to adapt to more frequent and intense rain fall events but also to counteract the effects of the urban heat island effect. We are learning that the way we have planned and designed our cities in the past lacked the focus on urban resilience and that we need to catch up fast. At the same time urban populations are evermore increasing and the need for a more inclusive planning becomes more evident each day. It is within this context that urban density, often translated into high rise developments as the final solution, needs to be reviewed. Reaching for the sky is not going to provide the solutions for all the challenges facing the urban environment.

In our paper we discuss how the answer could partly lie below the surface. Integrating underground space into the urban fabric is in our opinion a necessity as part of the climate proofing of our cities. This holds true firstly because underground space is part of the urban metabolism and needs to be appreciated as such. Urban drainage is often inadequate because the natural infiltration of rain water has been severely disrupted through over paving our streets, gardens and parks. The hardened urban surface is making rain water runoff into sewer systems that are becoming overloaded and unable to cope with climate change effects.

Secondly, urban underground space delivers ecosystem services to the city and offers invaluable resources in the form and shape of space, water, energy, and minerals. Safeguarding these services and at the same time utilising the resources, requires a balancing act by policy makers, decision makers and urban planners. Secondly, the premise that we can free up surface space by making more use of underground space is in our opinion too limited. Too often we see surface uses being placed below the surface, resulting in the same mono-functional use of space that is cluttering our cities and is one of the main causes behind the lack of urban space. The balancing act we mentioned also provides the opportunity to go for a more integrated approach that calls for a multi-functional space use. Why build a long tunnel that is only used to carry off rain water when there is rain fall? Isn't it possible, with a little more thought, to use the precious space that is created in a different way? In our paper we will argue that when it comes to seeing urban underground space as part of the urban metabolism, we need to develop an underground urbanism that ensures that the peculiarities but also the inherent advantages of underground space are fully appreciated. If we are able to do this, then creating urban density need not be limited to reaching for the sky, but can include exploring and exploiting the surface below the city. In that way future cities can become resilient and climate proof within the area constraints that exist and without giving way to uncontrolled sprawl.

1. Climate proofing and urban resilience

Climate proofing cities and making them resilient is very much a topic that urban planners need to cope with in the 21st Century. To understand how this relates to the topic of our discussion, namely the use of underground space, we need to have a common understanding what we mean with climate proofing and urban resilience.

Figure 1: The emergency management cycle. Source: Cornell University

One way of doing this is to take the emergency management cycle (see Figure 1) and see where climate proofing fits in. When looking at climate proofing in the context of the Paris agreement, we can distinguish two approaches: climate mitigation and climate adaptation. Climate mitigation is about taking those actions that will limit the overall effect of climate change, that is: what actions do we need to take to limiting the overall impact of climate change. This is often linked to reducing CO_2 emissions, decarbonising our cities and limiting the average global temperature rise to 1°C or 2°C. Most scientific research now confirms that climate change is happening and that there is no way we can reverse the process. What we can do is to limit the impact or the time within which the impact will occur. Given this fact, climate adaptation is concerned with how humankind and indeed our cities can adapt to what is to come. The coming decennia will see more rain, more wind, higher temperatures. We will see rain where there is now drought, and heat where it is now cold. The melting polar caps are a good example of this and the resulting sea level rise is threatening and will impact coastal plains and river deltas. A large part of the world's population live in or near coastal plains (see Figure 2). The World Bank projects that by 2025 at least 65% of the urban population on each continent will live in coastal zones prone to flooding and storms. (Rockefeller Foundation, 2013).

Climate mitigation is very much about prevention and mitigation. What is it we can do to reduce the risks and limit the impact? Climate adaptation goes a step further in that it asks what can be done now to prepare for imminent disasters that could strike urban areas.

Urban resilience in this context looks at the whole picture in terms of stresses and shocks that threaten our cities, whether they are natural or human in origin. Where climate mitigation and climate adaptation is linked to how human activity is causing climate change and with that impacting cities, urban resilience is concerned with the combined effect of stresses and shocks. As such, urban resilience will also look at how to respond and recover through disaster risk management.

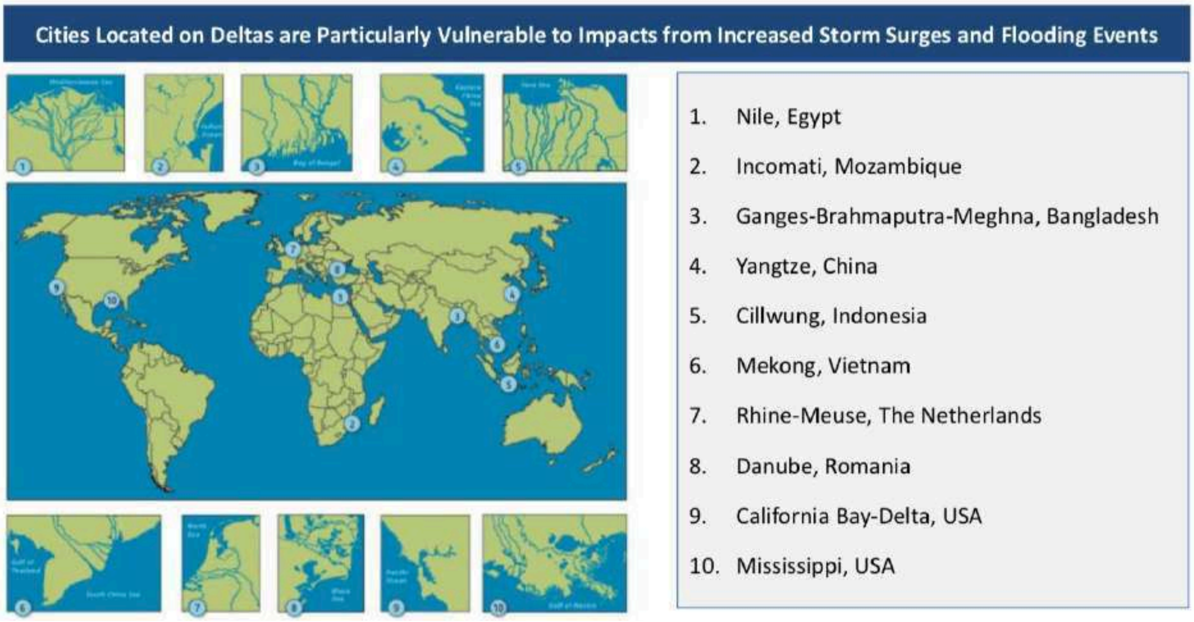

Figure 2: Cities located in Deltas. Source: Rockefeller Foundation.

The relationship between these aspects can be derived from the approach taken in the Netherlands in terms of coastal protection. It is a three-layered approach that considers both ‘hard’ or physical measures and emergency response. It is crucial that urban and territorial planning is seen as an integral part of the approach linking the need for physical measures with disaster risk management (Government of the Netherlands, 2009).

Figure 3: Multi-layer safety; prevention, sustainable spatial planning and disaster management . Source: Government of the Netherlands

The development of cities and especially rapid growing mega-cities has questioned how to maintain the core quality of cities. Cities as places to be, to live, to interact. Cities should be places we want to be in and enjoy, rather than functional places dominated by brutalist architecture where we have to be to survive. For urban planners this constantly requires questioning what it is that determines the urban being, the urban metabolism.

As Hajer and Dassen (2014) consider when writing about Smart Cities: “We have to reconnect the biophysical and social domains in new ways. Our first task is to create a broader awareness of what is required to make a city function. The urban metabolism is hidden. If we could unveil the urban metabolism, it would become clear what contemporary urban life consists of, and we would get an idea of what disconnect requires”. The disconnect they refer to is the question of weaning the city from fossil based and carbon emitting fuels. Their core consideration is however that to achieve this and to create a Smart City, it is vital to reconnect the biophysical and social domains in new ways.

It is our profound belief that this reconnect requires urban planners to consider the urban subsurface (Admiraal & Cornaro, 2018). With the subsurface we literally mean that what is below the surface. It is the unknown and unseen, yet in many ways it is also the foundation of the city and the supporter of life in the city. When looking at climate proofing our cities, at urban resilience or even in the bigger context of the urban being or urban metabolism, we feel that to make any sense of it all, what lies below our feet needs to be considered.

Firstly, we need to understand that the subsurface consists of more than just geology. Certainly, in some cities the support on which they are built consists of hard rock. In many other cities and especially those near the coast, this can vary greatly. This variation is not just in terms of supporting layers, it is a rich environment consisting of water flows and biodiversity in its own right. What we feel we need to consider is that as we discover the sky is not the limit, as we start to look at what opportunities lie below the surface of our cities, we cannot discount the unique properties of the subsurface.

2. Subterranean complexity

The complexity of the subsurface is best illustrated by the vast number of phrases used to denote it: subsurface, soil, below-ground, underground space, subterranean, geology. As discussed, the variety in geology also makes it complex. As the new Spatial Planning Vision for the Subsurface (Government of the Netherlands, 2018) points out, the world below our feet is an ecosystem that delivers services. As such, that ecosystem is vulnerable to interventions. It applies to the ecosystem services, but also to the quality of the soil and the groundwater. As such, we need to strike the right balance between making use of the subsurface, creating underground spaces that enhance the city, and preserving the quality of the same subsurface and the services it delivers. It is the balance between exploiting and preserving.

This should not come as a surprise to urban planners. The whole purpose of planning is to decide on how the use the available space and resources for the greater good of the city and its citizens. The same balance needs to be struck between public space and private space, between open areas and build-up areas. In terms of the subsurface there is however a major difference: the use of space below the surface is in most cases non-reversible and with that non-renewable. It means that physical underground space, once colonised by the urban need for space at the surface, in only a few cases will be returned to its original state.

A good example of this are former mines. In the case of the Netherlands the last coal mines were closed in the 1960s. They left an enormous legacy in terms of the largest industrial complex in the country, invisible below the surface, trapped in underground space for posterity. From a climate proofing point of view, they are interesting in that the Minewater project is now re-using the former shafts. In their own words: “A fully-fledged thermal ‘smart grid’ for delivery of heating and cooling water with a sustainable hybrid energy infrastructure has now been developed. This includes an independent pipe network to deliver both heating and cooling water to the connected clients.” (Minewater, 2018).

At the same time, the former mines are threatening the urban fabric and are a concern in terms of urban resilience in that they are stressing the surface as the water in the mines rises. Although the debate on the effect is still going on, it demonstrates how human intervention below the surface is still impacting us today, as is the way human induced earthquakes are causing social concerns in the North of the Netherlands. These are caused by the vast gas extraction that has taken place over the past 50 years.

These examples illustrate that activities below the surface can impact the surface and therefore need to be considered when bearing in mind urban resilience. There is also an interesting relationship between surface and subsurface in that development of one, often influences the other. Green parks are vital for our cities in that they help with clean air, produce shade and reduce the urban heat island effect. They provide citizens with space to recreate, to sport or to relax. They also provide capture areas for rainfall and natural infiltration into the soil and below. As we build up our cities, less and less space is available for natural infiltration, which in the long term can dry out the soil and alter its composition and thereby the natural processes that lie at the core of the ecosystem services it delivers. Conversely, once we start using the subsurface to create underground spaces, these influence what can still be done on the surface as well. Once an underground mass rapid transit system has been constructed, the ability to create further spaces above or below ground is impacted.

Having established that the subsurface should be part of urban planning practice, if only to fully comprehend the stress and shocks that could affect the city, we will take a closer look at how underground spaces can contribute to climate proofing and urban resilience.

3. Opportunities for underground spaces

To illustrate how underground spaces can contribute to urban resilience and climate adaptation, we will discuss two examples. The first is the Stormwater and Management Tunnel in Kuala Lumpur, Malaysia (see Figure 4). To all intent and purposes this structure was built with only one thing in mind, to rid the city of excess water during heavy rain fall to prevent flooding. It wasn't until someone smart mentioned the fact that for most of the time the tunnel would be empty and unused, as it doesn't rain continuously, that the idea to create a double-deck road tunnel inside the structure came about. The idea became a reality and the toll road now passing through has helped in recovering the cost for the total project in seven years (Admiraal and Cornaro, 2018). It also helped the city deal with notorious congestion. From our point of view this is an excellent example of how use of underground space can help a city with adapting to climate change and make it more resilient. It also is an example of a solution that is multi-use.

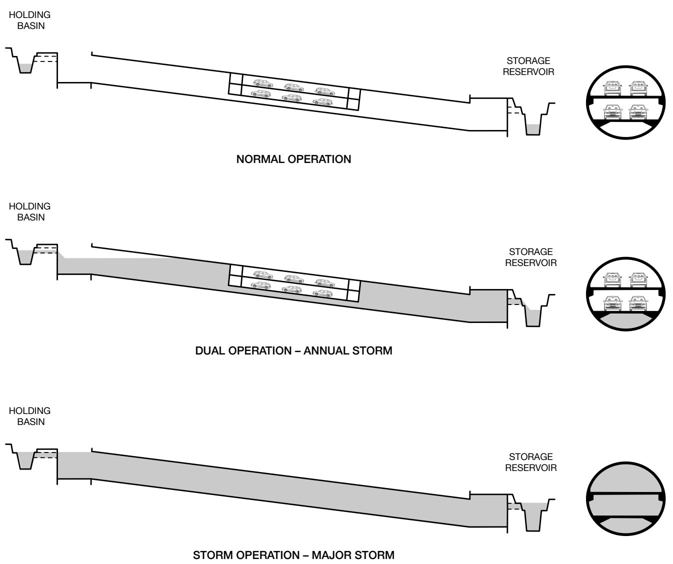

Figure 4: The SMART tunnel operating principle.

This aspect of multi-use is an important one. For decades we have been using up space at an alarming rate for both infrastructures and buildings that only perform one use and even then only part of the time. Think of highways running through cities, think of large office parks that empty at night, or shopping malls that lie at the edge of cities and attract large crowds away from the city core. As land becomes even more scarce as we have to rethink how we use it and even need to consider going below the surface, we need to get better at how we use the available space.

The example of SMART is an interesting case. It is also an example where the multiple uses cannot take place simultaneously. When the water comes, the cars need to be cleared of the road tunnel. So even though it is multi-useable, it can only facilitate one of the uses at a time. A step further is the underground car park in Rotterdam that combines space for parking cars with space for water retention basins. If during heavy rain fall the city sewers and canals cannot cope anymore, the water can be offloaded to the underground water retention basins for temporary storage. Once the rain has passed and water levels settle again, the basins are pumped out using the existing drainage system. This structure houses two uses that can both function at the same time. By combining them both into one project the advantage of lower cost per project and the availability of two combined budgets doubling the funding was used to make the project feasible (Ibid.).

The third example is underground mass rapid transport systems. They are of interest for two reasons. The first is that they are underground. As such they are a lot less susceptible to earthquakes than structures at the surface. This has been proven over time with earthquakes in both Japan and Chile. This advantage means that these networks can play an important role in disaster recovery. They provide an infrastructure that after the event is still available and not blocked by the damage that occurs at the surface. The second reason that they are of interest is that we can expand there under normal conditions by asking ourselves why they should only transport people. The primary use of these systems is rapid transport of people. As cities struggle more and more with inner city logistics, that is how to supply the city centre, couldn't we have the existing systems or the ones yet to be built take on the role of logistical support system as well?. In doing so we turn tunnels constructed for a single use into useful underground spaces that really serve the city by providing multiple services. The tunnel becomes a space that can be used for a variety of uses, including carrying cables and pipes. This is in much the same way as human-made caverns are being developed in Singapore, Hong Kong and Switzerland (see Figure 5). They are first and foremost providers of space. What is placed inside these spaces can vary over time from storage to industrial facilities to recreational facilities. The underground civil defence shelter in Helsinki that now serves as a swimming pool is a good example of the latter.

As Brown (2014) writes: "Today's transportation, waste disposal, water, sewage, and energy distribution systems are necessarily inter-dependent. Power plants require water cooling, water treatment and public transit require electricity, energy generation requires the transport of coal, and so on. And all of these systems rely on information technology (IT). Nevertheless, we continue to disaggregate them physically and jurisdictionally into distinct sectors, and we mentally separate utilities and the natural systems from which nearly all infrastructural services are derived."

We feel that any use of the subsurface should also be seen in the light of unifying the sectors that serve the city. As we do so we may find that we are providing services in a way that don't eat up the remaining space. By looking at underground space in a more appreciative way, but also seeing it as an opportunity for creating multi-use, one structure facilities, we contribute to the needs of the city without impacting land use in the traditional way. In our opinion underground space can play a role in delivering zero-energy projects with zero-land-use as the main advantage.

Figure 5: Human made cavern in Switzerland designed for industrial production. Source: Amberg Engineering AG.

In a yet to be published 'Words-into-Action' document on land-use management, the UN Office for Disaster Risk Reduction states: "The above notwithstanding, urban development and infrastructure projects can build disaster resilience in the following ways: (…) Design large scale underground spaces (e.g. car parking, tunnels, etc.) so they can serve a variety of DRR functions (e.g. as temporary water retention basins, as refuges) while also providing efficient access for servicing dense urban building blocks with water, energy and waste removal services. (Admiraal and Cornaro, 2018).

This is the way underground spaces can contribute to climate proofing cities and making them more resilient: by serving a variety of disaster risk reduction (DRR) functions. We do need to keep in mind that the complexity for the urban planner lies in the fact that it requires a 5D approach. Firstly, we need to move away from the traditional 2D approach to include 'depth' as a third dimension and approach space in 3D. On top of that two other dimensions need to be considered. One of them is time as we saw from the above, the other is geology. Time comes into play in terms of creating non-renewable spaces. It means we need to be clever when it comes to repurposing these structures. They may be non-renewable, but they can certainly be re-useable as we will see next.

4. **Repurposing existing structures**

The cityscape is rapidly changing. But as we move forward the future holds big questions. How will mobility evolve and how will car ownership maintain its social status? Already we are seeing how cars need to be adapted to the decarbonised city. Electrical vehicles are becoming the norm. Notwithstanding the fact that we don't really know where to get all the power from to charge them. Even if we can provide the power, the outdated electricity grids that were never designed with this demand in mind, will struggle to cope. With the advent of automated vehicles, the idea of calling for a pod that arrives at the door and takes you to your destination, might not be such a futuristic concept anymore. Hyperloop sees this as its standard mode of operation. In this way it could prove to be the disruptor that ends our idea of personal car ownership.

In Belgium, this vision made the city of Mechelen think about the future of its inner city underground car parks. What could we do with all this underground space once the demand for temporarily storing cars is no longer there? (Vlaams Bouwmeester, 2018)

Students of the University of Antwerp took on the challenge and started looking at this issue. What surprised one of the authors[1] was the enthusiasm with which the students took on the challenge and how they came up with multiple ideas. For students there was no drawback in the fact that these underground spaces were just that, underground. They all saw major advantages of unused spaces below the streets of the historic city centre that could serve a multitude of uses that would normally not be in reach. They also saw major opportunities to create additions to the urban fabric that would further enhance the city centre. The fact that many cities have historic centres they want to preserve make a strong case for repurposing existing underground spaces, whether they are existing basements, disused underground stations or as is the case in Mechelen future disused car parks. In the same way the Carrousel du Louvre has greatly enhanced the Louvre Museum in Paris, France, without damaging the cultural heritage it represents. Underground spaces can reinvigorate historic city centres and provide them with the services that modern city life requires. Indeed, it can help make these historic centres resilient and adapting them to climate change, again without the need to intervene in the heritage function they perform. (Admiraal, 2018)

The example of the Amfora project, a proposed concept making use of the space below the river Amstel in Amsterdam and its many canals, also aimed to do just that (see Figure 6). Even though this concept has not yet made it past this stage, it does provide a frame how we can see the cities of the future by preserving what we are proud of and providing new space to maintain liveability. Repurposing existing structures whether for storing water, storing data or growing food are all examples of how to achieve this. By combining these uses, that is reusing water, reusing residual heat and using it to grow plants or fish, we achieve a symbiosis beneath the city that will prove to be of immense value and contributes to our aim of decarbonising the city.

Figure 6: AMFORA project beneath river Amstel in Amsterdam. Source: ZJA Zwarts & Jansma Architects.

As we wrote in our book: “And an urban underground future, how will that feature in all this? We believe it offers yet untapped potentials. Not just in terms of spatial development and physical use. Underground space will become vital for survival in that it offers heat for energy

[1] Personal observations by Han Admiraal during workshop at University of Antwerp on 7 May 2018

and storage for water. It offers shelter, and it offers the ability to create connections that bypass obstacles that we have created on the surface. As such, it allows for efficient, straight line networks, minimising distance and maximising connectivity. It does require some imagination, it does require adapting legislation, and it might need some more advanced and faster technologies." (Admiraal and Cornaro, 2018)

5. Conclusions

When we look at our cities in terms of climate proofing and urban resilience we cannot afford to not look at the subsurface. In doing so we need to consider an approach that does justice to the unique environment the subsurface represents. A 5D approach is needed to not only look at the 3D spatial aspect, but also include the dimensions of time and geology.

Before even considering the use of the subsurface, a deeper understanding is required that enables decision makers to strike a balance between exploitation and preservation, that is between extracting resources from the earth and protection ecosystem services. The complexity of the subsurface stems from this, it is not just a physical foundation on which the city is based, it is a supporter of life at the surface as well.

The opportunities to create underground spaces and systems that enable the city to climate proof itself and become more resilient are there for all to see. Underground spaces can provide mobility and access even after major natural disasters. They can provide shelter and storage space. Even when it comes to energy they can play a role in providing heating or cooling or acting as an intermediary for storing wind or solar power.

The dimension time is crucial in our understanding that underground spaces once created cannot be undone the way buildings at the surface can be demolished. In this sense the space created is non-renewable. It is however re-useable as repurposing of existing underground structures is demonstrating. As such we need to look at creating underground spaces that serve multiple uses in the here and now, but also in the future. We need to move from creating mono functional underground structures to multi-use underground spaces.

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STRATEGIES FOR MAKING PERI-URBAN COASTAL COMMUNITIES RESILIENT IN SUB-SAHARAN AFRICA: *The Case of Ningo-Prampram*

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ABSTRACT

Globally, coastal zones are vulnerable to climate change impact of storm, rising water level, pollution and acidification. Resilience is the ability of a system, community, or society exposed to hazards to resist, absorb, adapt and recover from the effects of a hazard promptly and efficiently by preserving and restoring critical services. Resilience is also acknowledged both explicitly and implicitly in the range of the proposed SDG targets. Peri-urban areas are often seen as attractive places to live and work as it offers a high quality of life as opposed to busy and hectic urban living. The upside of this is a dynamism exemplified by economic success and business growth often clustered around vital nodes and edges: innovation centres, airports and other well-connected transport interchanges located in these Peri-urban communities. These communities eventually develop into urban areas which may be worse of in planning if not properly guided creating imbalances in the built environment.

Ningo Prampram is the interest of study for this paper, specifically Prampram which is its capital. This paper uses a pragmatic, mixed-method and exploratory approach with epistemological underpinnings which investigate the necessary interventions required in developing resilience into Peri-urban settlements. Ningo-Prampram is one of the fastest growing Peri-urban area in Ghana. Although this suburb was once a lightly populated residential area devoid of extensive commercial activities, it has sprung into a bustling and growing commercial spine due to its strategic location to Accra and Tema taking account its waterfront appeal and potential. Recommendations put forth from the study include the redesign of the built environment; towards a more responsive, low impact pattern of buildings and spaces. Also, it proposes that systems and measures which protect critical infrastructure against events which causes vulnerability in these communities must be used in tandem with ecological strategies.

Keywords: Resilience, Peri-urban, Prampram, Vulnerable, Community, SDG

1.0 INTRODUCTION

1.1 Global need for resilience for Coastal Communities

Historically, most cities have survived and thrived at locations with good accessibility (e.g. ports) or with favorable natural endowments such as a neighbouring river, a coastal location, or fertile soils. These topographical areas are often associated with an increased probability of hazard events—floods, cyclones, storm surges amongst many others (Neumann et al., 2015; Stefaniak, 2014). However, low elevation coastal zones (LECZ) cover 2% of the world's land area but contain 10% of global population and 13% of the world's urban population (Shah & Ranghieri, 2012). Moreover, an approximated 23% of the earth's populace (1.2 billion people) settle within 100km of a coastline (World Population Review, 2016; Neumann et al., 2015). By 2030 AD, a projected 50% of the planet's populace will inhabit coastal regions (USAID, 2011). As population density and financial activity within coastal region grows, pressure on littoral ecosystems intensify (UNEP, 2007). This number is only expected to grow in the years to come, as settlements located in coastal low lands continue to grow rapidly, either by necessity or choice (Henrique, 2015). This increases the level of risk within such communities. Currently, more than 70% of the world's coasts are experiencing coastal erosion, flooding, shoreline retreat; indicating the eventual damage and danger to many coastal areas (Addo, et al., 2011).

The principal cause of increase in natural hazards is the phenomenon of climate change, which is affecting communities today as seen with recurrent floods, seasonal drought and increasing land and water temperatures (UNISDR, 2011). Ruijsink et al. (2015) cites the United Nations Framework Convention on Climate Change (UNFCCC, 1992) definition of climate change as: a modification of climate patterns which is directly or indirectly ascribed to human influences which change the makeup of the earth's atmosphere over similar time periods. As temperatures increase, sea levels will continue to rise, and large storms will become more frequent and prolonged, leading to a higher incidence of flooding (Henrique, 2015). The issue of climate change has diverse implications endangering the existence of settlements especially coastal settlements because of their unique contact with the sea. According to Venkataramanan & Smitha (2011), the average global sea level rise primarily is as a result of three factors which include the thermal expansion of warming ocean water. The melting from the ice sheets of Greenland, Antarctica glaciers and ice caps, and the adding up of water from land surface runoff (UNEP, 2009). The Institute for Public Works in Australia (2008) states that for every 20 cm of sea-level rise, the occurrence of any extreme sea level of a given height increases by a factor of about 10. Hunter (2008) expatiates that by this approach, one should expect that in 2100 a rise of sea level of 50 cm would allow that events that occur once a year to occur several times within that same year. It is apparent that drastic and efficient measures are required to respond to the incoming threat that sea-level rise pose (UNEP, 2009). Levine, et al. (2011) opines that responding to climate change and its related uncertainty is a primal development task, stressing that the impact on world and local climate are expected to have considerable implications for biomes and the occupation of the towns that rely on these natural resources. According to UNFCCC (2011), governments, communities and individuals are introducing adaptive measures to minimize the effects of climate change. However, an analytical study of most interventions discloses that these measures in fact are not intended at increasing resilience of affected people rather they are reactionary and eventually costly thus it hardly resolves effectively impacts that are long term anticipated (UNFCCC, 2011).

Now, climate change has become a forefront development agenda jointly of advanced and developing countries. This is possibly influenced by the persuasive proof that buttresses the reality of this happening hence this makes it difficult for nations that are conservative and climate change deniers to unequivocally ignore issues related to climate change (Kankam-Yeboah, et al., 2010). Nevertheless, due to increasing occurrences of natural disasters and impact of climate change there is pressure to design and create resilient buildings, communities and landscapes that can withstand and adapt to changing risks, while being sustainable and creating healthy environments (Wholey, 2015). Resilience provides the capability to minimize distress whilst retaining its usage. When change occurs, resilience offers the structure for regeneration and restructuring (USAID, 2011).

1.2 Importance of resilience to the SDGs and Quality of Life

Resilience is the capacity of a community or society to adapt and react when exposed to a hazard in order to reach or maintain an acceptable level of functioning (Henrique, 2015). A resilient settlement is one that is able to cope with disaster and climate impacts now and in the future, thereby limiting the magnitude and severity of those impacts (ARUP, 2015). Given the close links between disaster risks and climate risks, efforts to build resilience in communities by integrating climate change adaptation with existing efforts in disaster risk management can be beneficial (ibid). Adaptation to climate change requires communities to plan based on current exposure but also on projected future changes that may unfold through gradual increasing changes (e.g., temperature increases) as well as extreme events (e.g., heat waves) (Shah & Ranghieri, 2012). The need for resilience in coastal waterfront communities satisfies portions of the Sustainable Development Goals (SDG). Moreover, resilience is acknowledged both explicitly and implicitly in a range of proposed SDG targets, these include: Goal 1- No poverty, Goal 3-Good health and well-being and Goal 11-industry, innovation and infrastructure, decent work and economic growth, sustainable cities and communities. These goals provide a framework for these specific targets in protecting the environment, people and ensuring prosperity for all (UIA, 2015). In summary, coastal communities by 2030 must strengthen and build resilience to vulnerability from climate related hazards and other economic, social and environmental shocks and disasters to ensure good quality of life for all (ibid). A focus on strengthening resilience can protect development and ensure people have the requisite resources, skill set and capacities to minimize, prevent, anticipate, absorb and adapt to a range of shocks, stresses, risks and uncertainties (Fehrenbacher, 2013). The concept has been applied across a wide variety of disciplines, though largely popular and employed in disaster management and provides a useful operational framework for reducing various risks faced by people and communities, now and in the future (ARUP, 2015).

1.3 Types of contributions built environment professionals can make to facilitate SDG

In this era of population shifts, climate change and unprecedented levels of urbanisation, professional stakeholders of the built environment have an important role in responding to the complex challenges of the built environment. Through the effective planning, designing, construction, development, management and improvement of cities, urbanisation can become a model for sustainable development; embracing the intrinsic link between the built environment and job creation, livelihood opportunities, and quality of life (UIA, 2015).

1.4 The future outlook of coastal communities in Africa and the need for thorough discourse of the Ghanaian case

Climate change is expected to affect coastal communities worldwide over the coming century. Sea Level Rise (SLR), although only one part of climate change phenomenon, will be one of the greatest impact experienced in the coastal zone, with increasing flood risk, coastal erosion and saline intrusion posing a host of socioeconomic and environmental implications. The successful integration of the natural, physical, social and economic implications occurring within coastal communities will be a major challenge (Nicholls and Branson, 1998). This will be key to ensuring the sustainable management of coastal systems. However, building public involvement and understanding for climate change adaptation policy will depend largely on how inhabitants process information and make decisions (Center for Research on Environmental Decisions, 2009). In coastal West Africa, rise in sea levels are linked to melting polar ice caps, consequently working with coastal erosion to eventually plunge coastal settlements (Bokpe, 2015; Goussard & Ducrocq, 2014). Bokpe (2015) cites UNIRIN projections that West Africa's shoreline stretching out from the orange dunes in Mauritania to the thick tropical forests in Cameroon will be under water by the closing of this century, as an apparent outcome of climate change. Other significant urban centers in West Africa which experts have classified as flood-prone include Nigeria’s Lagos, Gambia’s Banjul, Bissau in Guinea Bissau, and Nouakchott in Mauritania (Chukwuocha & Chukwuocha, 2014). Furthermore, the African continent comprise 320 coastal cities and 56 million inhabitants occupying seaside areas less than 10m above sea level and remain at risk in the fight against sea erosion and inundation (Bokpe, 2015). Amongst Ghana’s coastal front, Ghana’s south-eastern coast has suffered more from the negative effects of climate change (Dovie et al., 2014). However, the south-eastern section has been marked out as the most susceptible (Appeaning, 2015: Ly, 1980). Ly (1980) states that the south-eastern section is recognized as the most weathered section with frequencies as alarming as 4m/year before the construction of the Akosombo Dam on Volta River. The dam built in the 1960’s, decreased sediment sock to the coast creating a counterbalance in sediment deposition along the coast (Boateng, 2009). Subsequently the construction of the dam resulted in increased erosion levels, 8m/year around 1970 (Appeaning, 2015: Ly, 1980). Results of a historical shoreline change analysis (in Figure 1.0) from 1974-2005 show that erosion along the Ghanaian coast is widespread, with an average erosion rate of 1.5m/yr in other words 90% percent of the coast is eroding (Ashton, 2012).

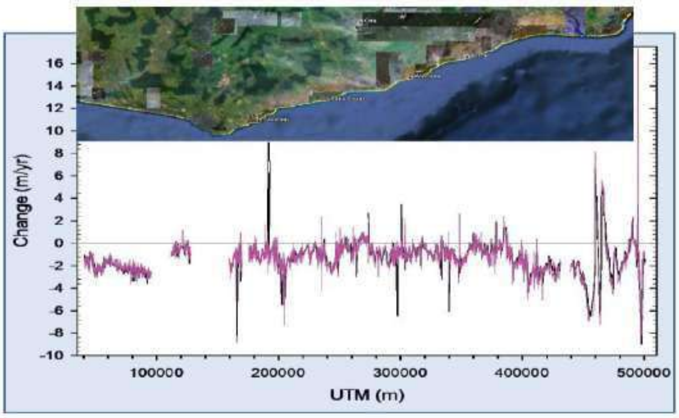

Figure 1.0: Results of historical shoreline analysis (Ashton, 2012).

To worsen the situation, the resettlement of individuals within the coastal areas and ruin of flora like mangrove swamps, extraction of valuable ore near sections of the shore damages the balance of the seaside structure and either starts or aggravates weathering in these areas (Appeaning, 2015). If this situation is unattended to, continuous erosion activities reveal that coastal shield areas are projected to be entirely weathered by 2100 (Bokpe, 2015). The EPA Status of the Ghanaian Coastal Zone Report (2006), indicates that two-thirds of the total land areas along the country's coast are in danger of being consumed by the sea; that for every metre rise in sea level, it is estimated that there would be 1,110 sq. km loss in land to the ocean. Bokpe (2015) citing a study from the Department of Oceanography and Fisheries of the University of Ghana, states that this impending danger is not only limited to coastal communities but also national relics like; the numerous forts and castles such as Osu Castle, one of the antiquities of the slave trade and symbol of political authority along the West Coast of Africa, would be swallowed up in sea's appetite. Also, it is projected that coastal erosion would overtake significant vestige like the Christiansburg Castle, independence square of Ghana and the Densu Ramsar area located in Accra between 2052 and 2082 – all located within the coastal region (Appeaning, 2015). It is expected that 1m sea level rise will engulf a large expanse of the Volta Delta ecosystem (Bokpe, 2015). Thus, there is the call to revise coastal erosion management using a holistic strategy which includes the ecofriendly method of harmonizing with nature and not fighting it (Appeaning, 2015). However, Appeaning (2015) posits that also adopting coastal management plans will permit a comprehensive evaluation of threats related to the shoreline eventually allowing the creation of a long-term policy framework to lessen the threats to the community and its environment.

Unfortunately, Ghana does not have a comprehensive development framework or policy to manage climate-related risks in coastal areas in other words building climate resilience has weak links between the national policy framework and district-level planning thus weak capacity in providing resources to assist climate-vulnerable communities to initiate resilience building by themselves (Dovie, et al., 2014). Neither are there explicit national building regulations (LI 1960) which stipulate how flood prone areas should be dealt with (National building regulation, 2006). Presently, coastal erosion management in Ghana is momentarily responsive, site-tailored and normally includes using stiff engineering methods. The existing strategies utilized by the government are unmaintainable and not sensitive to the environment (Appeaning, 2015; Olympio & Amos-Abanyie, 2013). The Government of Ghana usually proposes groynes and revetments which stabilizes the sections of the coastline of affected communities (Appeaning, 2015). Groynes are a type of coastal guard normally structural in nature, it involves the construction of barricades being built into the sea to minimize erosion. These primarily entrap and restrain the shore sand from relocating from the coast (O'Brien, 2014). Concrete structures used as obstacles are called revetments, these break off the impact of coastal erosion and absorb wave energy to reduce erosion on cliffs (Mangor, 2004). Some interventions include the Keta sea defence, Sakumono sea defence, Ada sea defence and New Takoradi sea defence among others (Appeaning, 2015; Boateng, 2009). Appeaning (2015) observes that the sea defense walls are temporary solutions that shift the problem from one area to another; for instance, the building of the Keta sea defence has led to heightened coastal erosion along the Ghana–Togo frontier by over 50%. The Oceanography and Fisheries Department in the University of Ghana (UG) has mapped the following town's red flags high coastal erosion:

- Greater Accra Region: Kokrobite, Bortianor, Labadi, Teshie, Nungua, Tema, Prampram, Old Ningo and Ada
- Volta Region: Keta, Dzito, Anyanui, and Atorkor
- Central Region: Elmina, Tantuam, Komenda and Senya–Breku
- Western Region: Esamang, Axim, Prince's Town, Dixcove, Adjua, Amanful Kuma, Shama and Atekechi.

Consequently, if the phenomena remains unchecked, it could drive away tourists and culminate in the loss of revenue to the country (Appeaning, 2015). According to Appeaning (2015), the creation of a comprehensive databank of the country's coastal geomorphology information would inform the appropriate authorities about changing trends which can affect the development of coastal tourism in the country (ibid). Bokpe (2015) opines that the sea rampage on the country's shoreline is aggravated by poor land use and poorly planned and designed buildings. With this risk in full glare, several measures would have to be undertaken to ensure the preservation of the Ningo-prampram settlement and other coastal communities. This would include the integration of climate change into local development planning in order to ensure that resources are available for community-based adaptation, and that local development initiatives do not increase vulnerability by overlooking climate risks (Dazé, 2010).

2.0 THEORECTICAL FRAMEWORK

2.1. Resilience and Peri-Urban interfaces

Today's world is rapidly urbanizing, with particularly radical urban growth anticipated in developing countries. This fast paced development has resulted in the creation of Peri-urban areas which are the extension of urban activities beyond existing administrative boundaries in urban regions (Marshall, et al., 2009) .The term 'Peri-urban' has been used to define 'a place, concept or process' (Narain and Nischal 2007: 261). 'Peri-urban' thus refers to the urban fringe and the physical edge of cities as a place, it refers to the movement of goods and services between physical spaces and to the transition from rural to urban contexts as a process and finally, as a concept, it refers to an interface between rural and urban activities, institutions and perspectives (Marshall, et al., 2009). In other words, Peri-urbanisation can be defined as "a process in which rural areas located on the outskirts of established cities become more urban in character, in physical, economic, and social terms, often in piecemeal fashion" (Webster, 2002, p. 5). Most literature has gone beyond defining the Peri-urban as a place where there is a mixture of urban and rural livelihoods being pursued, and rather theorises about the Peri-urban processes (Narain and Nishcal, 2007). However, Friedberg (2001) has argued that the Peri-urban areas are primarily integrated into urban environment. As such, Peri-urban areas occupy unique space which are simultaneously supported and endangered by the dynamics of the urban economy (Marshall, et al., 2009). Urbanization brings the creation of new opportunities, but also a dramatic increase in the concentration of poverty and environmental degradation in Peri-urban zones (UNFPA 2007). Also, the 'colonization' of urban fringes results in changes in land use, new forms of household composition, differential access to urban benefits (such as health infrastructure and employment) and increased pressure on common natural resources. The Peri-urban interface showcases a ''comme si comme ca'' phenomenon, usually characterized by either the loss of "rural" aspects or the lack of "urban" quality. From an environmental perspective, the peri-urban interface can be characterized as a varied montage of "natural" ecosystems, "agro-" ecosystems and "urban" ecosystems affected by the material and energy flows demanded by urban and rural systems (Allen, 2003).

From a socio economic viewpoint, the peri-urban interface also presents several peculiarities. The continuous but uneven process of urbanization taking place in these areas is generally results in land speculation and grabbing, change in economic activities, and the emergence of informal and often illegal activities such as illegal acquisition of land, mining or quarrying activities for the supply of building materials and others (Ianquinta & Drescher, 2000). Consequently, the social composition of peri-urban systems becomes highly heterogeneous because of the 'mixed' range of dwellers which include most often small scale farmers, informal settlers, industrial entrepreneurs and urban middle-class commuters that co-exist but with different and often contending interests, praxis and perceptions. This composition is subject to change over a period (Allen, 2003). In order words, the composition and interests of these groups tend to change over time, in a process characterized by the variable assimilation of new stakeholders (ibid). As a result, Peri-urban interfaces are typified as overlapping institutions in different sectoral units with different spatial and physical responsibilities. This is related to the changing geographical location of the Peri-urban interface or of the process whereby institutional arrangements or areas of remit tend to be either too small or too large, too urban or too rural in their orientation to address impending or unresolved issues (Ianquinta & Drescher, 2000).

2.2 Developmental Dynamics of Coastal Peri-urban interfaces in sub-Saharan Africa

The urban population in West Africa is particularly fast growing in the coastal areas (Hitimana et al., 2011). During colonial times, commercial activities concentrated strategically along the sea coast (Kuper, 1965). During the 1960s and 70s, new bureaucracies, infrastructure, and companies provided employment in coastal urban centres. This resulted in rapid immigration to urban areas in most sub Saharan African countries (Okpala, 2009). This hotspot of commerce became attractive because of the opportunities which would eventually reduce dependency on agriculture, diversify household income, improved social care and/or escape from armed conflicts (AfDB, 2005). In today's world, changing lifestyles and impact of internationalization has advanced urban growth (Cohen, 2006). Additional factors that contributed to the growth of informal processes of urban development in West Africa include governments' low levels of financial capacity, ineffective administrative systems, poor governance, mismanagement of resources, and corruption (Ianquinta & Drescher, 2000).

Ghana can be seen as an example for trends in urban development in West Africa (Otoo et al., 2006). Population densities along the coastline and traditional inland trading area such as Tamale and Kumasi, grew considerably during colonial times and after (Kleemanna, et al., 2017). Between 1960 and 1984, Ghana's population doubled (12.3 million in 1984; GSS, 1989) with an annual growth rate of 2.7%. For urban areas, migration from rural areas remained the main source of growth accumulating in an annual growth rate of 4.7% (Kleemanna et al., 2017; Frazier, 1961). This led to a strong increase in the urban population, which reached 50.9% of the total population in 2012 (GSS, 2012). This population growth was higher than the growth of the total West African population, which increased by about 40% between 1960 and 1980. Also, Ghana's urban population is higher than in West Africa, where in 2010 about 42% of the West African population lived in urban areas as compared to Ghana (OECD, 2015). This higher population pressure in Ghana has led to extreme pressure on natural resources, urban sprawl and creation of Peri-urban settlements which hitherto were small village or town settlements. Land use planning is key to meeting increasing demands for human needs and at the same time maintaining the natural environment. This poses a question as to whether peri-urban settlements cretaed by urbanization in major cities serve as catalysts or are a distraction or an indication of poor urban planning practices (Kleemanna et al., 2017).

2.3 Traditional Conception of Peri-urban Interfaces in sub-Saharan Africa

A key feature of Peri-urban environments is their dynamic nature, wherein social forms and arrangements are created, modified and discarded. It is important to recognize that the spectrum of change from rural to urban is discontinuous, "lumpy", multidimensional and that it arises from underlying social processes (Ianquinta & Drescher, 2000). For a thorough understanding of Peri-urban, one must understand the concept of urban and consider established theoretical definitions of urbanization/urbanism identify the following components: Demographic component (i.e., increasing population size and density), Economic sectoral component (i.e., a primarily non-agricultural labour force), and Social-psychological component (i.e., consciousness of what it means to be urban). Urbanization is a process of concentration and intensification of human life and activity. It is an uneven process that takes place in a physical environment. One consequence of urbanization is the uneven incorporation of a variety of institutional forms into the larger cultural environments, identified as urban, Peri-urban and rural (Mbiba & Huchzermeyer, 2002).

In our pursuit of a definition for Peri-urban, one also has to explore the larger question of the relationship between rural and urban environments. One observation that is well established in the literature is that rural out-migrants generally do not go directly to large cities. Rather, a series of moves are involved, called step migration, wherein rural migrants move first to villages or small towns and successively to more urban environments. Another observation in the literature is that migration does not sever most linkages between the migrant and her/his community of origin and family (Allen, 2003).

Together these points underscore the importance of conceptualizing the Peri-urban environment as a dynamic, transformative, and reciprocal arena linked at the macro level not only by economic activities and geography but also significantly by the social fabric of individual and family networks. Thus, the Peri-urban environment is dynamic exactly because of the flow of migrants and the density and heterogeneity of activities present. It is transformative because it changes the migrants and the migrants change it. It is reciprocal not only because individual migrants and the social environment influence each other, but also because the individual links between donor areas and the receiving areas continue to induce change in both directions at the aggregate and institutional levels (Ianquinta & Drescher, 2000).

2.4 Resilience strategies with respect to Waterfront communities

Communities can assess, manage, and limit the risks of potential disasters and climate change impacts to protect their populations and assets. Managing these risks to build long-term resilience involves understanding the level of exposure and sensitivity to a given set of impacts, developing policies and effective programs to reduce impacts, and identify resources to promote investments and planning that will limit vulnerabilities and enhance adaptive capacity (Shah & Ranghieri, 2012; ARUP,2015). Fehrenbacher (2013) reminds that the resilient design and building means commencing the design process by considering thoroughly the typical use scenarios of the building, frequent points of stress resulting from regular use, in addition to potential disaster situations that could question the integrity of the building and/or jeopardize its occupants within that environment. The local environment determines the features that make a building resilient or not thus a resilient design is always site or area defined (Rettenwender & Spitz, 2009). According to Alfraidi, et al. (2015), a comprehensive resilient strategy includes understanding of site, layout, structure, envelope, system and operation (as summarized in table 2.0).

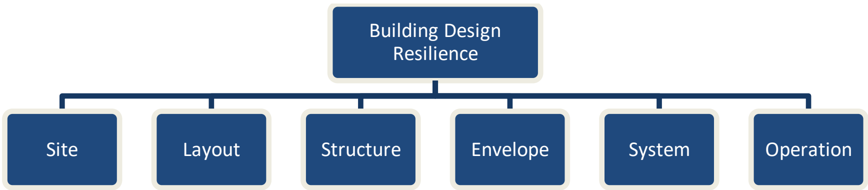

Table 2.0: Classification of Design Resilience Strategies (Alfraidi, et al., 2015).

- Site: Data from the site analysis influence the design process in order to develop a resilient design targeted at tackling the threats of climate change (Alfraidi, et al., 2015). For instance, the determination of the wind properties and the danger of inundation and erosion helps in influencing landscape design (Roy, 2013).
- Layout Design: The design of the layout should be adequately adaptable to permit a space to be reconfigured whilst retaining the use of other adjacent spaces (Alfraidi, et al., 2015).
- Structure: This refers to the ability of a building's structural system, materials and foundations to maintain its function in advent of changes related to climate and to decay graciously when necessary (Alfraidi, et al., 2015). These strategies include elevating floor levels, electrical fittings and equipment in order to stop or reduce with projected flood level (Henrique, 2015).

- Envelope Design: This involves the choices of material, shape and orientation of roofs which are significant influences in deciding on envelope resilience. These key factors must react to variations within the climate and deliver both long life span and robustness (Henrique, 2015).
- Building system: These are designs that include interventions which allow the building (system) to resist distress and disturbance (Alfraidi, et al., 2015).
- Operation: This involves the ability of a system to adopt to unexpected dangers or shocks and recover without causing disruption in routine social activities (Alfraidi, et al., 2015) .

Other resilient considerations would include use of landscapes, blue green infrastructure, land geomorphology, respect of natural landscape patterns (i.e. Fractals) other than using conventional planning methods at all times. NYC Department of City Planning (2013) summarizes a few resilient and adaptive methods for coastal settlements in Fig.3.0

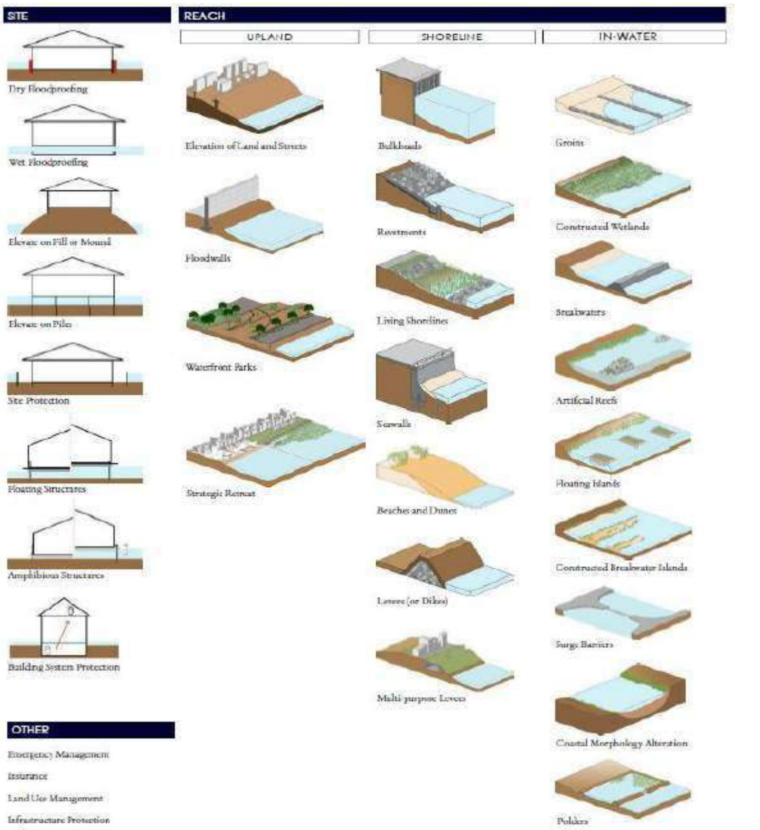

Figure 3.0: Resilient approaches for waterfront (coastal) communities (NYCDCP, 2013)

3.0 CASE STUDY

3.1 Hanoi, Vietnam

Vietnam, one of Southeast Asia's stable economic country is experiencing one of the greatest urban transitions in the world. At the national level, the urban population increased from 23.7% in 1999 to 29.6% in 2009 (with 25.4 million urban residents out of the country's 85.8 million people) (Nong et al., 2015; VSY, 2003). The urban population continues to grow at an unprecedented rate and is projected to increase by 45% by 2020, which translates to more than 30 million urban residents (Nong et al., 2015). Vietnam has a population of nearly 90 million, which makes it the third largest country in Southeast Asia and the 13th largest (by population) in the world. A little less than 30% of the population lives in urban areas, but the urban population is growing rapidly at a rate of 3.4% per year. Many of the country's cities are located along Vietnam's long coastline, rivers, and low-lying areas, rendering them particularly susceptible to hydrometeorological disasters now and into the future (Shah & Ranghieri, 2012). Because of its topography, Vietnam is susceptible to several types of natural disasters thus Disaster risk reduction and climate adaptation clearly has be mainstreamed into Vietnam's urban strategy (ibid).

Hanoi, the second largest city in terms of population and the capital of Vietnam is situated in the fertile Red River Delta, Northern region of the country. Hanoi is bounded by Thai Nguyen province to the north; Bac Ninh and Bac Giang to the east, Ha Tay to the southern west, and Vinh Phuc to the west (see Figure 3.1). The population of Hanoi has increased more than 40 times from the late 1910s to the 2000s. The rate of growth in urban population of Hanoi remained higher than peri-urban, and the difference is increasing overtime. The higher urban population growth of Hanoi is mainly because of the expansion of the urban boundary of the city to the peri-urban periphery and migration from peri-urban and other provinces to urban areas. Therefore, the proportion of total population living in urban Hanoi is continuously increasing. The urban and peri-urban ratio of 31:69 in 1978 has changed to 54:46 in 2001(Vien et al., 2005). By 2002, urban citizens occupied 53.43% in the total population. The average population density was 3,122 people/km^2, but it is quite different from that between urban and peri-urban areas: The urban was 18,220 people/km^2 (especially in Dong Da district: 35,341 people/km^2) while peri-urban area was only 1,600 people/km2 (the highest place-Tu Liem district: only 2,841 people/km^2) (Vien et al., 2005; Vietnam statistical Yearbook, 2002).

Figure 4.0: Geographical location of Vietnam (Vietnam Statistical Yearbook, 2008)

In 2003, two new urban districts named Hoang Mai and Long Bien of Hanoi were established. The two districts are split from parts of Thanh Tri, Gia Lam peri-urban districts, and Hai Ba Trung urban district (Vien et al., 2005). Until recently, the focus on urbanization in Vietnam was mainly placed upon the larger cities, for example Hanoi, Haiphong and Ho Chi Minh City. Nonetheless, intermediate-sized cities will become increasingly important in the coming years like Thua Thien Hue Province, as these cities are seen as new growth areas where opportunities for development are still present (Satterthwaite and Tacoli 2003; UNFPA 2007). The promotion of urbanization in intermediate-sized cities in an attempt to promote economic development across different regions and cities (Nghi 2008). This will also slow down further growth of already large cities such as Hanoi and Ho Chi Minh City. The Vietnamese government regularly opts for the conversion of agricultural land to facilitate further urbanization and industrial growth (Van Suu 2008; Dien et al. 2011). While urbanization is on the rise, at present, 70% of the Vietnamese population remain rural citizens, whose lives are heavily impacted by urban development policies, including agricultural land conversion. However, the Vietnamese government has taken steps in learning from their Dutch counterpart ways of increasing resilience in their region through architectural and engineering methods as discussed in the theoretical framework (Thinh 2009; Dien 2011).

4.0 METHODOLOGY AND PROFILE OF STUDY AREA

4.1 Research Methodology and Data Analysis Strategy

After exploring the main theories and concepts used in academic debates related to the resilience and examining Peri-urban issues, this section highlights the methodological approach used in the research. The study adopted a mixed method approach with a ratio of 80:20 (Qualitative: Quantitative) with underpinning epistemological knowledge about Peri-urban areas and interfaces and resilience strategies for coastal communities employing literature review. The research also employed a case study approach which was exploratory in nature. Desktop analysis of archival documents as well as secondary data from the statutory bodies and institutions in the municipality was relied upon. A visual survey that sought to establish the state of the Prampram community with respect to the current state of infrastructure, community amenities, socio-economic, cultural, ecology and institutional framework was also undertaken. Philological analysis was undertaken using aerial and normal view photos as well as panoramic views of the townscape. Geographic Information System (GIS) Software ARCGIS 10.2 was used to perform spatial analysis and projections after the existing maps were updated through the visual survey. In other to understand the Prampram community ecology, community narratives from key stakeholders was also solicited to appreciate the expansive psychological, cultural and political dynamics that may influence the resilience of the Peri-urban environment. This drew out stakeholders' rich holistic and ecological understanding which aided the research team to paint a contextual picture of Prampram as baseline data. The methodology used drew out community themes in solidarity with its needs, strengths, aspirations, challenges and changes.

5.0 Results and Discussions

5.1 Profile of Prampram

This section summarizes the physical characteristics of the Ningo Prampram community by adopting Kevin Lynch description of urban principles. Lynch (1960) describes an urban environment as comprising edge, node, path, district and landmark. Thus under the visual survey, the following themes were evaluated; natural environment, existing land uses (districts),community services, housing, transportation issues (edges, nodes, path landmark), population and employment, local economy and previous planning interventions employed within the community.

5.2 Ningo Prampram

Ningo Prampram is a Peri-urban community that consists of two main towns Ningo (old and new) and Prampram. Ningo-Prampram covers a total land area of about 622.2 sqkm. The district is located about 15 km to the east of Tema and about 40 km from Accra, the capital of Ghana (GSS, 2010). The district is bounded in the north by Shai-Osudoku district, south by the Gulf of Guinea, in the east by the Ada East district and to the west by Kpone-Katamanso district (MMDA, 2014). The district's proximity to Tema and Accra makes it easy for community members to have access to many social facilities and infrastructure, such as, good roads, water, hospitals and electricity. The district also serves as a dormitory for workers in many industries in Tema and Accra metropolis (GSS, 2010).

Prampram which is the capital of the Ningo Prampram District, is one of the fastest Peri-urban areas amongst Dodowa, Pokuase, Amasaman and Afienya in the Greater Accra Region of Ghana. Although this suburb was once a quiet, lightly populated residential area devoid of extensive commercial activities, it has within the five years sprung into a bustling and growing commercial spine due to its strategic location within the Accra and Tema boarders. Figure 5.0 illustrates a map showing boundary of Prampram.

Figure 5.0: Map showing boundary of Prampram (Google Earth, 2017)

Figure 6.0: Aerial view of Prampram shores with its community in the background (Authors fieldwork, 2017).

5.2.1 Population

The total population of the district is 70,923 out of which 47.3% are males and 52.7% females. Also, 41.7 percent of the population live in urban localities and the remaining 58.3 percent are in rural localities (GSS, 2017). However, the population has a youthful dependency ratio as illustrated in figure 7.0

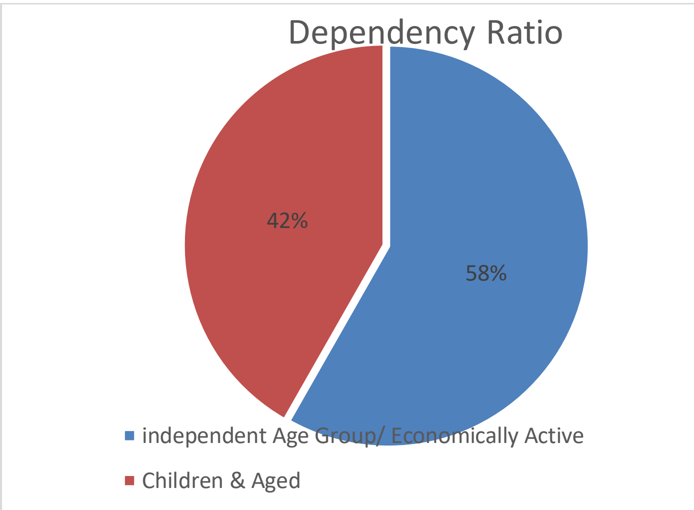

Figure 7.0: Dependency Ratio (representation by Authors, 2018)

5.2.2 Relief and drainage

The district forms the central portion of the Accra plains. The relief is generally gentle and undulating, a low plain with heights not exceeding 70m. The plains are punctuated in isolated areas by a few prominent inselbergs, isolated hills, outliers and knolls scattered erratically over the area (MMDA, 2014).

5.2.3 Climate

The south-eastern coastal plain of Ghana, which encompasses the Ningo-Prampram district, is one of the hottest and driest parts of the country. Temperatures are however subjected to occasional and minimal moderating influences along the coast and altitudinal influences affected by the Akwapim range in the northwest. Temperatures are appreciably high for most parts of the year with the highest during the main dry season (November – March) and lowest during the short dry season (July – August). The maximum temperature is 40 0 C.

The combined effects of high temperatures and high insulation levels, on the other hand, are of invaluable asset to the salt-making industry, as they account for the high and rapid rates of stalinization and crystallization crucial for the winning of salt. They also provide enormous potentials for solar power development (MMDA, 2014).

5.2.4 Local Economy

The local economy of the district is made up agriculture, commerce and services. Other thriving new and lucrative activity includes real estate activities which form the backbone of the economy as the district is largely becoming a dormitory settlement.

5.2.5 Service

The service sector covers a wide range of activities: finance, commerce, real estate and housing development, health, education, sanitation and water, electricity, transport, hospitality and tourism, etc. The District has only two (2) banking facilities (i.e. Dangbe Rural Bank at Prampram and a branch of the Dangbe Rural Bank at Ningo). The real estate and housing development is the fastest growing sector of the district economy. There are nearly twenty (20) different real estate companies developing properties within the District. The district has become an ideal place for such activities because of its proximity to Tema and Accra.

5.2.6 Roads

The total length of roads within the District area is 264.9 km made up of asphaltic concrete, surface dressed and unpaved roads. The District can also boast of two (2) first class roads

(Tema – Akosombo & Tema – Aflao) and a second class road that links Dawhenya to Prampram as illustrated in fig 8.0.

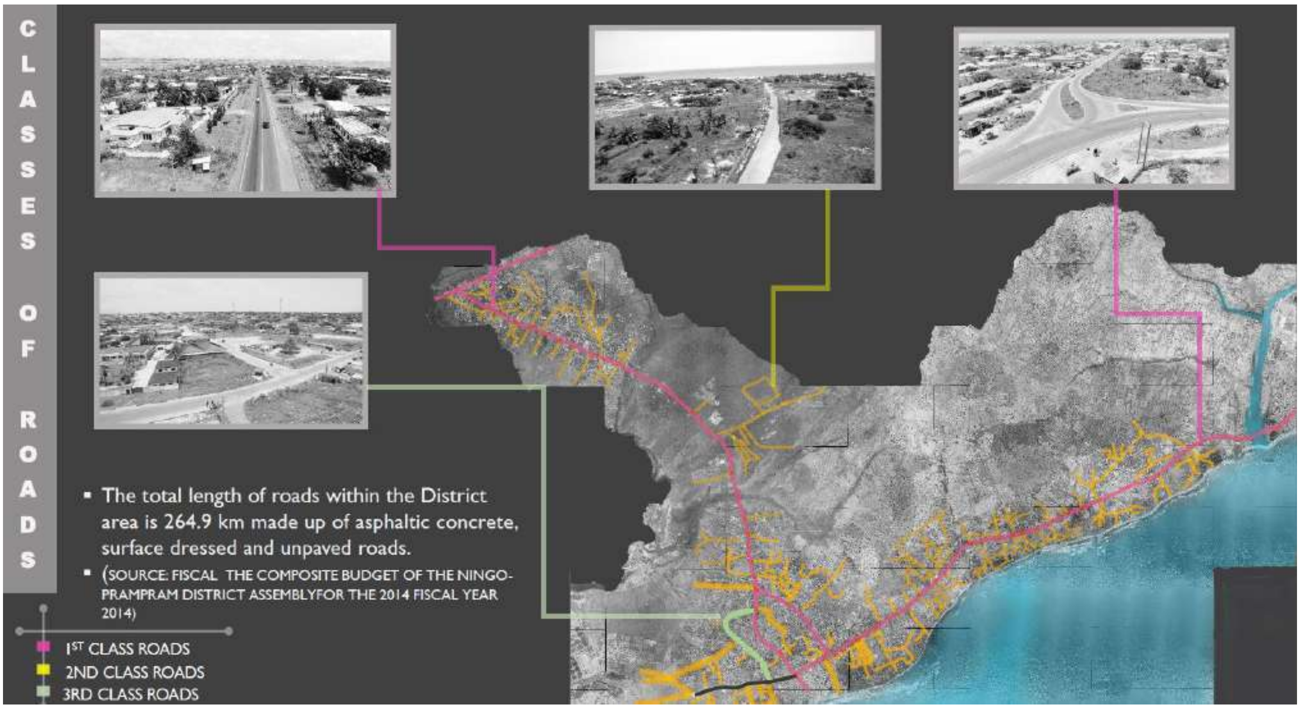

Figure 8.0: Classification of roads in Prampram (KNUST Department of Architecture, 2017).

5.2.6 Education

The District has a total of 199 basic school facilities out of which 47% are private. It also has one (1) privately administered tertiary institution (Central University College) which attracts students from all over the country and beyond resulting increased 'migration' of people from the main city center (Accra) to this peri urban community.

5.2.7 Health

The District has a total of twelve (15) health facilities out of which seven (7) are privately owned. Out of these facilities, there are five (5) CHPS compound constructed at various vantage locations within the district to make health care very accessible to the local people. The private health facilities augment the efforts of that of the public by providing services ranging from midwifery to obstetrics and Gynaecological services (GSS, 2010).

5.2.8 Hospitality Industry

Although this sector does not play a major role in the local economy, the tourism and hospitality sectors in the district have great potential. For instance Prampram and Old Ningo are one of the oldest European coastal settlements in Ghana. Prampram was the site of a small British trading post and fort built in 1742, while Ningo was the site of a Danish fort from 1735 until it was handed to Britain in 1850. However, neither fort survived to this modern day, except for some traces of Prampram's Fort Vernon remains. The main attraction of the area is the beach, particularly the stretch around New Ningo, generally regarded as safe for swimming and dotted with holiday homes. The estuary on the west flank of Old Ningo has natural beauty enhanced by colourful fishing boats moored on the beach. Prampram also boast of the first Police Station built in the country.

5.2.9 Previous Planning Interventions

Due to the strategic location of Prampram to the industry city, Tema and the capital of Ghana, Accra, attempts have been made by local planners to restructure the town from its organic form to western grid pattern. Apart from the local planning interventions, the UN Habitat in 2016 made planning proposals with regards to the master planning of Prampram. This is illustrated in figure 9.0 and Figure 10.0 respectively.

Figure 9.0: Prampram land Use Plan (local interventions) (KNUST Department of Architecture, 2017)

Figure 10.0: UN Habitat masterplan proposal for Prampram (UNHABITAT, 2016)

5.4 SWOT Analysis of Prampram vis-à-vis developmental plans

Analysis	Remarks
Strengths	-Resilience strategies have been integrated in the planning by using blue-green infrastructure in the UN Habitat masterplan proposal
Weaknesses	-Initial Local plans did not consider the incorporation of resilient strategies - Grid pattern adopted may increase vehicular traffic situations within the Peri-urban community -Planning type adopted is not organic to the current lifestyle of the people
Opportunities	-Tourism can be boosted -Coastline can be protected and preserved; lives, properties and livelihoods of fisher folks can be protected -Improve current services and roads within the communities -Alternate routes should be created and improved to reach other parts of the main city without using the current existing roads which cause vehicular traffic especially during the early and late hours of the day due to influx of Peri urban dwellers
Threats	-Tendency to destroy the natural organic form of the settlement which had the semblance of fractals due to the introduction of grid pattern planning

5.4 Discussions

Data obtained from literature and field work conducted in Ningo Prampram illustrates that Peri-urban communities function as satellite towns to main cities due to their proximity. Also, due to the affordability of lands, rent and/or leases in Peri-urban communities. Even though distances to city centres may be further away from their places of dwelling. Many Peri-urban dwellers also prefer the quiet ‘country’ nature of Peri-urban areas but with enough amenities and services to make living in such communities comfortable. The Peri-urban environment must also be viewed as a dynamic, transformative and reciprocal linked at the macro level not only by economic activities and geography but also significantly by the social fabric of individual and family networks.

Ningo Prampram is a Peri-urban community located at the outskirts of Accra and Tema, both important commercial and industrious hub of Ghana, respectively. As a result of urban sprawl and expensive accommodation and land in the main city center, most middle income and poor families are locating their homes to the outskirts of Accra and Tema. Field studies conducted in Prampram revealed that Ningo Prampram has seen an increase in population, provision of services and increased attention from real estate developers seeking to take advantage of the housing market deficit. The introduction of Central University has also influenced the population dynamics and commerce within the area as it attracts businesses both small and medium scale to provide for the university population as experienced with other public universities in the country, as in the case of University of Ghana, Legon and Kwame Nkrumah University of Science and Technology, Kumasi. Further developments prove that the Government of Ghana intends to move the Government Seat to Prampram as a mechanism to decongest the National Capital, Accra. It has been arranged that the headquarters of major Government Institutions, Ministries and other private institutions would be transferred to Prampram. Additionally, Prampram is proposed to host another international airport to compliment the Kotoka International Airport in Accra. This implies that Prampram could be transformed into a government city or an aerotropolis or both hence must consider the issue of resilience both as a waterfront community and in its social and infrastructural system before it expands into a major city center and continues the chain reaction of creating other Peri urban communities which surround it. Consequently, the master plan proposal has been accepted by the UN Habitat lab by the Ningo Prampram district even though by the SWOT analysis conducted, the masterplan is not sympathetic to the culture of the people of Ningo-Prampram. However, it is likely that even though resilient strategies have been integrated into the master plan proposal. The local inhabitants of that area may not adjust properly or the reality and vision of the masterplan may totally be defeated when implemented in spite of the infrastructural measures adopted.

6.0 Recommendations and Conclusions

Based on the culmination of findings from literature and field studies. A visual survey undertaken in the community revealed that there is a high influx of students, workers and families acquiring accommodation within the community. Ningo Prampram like most coastal communities in Ghana, has great potential as a tourist destination away from the bustling nature of Accra and Tema. From literature review and field studies, it can be summarized and concluded that Peri-urban communities requires resilience strategies which include:

- The consideration of coastal geomorphology measures like coastal retreat, waterfront parks and elevation of land and streets
- The incorporation of Architectural and Peri-urban planning approach such as elevation of buildings, wet proofing buildings, complete barricade of site from flooding situations and the use of amphibious building structures.
- The role of 'hard' engineering methods are also required to maintain a resilient waterfront. These would include strategies like building levees, dunes, revetments and surge barriers.
- Also, the Incorporation of blue green infrastructure such as storm water systems and the use of mixed used open spaces can also improve resilience.

The following recommendations were concluded on as relevant for the growth and resilience of a Peri-urban town as a resilient coastal waterfront community. Ningo Prampram requires a masterplan which must embody an increase in the level of protection and minimizes the impact of possible flooding. This master plan should allow for the natural movement of water while integrating safe routes, raised access to the buildings, permeable landscaped surfaces and basins, all without compromising the aesthetic and social aspects of the design. The waterfront must be developed with appropriate facilities to attract tourists (local and foreign) to facilitate tourism in that area. Also, a comprehensive coastal geomorphological information to develop custom solution to safeguard the coastline. In planning Peri-urban settlements, urban planners should consider other organic forms of planning like the use of fractals to develop masterplan or land use plans for Peri-urban communities

For future studies, it is encouraged that simulations should be conducted to investigate the viability of the masterplan proposal and what effective alternative can be used to develop proposals for coastal Peri-urban waterfront communities.

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Planners' information need in adaptation to climate-induced floods

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Abstract

This study investigates urban planners' need for information to adapt to climate change. Interviews with planners in Trondheim and Stavanger disclose gaps in the provision of data and needed tools.

Climate change is increasingly seen as a major challenge within the field of urban planning. Many places will need to adapt to new climatic conditions, resulting in more severe droughts; rising sea levels; increasing precipitation; air pollution; water scarcity and increasing risk of landslides. Despite the growing awareness of the potential consequences of climate change, the process of climate change adaptation remains slow. In Norway, the central role of the local municipalities in the climate change adaptation process was underlined in the White Paper on climate change adaptation and urban planning has been given a central role in the adaptation process.

One of several reasons for the passive approach to climate change adaptation is the lack of relevant information. Although there is an abundance of research about climate change and its consequences, local officials report that the available data is often not relevant or applicable to the adaptation process on local level.

This study explores planners' information needs regarding climate change adaptation. More specifically, the focus is set on adaptation to climate-induced flood events, as a result of increasing precipitation and sea level rise. Two case studies of the Norwegian municipalities of Stavanger and Trondheim are used to shed light on the necessary data and tools to enhance adaptation to flood risk through planning. The study also considers to what extent the expressed information needs can be covered by existing information resources, as well as what data and tools that would be useful but are currently unavailable in the planning process.

1 Introduction

Climate change is a challenge gaining increasing interest and concern within the field of urban planning. Many places will experience more extreme climates with more severe droughts; increasing precipitation; rising sea levels; landslides; air pollution or water scarcity (Field *et al.*, 2016). Despite the rising awareness of the potential consequences of climate change, the process of climate change adaptation remains slow. In Norway, the local municipalities were assigned the main responsibility for the adaptation process, with the White Paper [*Stortingsmelding*] on climate change adaptation (St.meld. 33, 2012-2013), nevertheless many municipalities remain passive actors in the adaptation process.

Previous research finds that one of the reasons for the slow adaptation process in local municipalities is the lack of relevant information. While there is a lot of information available about climate change and its potential effects, officials on municipal level report that they lack information that is locally relevant and useful in the local adaptation process (Aall *et al.*, 2015; Dannevig and Aall, 2015; Hanger *et a*l., 2013; Storbjörk, 2007; Tol *et al.*, 2008). Guidance material specifically targeting adaptation in the municipalities is often dominated by general information about climate change and lacks descriptions of specific adaptation measures that could be implemented (Hauge *et a*l., 2016). A survey conducted among Norwegian municipalities showed that 9 out of 10 municipalities wish to have more information about the local effects of climate change (DSB, 2008). The mismatch between the existing information resources and the local planning practitioners' need for information represents therefore a substantial obstacle to incorporating climate change adaptation in municipal planning processes.

The main motivation for this study is to define which information resources are needed in planning for climate change adaptation within the specific scope of climate-induced floods in Norway. Climate-induced flood risk includes sea level rise and urban runoff.

The research question may be expressed as: What data, tools and guidance material are needed to improve flood adaptation in municipal planning processes?

The methodology is presented in Section 2, together with the chosen case studies. In Section 3, the findings are presented and discussed in relation to relevant planning theory, in order to assess the necessity of information resources for a pro-active approach to flood adaptation in planning. Section 4 summarizes the main findings of the study and gives some suggestions for implementation.

2 Material and Methods

2.1 Case study 1: Stavanger municipality

Stavanger is a coastal municipality in south-western Norway, incorporating the city of Stavanger and its immediate surroundings with a population of 130 000 inhabitant (SSB, 2018). Projections suggest that the region will see a 10 percent increase in the average annual precipitation until the end of the century (Miljødirektoratet, 2015). In addition, the number of days with extreme precipitation could more than double in the worst scenarios (Hanssen-Bauer *et al.*, 2015). The risk for floods will thus increase, especially in urban areas in form of increasing urban runoff (Miljødirektoratet, 2015). Stavanger is also vulnerable to the effects of rising sea levels. Already today, central parts of the city are at flood risk during storm surge events (COWI, 2017) and the sea level is expected to rise by up to 80 centimetres by the end of the century (Simpson *et al.,* 2015). A recent cost-benefit analysis of future flood damage in Stavanger estimates the potential costs to 11 billion NOK by 2090, a cost that could be reduced to 3 billion if adaptive measures were implemented (COWI, 2017).

2.2 Case study 2: Trondheim municipality

Trondheim municipality is, with its 190 000 inhabitants the third biggest municipality in Norway based on population size (SSB, 2018). Historically, about 50 different flood events have been registered in Trondheim, primarily related to spring floods of the nearby rivers and streams, but more recently also due to extreme weather events. Climate projections suggest that the region will face both increasing precipitation and sea levels, resulting in higher flood risk. The total annual precipitation is expected to increase with 17 percent in the coming century in the worst scenario and the number of days with extreme precipitation could increase with up to 77 percent (Hanssen-Bauer *et al.*, 2015). While sea level rise has so far been compensated for by the regional effects of land rise, it is expected a sea level rise of 53 centimetres by the end of the century (Simpson *et al.*, 2015). This will increase the risk of flooding in the coastal areas especially when storm surges and wave effects are considered.

However, in opposition to Stavanger, the possible consequences of sea level rise are not yet seen in Trondheim today.

2.3 Methodology

The study is primarily based on twelve in-depth interviews with public officials at administrative units involved in planning processes in Trondheim and Stavanger municipality. Considering the lack of previous research about the information needs in the planning process with regard to adaptation, the study is intrinsically exploratory in character. As a result, the interviews followed a semi-structured interview design. The interview included a selection of mandatory topics to ensure that key areas were covered, while allowing other (potentially new) topics to be addressed.

The mandatory main questions and topics that have been addressed are detailed in the following:

- Background?
  Topics: task, role, previous experiences.

- How is climate change adaptation to flood risk addressed in the municipal planning processes today?
  Topics: Previous flood events, cause, effect on the society, effect on the planning process, need for adaptation, factors for facilitating adoption, focus area for climate change adaptation, adaptative measures, success, failures.

- Are the available data/tools/knowledge sufficient for enabling climate change adaptation to flood in municipal planning?
  Topics: Accessibility, relevance, success, failures, user-friendliness, capacity building, responsibility, in-house developed tools, communication.

- How could one better accommodate the needs for data/tools/knowledge about climate change adaptation to flood in the municipal planning process?
  Topics: improvement, lack, communication, dissemination, format, capacity building, prospects.

The organisation of the adaption process varies among the municipalities, and it was therefore not clear from the start who the most relevant informants would be. The coordinator for climate change adaptation provided contacts with relevant interview objects. Priority was given to people who had experience of working with flood adaptation. Their input was therefore assumed to be more informative based on their previous experience. In addition, "*snowball sampling*" was used to identify other relevant interview objects.

3 Results and discussion

3.1 Knowledge-status on climate change adaptation in the municipal administration

The interviews suggest that there is a **general lack of knowledge** and competence within the field of climate change adaptation. The competence on flood adaptation, especially concerning sea level rise, is often very limited in the municipal administrations. Several of the interview participants claim that the competence on climate change adaptation varies a lot from person to person and is primarily based on individual engagement and interest in these issues. "Not all 50 people who work at the planning office are fully updated on these issues. Even though the aim is that they will be", says one of the interview participants. When asked to name the most important factor for strengthening climate change adaptation in planning, one of the planners brings up the need for a "general understanding of what climate change adaptation is", which suggests that even a basic understanding of the concept might in some cases be missing. Awareness about the need to adapt, together with knowledge about available adaptive measures, are identified as two of the prerequisites for succeeding with planned adaptation (Füssel, 2007). Thus, the absence of these factors could explain why climate change adaptation often has not come further in the municipalities.

The competence gap is most likely even **larger in smaller municipalities** with fewer resources set aside for climate change adaptation. Trondheim municipality was reported to function as a mentor on climate change adaptation for smaller municipalities in the region of *Trøndelag*, none of them had addressed the need for adaptive measures before.

Although the competence level might not be sufficient, the focus on climate change and adaptation to flood risk was reported to have **increased dramatically** in both Stavanger and Trondheim municipalities. "I have worked here for 25 years now and in the past 5 years it has become a growing focus on these issues" said one respondent in Stavanger. At the same time, another respondent noted that flood adaptation was not a central issue on the planning agenda. "In most plans, this is not the main focus, because there are many other things we need to take into consideration as well".

The interviews also suggest that there have been some **internal competence-building initiatives** on climate change adaptation, such as seminars and thematic meetings. However, these have primarily been singular events. In addition, both Stavanger and Trondheim established an intersectoral working group on climate change adaptation, in order to improve the communication between different disciplines and to ensure a more holistic approach to adaptive measures. Interview participants from Stavanger municipality appeared to be satisfied with the intersectoral working group, especially since it includes not only technical service units but also the planning and building inspection units. "But we are not done yet. There is still some potential for improvement", one person says, pointing to the need for some organisational changes and to strengthen the mandate of the group. The intersectoral working group in Trondheim also showed potential for improvements, among other aspects to overcome lack of engagement and insufficient competence among the members. "We need some restructuring, otherwise we will not move forward", said one of the members of the group. "Not everyone has the time, they are not dedicated and competent enough" said another respondent. Lastly, both municipalities are also members of various cooperation networks on climate change adaptation that provide a platform for exchanging experiences and learning from others. However, for the exchange to be fruitful the knowledge must be brought into the local adaptation process. "The network is meant to provide competence and inspiration, but this has to be included in the documents back home, otherwise it makes no sense. It does not matter if you sit here [in the network] glowing with enthusiasm and interest if you do not bring it back home", said one of the respondents.

As a result of limited competence and capacity within the municipal administration, analyses related to flood adaptation in the planning process are usually conducted by **external consultants**. However, one planner underlined that there are not many experts in this field also among private consultants: “The amount might increase if more municipalities begin demanding these [analyses]” said the planner. While no further assessment of the knowledge status among private consultants has been conducted in this study, the interviews suggested that the competence on adaptation to climate-induced floods is rather limited both in the public and the private sector.

The type of mentioned information resources has also been observed to largely depend on the **type of flood risk**. As shown in Figure 1, the interview references to data and knowledge predominantly address adaptation to sea level rise, whereas references to tools are slightly more directed to adaptation to urban runoff. Two hypotheses might explain this tendency: a) reliable data on urban runoff might be difficult to acquire due to the unpredictable nature of the intensive precipitation; or b) a relative lack of information resources on sea level rise would result in a higher demand.

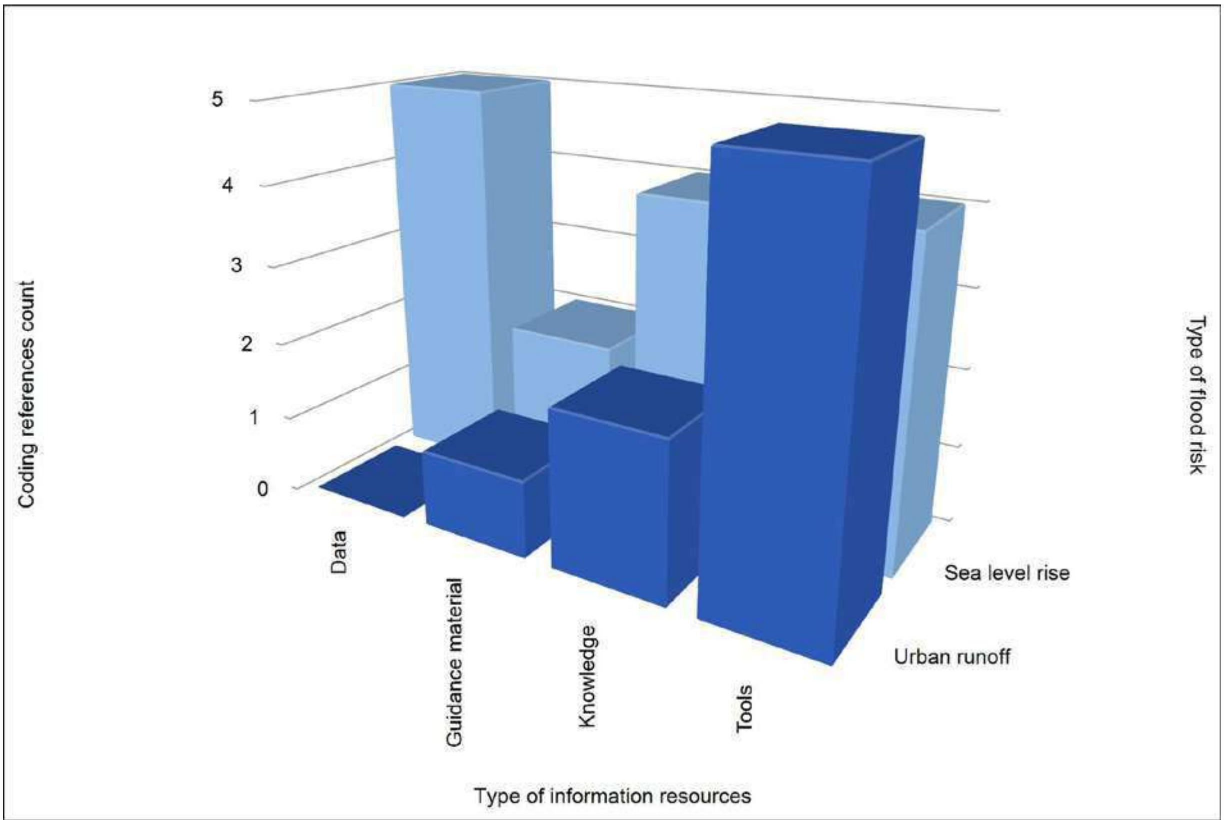

Figure 1: The recurrence of the flood types in relation to the different types of information resources in the interview material.

3.2 Data

Access to data is important in climate change adaptation, both for identifying vulnerabilities and for designing sufficient adaptive measures. **Geographic data** is an important part of the information used to predict and prevent flood risk and is often presented under the form of flood risk maps. One of the key challenges related to geographic data appeared to be the quality of the data sets. "All units try to keep up to date […]. But sometimes we need more precise and more detailed data", said one respondent working with geographic data. Using inadequate data sets in flood risk analyses can result both in that vulnerable spots are missed and that the flood risk zones that require adaptive measures become unnecessarily large. This appeared to represent a critical challenge for mapping waterways. "It is like this with GIS analyses: 'nonsense in, nonsense out'. And this is also the weakness of our old flood way analysis. We see that it does not entirely match with reality [...]. The culverts and streams and such were not sufficiently mapped", said another employee from the geo-data unit. The identification of streams from *Felles Kartdatabase* (FKB) has been based on whether or not the stream is visible on an orthophoto. This approach was reported as problematic in vegetated areas where visibility is low, resulting either in arbitrary mapping or in stream discontinuity.

Laser scanning is mentioned as one of the main solutions for addressing the problems with data resolution, according to NOU 2010:10. "With laser scanning, even in areas with spruce forest, there will be some laser rays reaching the ground, so you get a terrain model also where there is forest", explained one respondent from the geo-data unit. The ongoing nation-wide laser scanning of Norway was therefore observed to be a much-welcomed initiative.

The project began in 2015 and terrain models for large parts of the country are now openly available online. "Previously, the municipalities had to finance and buy this service themselves, but the ongoing laser scanning is actually tax-financed" mentioned a respondent. Hence, in addition to improving the quality of the terrain models, the national laser scan improves the availability of data especially for smaller municipalities that might not have had the resources to conduct mapping projects of their own, thus laying the ground for better flood risk analyses.

Besides geographical data, respondents in both Stavanger and Trondheim municipality noted the importance of **historical data** of flood events. Past flood events were also described as the most reliable source of data for predicting future flood risks. "It is our strongest card in planning, that we prevent [flood risk] based on our previous experiences", said another respondent from the geo-data unit in Stavanger, while agreeing that scenario-based predictions of the future were also important despite their high uncertainty. Both municipalities have records of previous flood events, however the awareness and use of these records seemed to be limited in some of the administrative units, at the same time as being mostly person-dependent. "I have at least not been taught where to look for such information", revealed one respondent from the water management unit. "I know that those who have worked here for a long time know this by heart. But the question is what happens when they leave? Should we then learn it all again?".

The interviews revealed that many of the actors in the planning process have limited or no awareness of the **validity of the data** flood adaptation is based on. "It is a rather simple procedure when I look into the zoning plans", said one respondent at the water management unit. "We just look at the output of these [flood risk] models. But the question is, how well do these results represent reality? I actually don't know that". Only one municipality appeared to actively attempt to verify and validate data used in the planning processes. The verification of data was then primarily based on the engagement of one person at the contingency unit: data could then be verified via the use of external contacts, such as research institutes and national agencies. "I haven't heard about any other [municipalities] that do what I do […] Many just skip this part and hope for the best", said the contingency official. The underlying problem to the lack of data verification is the limited expertise within the municipalities. "It is very specific knowledge that we don't have. There is no one in the municipality [administration] who has expertise on wave impact and such things. And then we are a rather large municipality, so the smaller municipalities don't have a chance to check these things", claimed another informant. As a result, many public officials have no choice but to trust the data provided by external sources.

The inability to verify data also results in the use of **outdated data**. "There were some discussions about what data that would be correct to use for a plan we were working on. You have some [data] [...] and then there was some work […] that was more recent but not approved by the ministry", explained one planner. "We thought we should nonetheless use those that had been approved on a national level [...] even though those numbers were starting to get a bit old". Similarly, one of the respondents from the environmental unit noted that the municipality's flood risk maps, which were made in 2011, were already outdated by newer data. "If you look at the maps on the municipality's website you will see the old sea level estimate from 2011, which says 40 cm sea level rise […]. However, the new guidelines from the Norwegian Directorate for Civil Protection (DSB) [*Direktoratet for Samfunnssikkerhet og Beredskap*] say 70-80 cm, and even more recent research says that we can forget about these small numbers, it will be 100-150 cm". The time lag of acquiring and internalising the most recent data therefore slows down the adaptation process further.

3.3 Tools

GIS software products are one of the key tools in flood adaptation and are used to create flood risk assessments as well as to identify the existing waterways and catchment areas.

GIS tools are often used to generate static 2D maps, however several respondents mentioned **3D-visualisations** as one type of tool that could benefit from further exploration. "If you visualise [flood risk] [...] in 3D […] it becomes understandable to everyone", claimed one respondent from the geo-data unit.

To some extent, the needs for data and tools in the adaptation process was observed to trigger the development of **new functions in the existing simulation software**. Users' needs were in some cases communicated back to the provider, who could then incorporate more customized functionalities. According to one respondent from the geo-data unit, it was easier to influence Norwegian software providers compared to international ones. This was particularly relevant when many municipalities experienced similar problems. "If it is a large company that is based in Europe or the United States, then it is rather difficult to have an impact", described the respondent, who also underlined the importance of educating providers who were not necessarily aware of the challenges regarding flood adaptation.

Quantitative evaluations were also mentioned as important for bringing flood adaptation higher up on the agenda. "Everything you quantify and measure gets prioritised", revealed one of the water management engineers in Trondheim. Although both municipalities implemented regulations and guidelines to enhance flood adaptation through the planning process, neither of them conducted any evaluation of the impact of these measures. The definition of key performance indicators is necessary for identifying both successful examples and problems and would result in a more efficient adaptation process.

Economic analyses of adaptive measures and flood scenarios, when combined to quantitative evaluations, represent not only an opportunity for evaluating a strategy in terms of risk reduction and implementation rate, but would also further inform decision-making and lead to more efficient adaptation. "Transforming it into [monetary value] will allow for comparing, when you are dealing with complex issues involving both 'apples and pears'", said one respondent from the water management unit. Yet the interest in conducting economic assessments was observed to be seemingly low. A cost-benefit analysis of flood damage was developed in one of the municipalities: a GIS-based analysis enabled the estimation of future costs of flood damage to infrastructure as well as possible costs and benefits from adaptive measures. "This is a tool that all municipalities could use if you familiarise yourself with it", said an informant from the contingency unit. "I haven't received many inquiries about it so far, so I suppose there is not so much focus on these matters".

Other key tools used in the planning process today are the various **construction standards**, such as the local water management regulation [*VA-normen*] and regulations on technical requirements for construction work [*Byggteknisk forskrift* (TEK17)]. However, standards are inexistent for more specific solutions such as blue-green solutions, although these are viewed as the preferable and more sustainable way of handling urban runoff. Choosing blue-green solutions therefore becomes a riskier investment, since consultants are not responsible for potential flood damage as long as they act in accordance with the approved practice in many cases the existing construction standards. But when no such standards exist, *e.g.* for blue-green solutions, it is more difficult to claim that sufficient measures were taken if damage were to occur. One water management engineer therefore asked for similar standards for construction and dimensions also for blue-green solutions. "I think it is essential for the implementation of blue-green solutions. Consultants and developers need to feel certain that the solutions they implement are reasonable, and perhaps most importantly, that they will not risk getting responsibility for damage that could happen in the future".

Several of the interview participants claimed that the tools that are available today are generally good. When it comes to **possible improvements** the opinions are more divergent. One informant claimed that there were already rather many tools available, while another was surprised that not more tools had been developed and taken into use. The latter also noted that the main weakness was the quality of the input-data rather than the tools themselves.

Sometime tools exist but are not used by the municipalities. One possible explanation to the **limited use of tools** is the lack of awareness and competence. Toolboxes that collect relevant resources can be found; however, these are not necessarily complete and are often one of many such resources collections. In addition, the employees experience that it is difficult to stay fully updated on developments in the field. "It is a very large organisation and many areas of responsibility and many people, so it is not always easy to keep update on everything that is new", according to a planner.

3.4 Guidance material

A large amount of guidance material on climate change adaptation has been published in recent years. A review of 84 different reports and websites addressing climate change adaptation was published by *Klima 2050* (Hauge *et a*l., 2016) and identified some **general trends** in the existing guidance material. Firstly, it often focuses primarily on general information about climate change, rather than detailed information about implementation of possible solutions. Secondly, much of the guidance material lacks a defined target group, which may reduce the effectiveness of the communication. Moreover, none of the reviewed guidance material focused on decision-making processes and coordination between different sectors in the adaptation process. These findings were also reflected in the interviews.

The guidance material that is available **does not reflect the need** of the users. One respondent described difficulties in finding more technical information in the guidance material. Another one asked for more examples of how adaptive measures could be implemented in practice and for more information about the implementation process. The guidance material was also mentioned to be too much simplified, *e.g.* in regard to the complexity of the impact of waves on sea level rise. At the same time, users reported to experience difficulties when navigating through an overload of information. "If it is like you say that there are more than 80 reports out there, it is rather obvious that it will be difficult to keep track of it all", reflected one planner.

The absence of process-related guidelines was also considered as an opportunity for improvement on adaptation. "There should be [...] guidance material for each phase [in the planning process]", said one informant. "Those who are responsible for the different phases in a project need to get clear guidelines describing that 'here you should watch out for this; and consult these actors and ask about such and such'. Then you can say that this is done; OK, move on to the next phase. [...] There is too much discussion about this [process] in general" observed an informant from the environmental unit.

There is also an **uneven focus** on the different topics covered in the guidance material. The interviews indicated that the available guidance material is more useful for dealing with urban runoff than it is for addressing sea level rise. This is in agreement with the thematic analysis presented by Hauge *et al.* (2016), which showed that 19 percent of the guidelines reviewed focus on urban runoff, compared to merely 1 percent that dealt with sea level rise.

The often **poorly defined target group** is mentioned as another challenge with the current guidance material. "Who is it made for? Is it for someone with a PhD or are they written for [anyone]?" asked one informant from the environmental unit. The unclear target group was also considered to be one possible explanation to the limited usage of the existing guidance material. However, when asked about who primarily uses the guidance material, the general perception was that the resources were used. "Maybe the environmental unit uses it. The building inspection office and the planning office probably also must look into these matters. [...] Guidance material on climate change adaptation should also be something that the water management unit goes though", estimated one planner. Nevertheless, most of the interview participants primarily talked about others using the guidance material, while those that did use it mainly emphasized its deficiencies.

4 Summary and conclusions

To answer the question: what data, tools and guidance material are needed to improve flood adaptation in municipal planning processes? Twelve interviews were conducted with public officials at administrative units involved in planning processes in Trondheim and Stavanger municipalities in Norway.

Adaptation was shown to gain importance within the planning field, mostly via increased efforts to strengthen competence. However, there is still a need for greater knowledge and awareness on adaptation. The engagement was observed to largely vary, both among individuals and depending on the type of flood risk concerned. The main results suggested that adaptation planning is still not fully institutionalised in the planning practice and is given attention on a more ad hoc basis.

Results showed that there is an ongoing and seemingly accelerating process for improving the quality and access to data used for flood adaptation planning. Yet the major challenges were observed to be related not to the data itself but rather to the ability to make use of it. The interviews unveiled weak points in the organisation of data and the competence of its users, suggesting that these could be possible areas for improvements.

The interviews also suggested that there is a potential for improvements, both regarding the use of existing tools and the development of new tools. The development of tools for visualisation, quantification and standardisation could provide better decision-making support. In addition, organisational and educative measures could probably enhance usage of the already available tools.

Finally, the interviews confirmed the previously observed trend: the available information resources on adaptation do not correspond to the information needs in the municipalities. One measure for improving the usefulness of the guidance material would be to better coordinate the content with the needs as expressed by the users. The use of the existing guidance material would also benefit from better organisation and awareness of the existing material and, perhaps foremost, a reduction in the number of reports and documents.

This study is expected to inform the research agenda and thus to contribute to the development of information resources that are better adapted to the planning practitioners' needs. It is hoped that this study will in the long-term increase the resilience to negative effects of climate change.

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Sustainable and smart energy transition in cross-border territories. Insights from the European Alpine macro-region

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1. Energy transition in Europe and in the EUSALP macro-region

1.1 The European perspective

Since 2008, the European Commission is pursuing Member States to improve their climate and energy strategies and legislation in order to achieve ambitious goals. Starting from the pioneering “20-20-20 package” (European Commission, 2010) – aiming at a 20% reduction in GHG emissions (on 1990 levels), an increase to 20% of EU energy from renewable sources, and a 20% improvement in energy efficiency by 2020 – medium and long-term targets have become even more challenging.
The European Commission's 2011 Energy Roadmap (European Commission, 2011) defines development routes and priority investments needed to foster renewable energy penetration, energy efficiency increase, and to smarten grid infrastructure. The final aim will be reducing greenhouse gas emissions by 80-95% by 2050, developing a new social and economic model, called “low carbon” (Aiken, 2012). Within this vision, specific areas are mentioned as key points, as the construction sector, striving for their decarbonization (da Graça Carvalho, 2012). For example, the European Strategic Energy Technology Plan 2008 (SET-Plan) (Commission of the European Communities, 2007) supports the overrun of the “nearly zero energy buildings” concept in favor of “positive energy districts” where smart interconnected efficient buildings produce on a yearly basis more primary energy than what they use. Or the EU “winter package” 2016 (European Commission, 2016) proposing new consumer-centered energy rules to smooth the transition and recognizing how “local energy communities can be an efficient way of managing energy at a local community level by consuming the electricity they generate either directly for power or for (district) heating and cooling, with or without a connection to distribution systems”.
In fact, to achieve this smart energy transition in a fast and efficient way, and to metabolize deep cultural-societal changes, a strong international cooperation is needed. On one hand, sustainable-energy strategies and projects, like those developed since 2008 under the framework of the Covenant of Mayors initiative or within specific calls for funding (e.g. Interreg or Horizon 2020) are strongly encouraged. On the other hand, it is crucial that territorial strategies dealing with a more general cross-border coordination incorporate this new energy paradigm into their governance systems (Osuch, Pawlak and Sowińska-Milewska, 2009).
This is the course of action taken by the EUSALP, the European macro-regional strategy for the Alpine region. So far, there are four macro-regional strategies around Europe, and EUSALP is the newest one, it was launched in 2015 and is going to provide a framework for cooperation, coordination and consultation between and within Alpine states facing common challenges (DG Regio, 2015). It is a great opportunity for stronger regional cohesion and coordinated implementation of sectoral policies among nearby territories, including obviously the energy ones.

In this regard, our paper starts to investigate some crucial points related to following questions:

I. How is the EUSALP territory addressing the energy transition through energy planning instruments and strategies?

II. Are neighbor territories already cooperating to achieve coherent and integrated cross-border energy strategies?

The paper begins offering an overview on the EUSALP, its energy figures and ambitions (section 1). Then it proceeds recalling the materials and data used for the analysis (section 2), leaving to the reader the possibility to explore them more in detail. Finally, it provides some preliminary answers to the research questions (section 3) and draws conclusions, also defining possible future research areas (section 4).

1.2 The macro-regional strategy for the Alpine region

The EUSALP embraces seven Countries, of which five EU Member States (Austria, France, Germany, Italy, and Slovenia) and two non-EU countries (Liechtenstein and Switzerland) distributed around the Alps, a 1,200 kilometers long mountain chain. Austria, Slovenia, Liechtenstein, and Switzerland are entirely included in the EUSALP, while remaining countries only participate with some territories. Figure 1 shows the location of the EUSALP region within Europe and highlights the 50 territorial entities that it embraces (half of them are Swiss cantons, whose borders are not drawn in the map).

Figure 1: EUSALP territory overview by countries. Source: Eurac Research.

Looking at the map it is clear how EUSALP not only deals with sparsely populated mountain areas. It includes also flatlands, where large metropolitan areas are located, and even coastal regions. In total it covers near 10% of the EU surface (more than 470,000 km2), encompasses 16% of the population (about 70 million of EU citizens and 8 million of non-EU), and generates the equivalent of the 20% (3,100 trillion €) of the GDP of the EU (Tomasi et al., 2019). In fact, the EUSALP motto says “mountains and plains addressing together common challenges and opportunities”[i]. Therefore, spatial-socio-economic heterogeneity matters in the EUSALP and it must be carefully considered by its governance board in the development of actions within the three thematic policy areas (economic growth and innovation, mobility and connectivity, environment and energy) and in the cross-cutting one (governance).

In particular, there are nine Action Groups (AG) in charge to translate the identified issues and potentials into concrete actions and more specifically the AG9 has the mission to "make the EUSALP territory a model region for energy efficiency and renewable energy" (DG Regio, 2015).

The AG9 has some specific objectives, namely:

I. setting up an Alpine energy efficiency cluster. This cluster should serve as a forum for cooperation and innovation, bring technical solutions for the specific energy needs of the Alpine Region, and develop energy efficiency processes and products particularly adapted to the Alpine Region, especially in the housing and mobility sectors;
II. greening the Alpine infrastructure: focusing on energy efficiency in the building sector and promote harmonized, affordable and operational assessment tools to be used by public authorities in order to boost sustainable and low-carbon buildings in the Alpine Region;
III. setting up an Alpine renewable energy cluster while taking into account ecological, economical and land use issues and considering societal trade-offs;
IV. support energy management systems in the Alpine Region by developing, sharing and installing energy efficiency and decentralized monitoring systems at the local level and by promoting regional energy monitoring;
V. support a better use of local resources and increase energy self-sufficiency while reducing impacts on climate and the environment.

Current energy consumption in the EUSALP amounts to some 2,300 TWh/year. On average, each EUSALP inhabitant has a per capita consumption of 28 MWh/year, which is slightly above the EU-28 average (25 MWh/year). The share of renewable energy sources (RES) in heating needs in the EUSALP territory rounds 21% (slightly better than EU average) mostly thanks to biomass. On the contrary, the share of RES in the electricity generation is quite high (40% against EU average 29%), especially due to a strong and well-rooted hydropower production in the core Alpine territory (Tomasi et al., 2019). Thus, there is room for improvement in several areas, in order to become an "exemplary territory" in energy efficiency and share of renewable energy sources.

2. Research materials and sources

It is clear that to achieve the above-mentioned energy-related objectives it is fundamental to gain knowledge of the status quo of EUSALP energy balances, energy strategies, targets, and expectations expressed by the different territories. To define the overall picture and to better understand peculiarities, the AG9 developed in 2017 an online energy survey. Results of this survey have been summarised into the "EUSALP Energy Survey Report 2017" (Bisello et al., 2017). Integrated by further desk research, they are the basis of this paper and have been used mainly to answer the first question. The second point has been addressed by investigating one fundamental international cooperation programme in the Alps: the Interreg Alpine Space programme. This programme is financed through the European Regional Development Fund (ERDF) as well as through national public and private co-funding of the Partner States. In the current programming period, 2014–2020, the programme is investing €139 million in projects through which key actors develop shared solutions for prevalent Alpine issues (www.alpine-space.eu). These projects have on average 85% EU co-financing rate.

3. Main findings

3.1 Energy strategies and planning instruments of the Alpine territories

In order to shed light on the current energy strategies within the EUSALP, data about existing energy transition visions and their implementation has been retrieved through the "EUSALP Energy Survey 2017". Data entered by the respondents has been checked and integrated by desk research when missing or incomplete. Aiming to draw a broader context of energy planning, national and European energy plans and strategies have been added to local energy transition planning instruments. The final list consists of 125 documents that can be classified as energy laws, programming documents, and planning operational instruments. Among them the broad majority addresses energy transition in general, 11 focus on the expansion of RES, three on energy efficiency and two on air emissions. Each local, national and supranational energy strategy and planning instrument has been then further characterized by its publication year and finally compared. Figure 2 depicts an overview of recent energy strategies and planning instruments developed within the EUSALP area, and compares local instruments to national ones, while Table 1 synthesizes the steps of development of the European energy strategy for the medium as well as the long term.

As predictable, the planning of energy transition in the European member states follows the adoption of the European energy strategies. In fact, Austria, Germany and Italy published their first energy strategies between 2010 and 2011. Moreover, even if Slovenia never succeeded in releasing the new National Energy program, which should replace the old one, it adopted manifold sectoral action plans in the last decade (Ministry of Infrastructure, 2010). Moreover, a new regulatory impulse is taking place, as Austria, Germany, and Italy published new energy plans very recently (2017-2018). Liechtenstein, even if not an EU member State, adopted its medium term energy strategy in 2012, and recently monitored the state of its implementation.

A similar trend also characterizes the energy strategies of the EUSALP territories belonging to EU-member states, except for France. In fact, they generally developed local energy transition programs and planning instruments after the entry into force of national regulation.

On the other hand, Switzerland shows an opposite trend: the majority of cantonal energy strategies are prior to the federal energy strategy, which sets energy transition objectives and principles to be reached by 2050. The Swiss federal energy strategy is characterized by the need for progressive withdrawal from nuclear energy production. Germany too has developed its energy strategy, which stresses the urgency to define a nuclear energy exit, following the dramatic events of Fukushima in 2011. Even if a few local energy strategies of Swiss cantons state the willingness of decreasing and ultimately stop electricity production from nuclear plants in the next future (e.g. Schaffhausen and Thurgau), the majority of cantons released their energy strategies before 2011, and have not renewed them more recently.

	Year	Strategic document / Initiative	Focus
European Union	2008	Covenant of Mayors	Climate urban target
	2010	Energy 2020. A strategy for competitive, sustainable and secure energy	Climate-energy targets
	2011	Energy Roadmap 2050	Climate-energy targets
	2014	2030 Energy Strategy	Climate-energy targets
	2015	Covenant of Mayors for Climate & Energy	Climate-energy urban targets
	2016	Clean Energy for all Europeans	Energy Measures

Table 1: Main strategic documents and Initiatives for the energy transition in the EU. Source: Eurac Research.

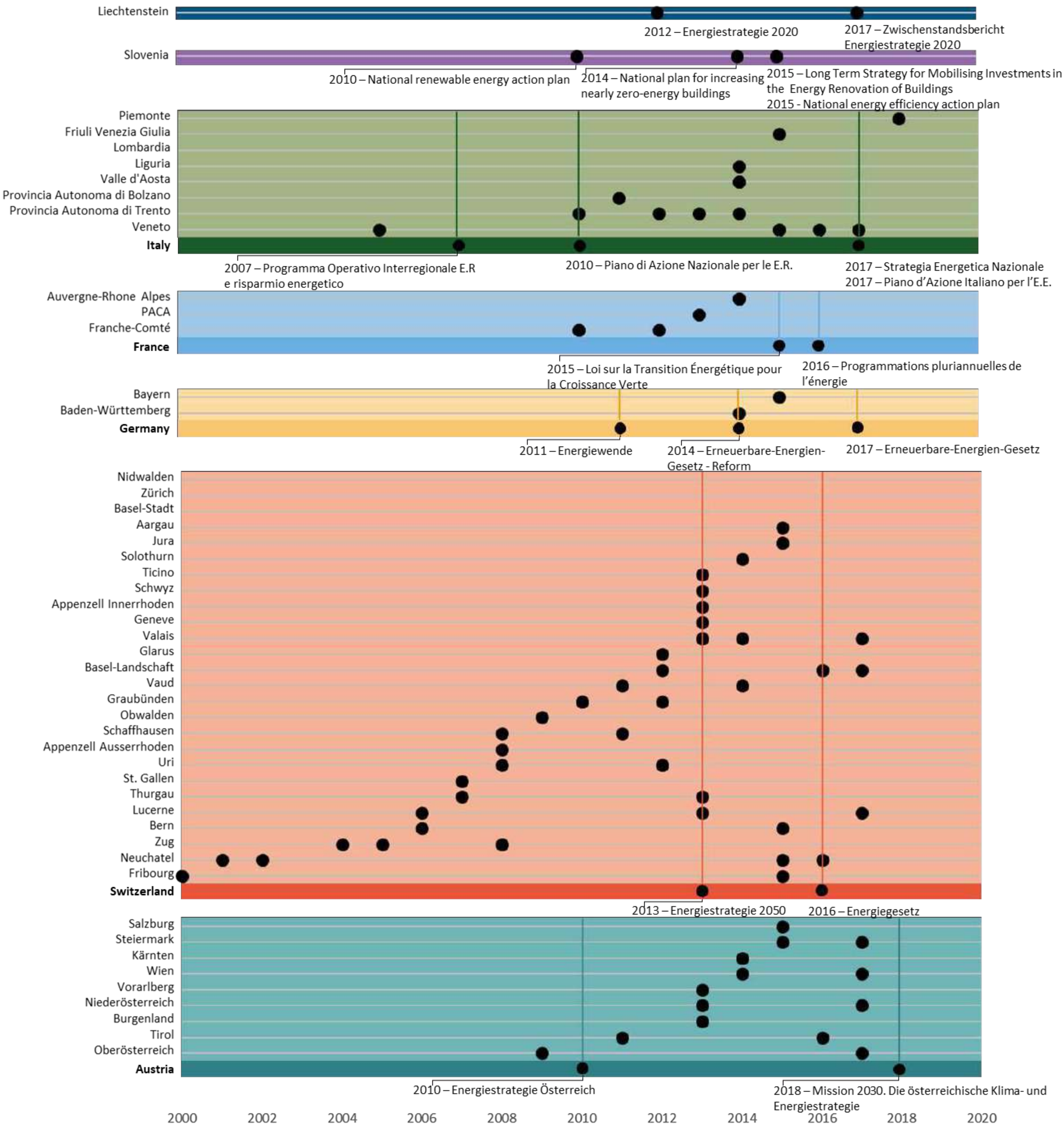

Figure 2: Energy strategies and planning instruments of EUSALP local territories and national states. Data source: EUSALP Energy Survey 2017 and Eurac Research elaborations.

3.2 EUSALP energy targets – increasing RES in the medium term

Increasing the share of RES in gross final energy consumption is one of the three fundamental objectives for climate and sustainable energy identified by the EU (European Commission, 2010). The other two concern the reduction of greenhouse gas emissions and the savings in primary energy consumption. Similarly, in their energy strategies, the EUSALP territories set the goals and commit themselves to reach them within a certain target year, defined in the medium or long term. Although the majority considers the 2020 as medium term target year, a few commit to reach them within the 2025 and some others the 2030. Here the medium term targets of share of RES have been considered; data about such goals has been retrieved via the "EUSALP Energy Survey 2017" and if missing it was integrated by further desk research. Switzerland has been treated as a whole due to generalized lack of data about the cantonal medium term targets of renewable energy penetration in the energy mix.

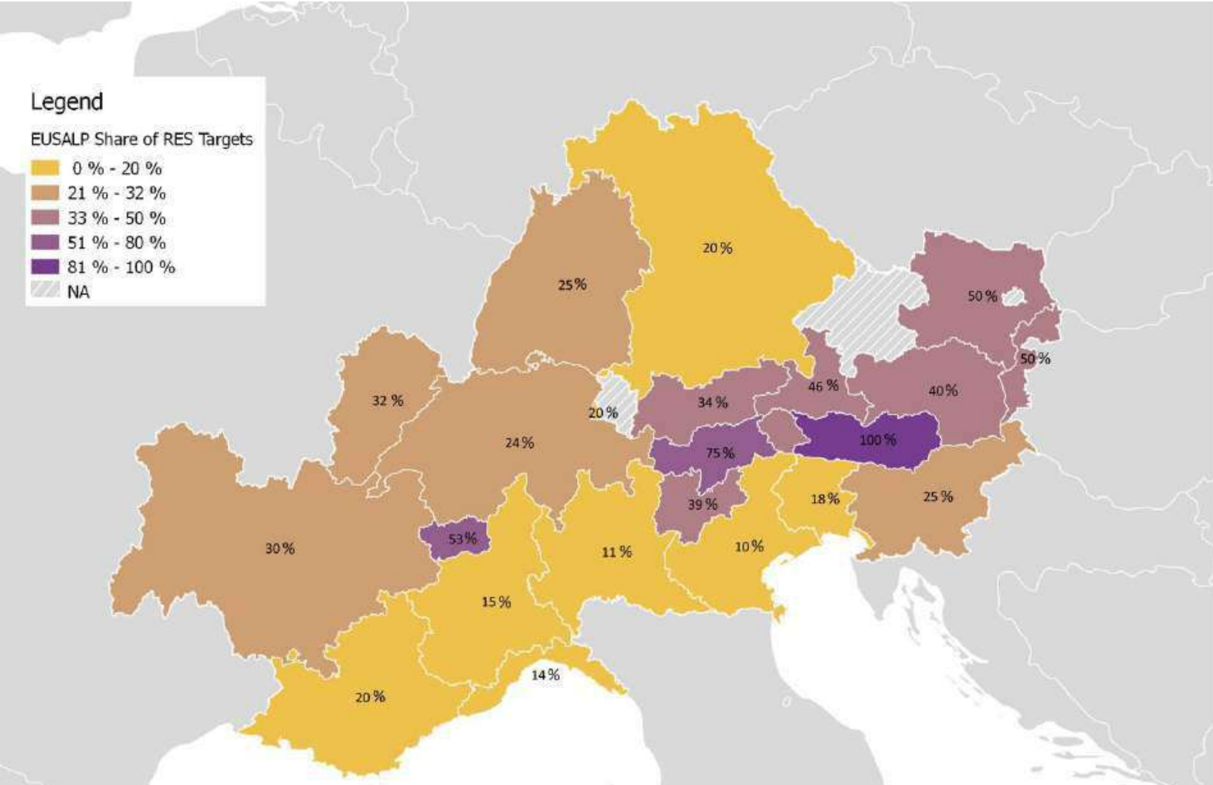

Figure 3: Share of RES in the medium term targets set by the EUSALP territories. Source: EUSALP Energy Survey 2017 and Eurac Research elaborations.

The spatial analysis of the data about the targets returns a heterogeneous picture of the EUSALP area: in general, more extended and industrialized territories show lower RES targets, while the core alpine and less densely inhabited regions seem to be more ambitious in setting their medium term targets, as figures in Table 2 demonstrate. In the specific, as Figure 3 shows, those EUSALP territories that are more peripheral set energy targets below the 20%, as well as Liechtenstein that, although not being an EU member state, appears aligned with the European energy targets. On the other hand, Slovenia committed to go slightly beyond the energy objectives set by the European Commission, as well as Switzerland, even if this latter is not a EU member state. The Austrian regions, at least those providing data, are more ambitious; in fact, they strive to cover up to the 50% of their energy consumption with RES. Two Italian core alpine provinces intend to perform even better in the medium term, namely South Tyrol and Valle d'Aosta. Finally, the Austrian region of Carinthia stands out, aiming to fulfill its energy transition by 2030.

	Population	% EUSALP	Surface	% EUSALP
Group 0% - 20%	39,883,432	50%	182,743	39%
Group 21% - 32%	30,082,001	38%	183,592	39%
Group 33% - 50%	4,948,321	6%	65,597	14%
Group 51% - 80%	646,816	1%	10,653	2%
Group 81% - 100%	557,047	1%	9,542	2%
NA	3,608,309	5%	15,017	3%

Table 2: Comparison of EUSALP territories grouped classes of share of RES targets in terms of population and surface (km2). Data source: EUROSTAT and Eurac Research elaborations.

3.3 Energy cooperation within neighbor territories in the Alps

Both the management bodies of EUSALP and Interreg Alpine Space (AS) programme foster synergy between the EUSALP AGs and the Interreg Alpine Space projects. AS projects directly contribute to the implementation of the macro regional strategy because the majority of territories eligible for funding are within its borders. As shown in Figure 4 the core Alpine area is also interested by the Alpine Convention, which is an international treaty between the Alpine Countries (Austria, France, Germany, Italy, Liechtenstein, Monaco, Slovenia and Switzerland) as well as the EU, for the sustainable development and protection of the Alps[ii].

Figure 4: Overlapping perimeters of EU Alpine Space Interreg programme (red), EUSALP macroregional strategy (blue) and Alpine Convention international treaty (green).

As Table 3 reports, currently there are ten approved projects in the period 2014-2020 under the priority axis "Low-Carbon Alpine Space": seven addressing the specific objective (1) to establish transnationally integrated low carbon policy instruments, and those remaining the specific objective (2) to increase options for low carbon mobility and transport[iii]. The overall budget allocated for cooperation projects under these topics touches €25 million and projects are working in close cooperation with various EUSALP AGs.

Project acronym	Map Key	Project name	AS Specific Objective	N° of Partners	EUSALP AGs	Project budget
CaSCo	1	Carbon Smart Communities	1	11	2 - 9	€ 2,291,187
CESBA Alps	2	CESBA Alpine Space – Sustainable territories	1	11	9	€ 2,818,739
GREENCYCLE	3	Introducing circular economy system to Alpine Space to achieve low-carbon targets	1	9	2 – 6 – 9	€ 1,946,271
GRETA	4	Near-surface Geothermal Resources in the Territory of the Alpine Space	1	12	9	€ 2,962,952
IMEAS	5	Integrated and Multi-level Energy models for the Alpine Space	1	12	9	€ 2,146,210
PEACE_Alps	6	Pooling Energy ACtion plans and Enhancing their implementation in the Alps	1	10	9	€ 2,148,879
THE4BEES	7	Transnational Holistic Ecosystem 4 Better Energy Efficiency through Social innovation	1	14	9	€ 2,900,412
AlpInnoCT	8	Alpine Innovation for Combined Transport	2	15	4	€ 3,088,272
ASTUS	9	Alpine Smart Transport and Urbanism Strategies	2	12	4	€ 2,395,951
e-MOTICON	10	e-MObility Transnational strategy for an Interoperable COmmunity and Networking in the Alpine Space	2	15	4 - 9	€ 2,085,556
						€ 24,784,430

Table 3: Co-funded AS projects under the "Low Carbon" priority axis in the period 2014-2020. Data source: Alpine Space project database and Eurac Research elaborations.

The overall number of involved legal entities is 93, lower than the algebraic sum of consortium members, because the majority of them only participates in one project, but a few are involved in multiple initiatives (partners are 36% public authorities and energy agencies, 38%R&D institutions, 13% NGOs, and 6% business entities and SMEs). The most active is in fact the French energy and environmental agency "Auvergne Rhone-Alpes Énergie Environnement", with seven running projects. Far behind are the Slovenian research institute "E-Zavod" and the Italian regions of "Piemonte" and "Lombardia" having four projects each one. Then come another Slovenian institution called "BSC, Business Support Centre, Kranj", the German NGO "Climate Alliance" and the "Liechtenstein Institute for Strategic Development", each with three projects. Seven entities are members of two project consortia.

Considering the amount of different entities, the most represented State is Italy (some 30% of the total partners are Italian), then comes Germany (22%). The two non-EU countries Swiss and Liechtenstein lie at the bottom of the chart, having respectively 5% and 2%. Remaining countries count 13% each. Italy is also the most frequent leader, coordinating four projects, while non-EU countries never appear in this role.

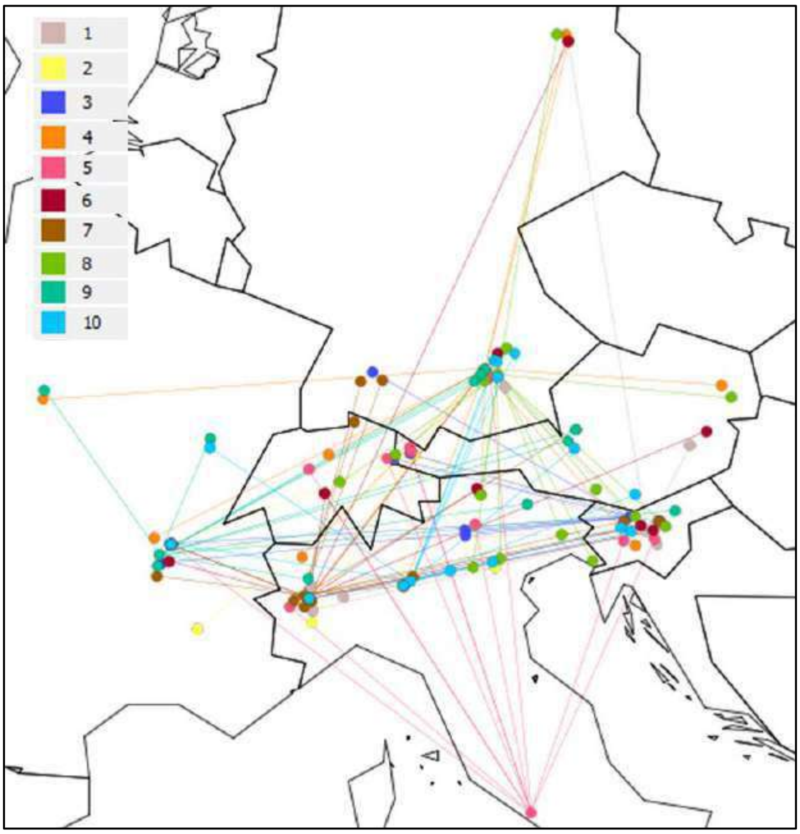

Figure 5: Network of relationships in energy related AS project.
Source: Eurac Research elaborations.

Thanks to the software Gephi (https://gephi.org/) it was possible looking more in details at the geographical distribution of partners and networks defined by projects (see Figure 5). The German state of Bavaria, Slovenia and the Italian region Veneto are the more active (each one 13-14%). Just by adding those coming from the French region Auvergne-Rhône-Alpes (8%) is covered almost half of current partners in the entire Alpine Space Programme (48%) related to low carbon objectives. At the opposite, near four fifth of Swiss cantons, half of Austrian states and one Italian region (Liguria) never provide consortium members. A few partners have the legal seat outside the EUSALP borders.

Partners from Bavaria, Slovenia and the Veneto region actively cooperates in seven out of ten project, forming the stronger territorial relationship in the EUSALP area, which involves only the eastern side, although among non-adjacent territories.

Coming back to the most active single legal entities and cross border international relationships, it comes out that “Auvergne Rhone-Alpes Énergie Environnement” often cooperates with research institute “E-Zavod” and the “Piemonte” region. Inter-regional cooperation within national borders is particularly evident in Italy between “Piemonte” and “Lombardia” regions that join three projects together.

4. Conclusions

The paper discusses the results of recent research on energy issues related to the Alpine Macro-Regional Strategy – EUSALP, and ongoing cross-border cooperation. EUSALP is promoting the idea of a unified and harmonized approach to the energy transition. Even if this aim is highly recommendable, the status quo is quite different for several reasons. Some of them relate to geographical, social and economic characteristics of the territories, while others to historical reasons and different national policies and strategies. Renewable energy targets widely differ in times and ambition, although the general aim is to increase the share of RES replacing fossil fuels or nuclear plants, and some clusters of territories sharing a similar effort in the energy transition can be identified. Further research should explore which features possibly explain such clustering. Once again, different strategies and context define various trajectories. Given that, much more effort is needed to combine them in a rational way and to find synergies. We suggest to repeat this analysis in the next future to monitor if local territories will follow national regulatory momentum. This will help us to answer in a more robust way the question "Is there a regulatory push from the supranational (EU and other transnational initiatives) to the national, and finally the local regulatory level, or are local territories pushed forward in the governance of energy transition by other drivers?". An effective planning and monitoring system for the strategies implementation that allow to harmonize the initiatives and track the progress made would be desirable, as well as assessing the co-benefits that coordinated energy transition strategies can deliver to the society, exceeding the avoided CO_2 emissions (Bisello et al., 2017)

Concerning the second point of our investigation, it results that cross-border regions in the EUSALP are already actively involved in several projects, aiming to share best practices, define guidelines and disseminate insights on specific energy technologies, certification tools and modeling approaches. Some "cooperation patterns" are recognizable, showing attitude of local entities (mainly public administration and NGOs) to interact with nearby and non-adjacent regions. The presence of business players and SMEs should be encouraged, to reinforce the quadruple helix concept (Carayannis and Campbell, 2010), enabling regional innovation ecosystems to properly growth, defining smart specialization strategies (Vettorato, 2017). On the other hand, still too many territorial entities are not involved in energy related Alpine Space projects. Moreover, joint projects aiming to design and implement a coordinated regional energy planning system are still missing. Further projects addressing cross-border energy planning and monitoring should be encouraged through EU funding programs, involving all the EUSALP territories sharing similar ambitions and eager to overcome recurrent problems. To harmonize targets and approaches a voluntary initiative similar to the well-known Covenant of Mayors (addressing the regional dimension in planning for adaptation and mitigation instead of the urban one) could be useful. Insights gained from EUSALP research are replicable in other cross-border regions that promote a sustainable and smart energy transition (e.g. the EU Macro-Regional Strategy on the Baltic Sea Region – EUSBSR, the EU Macro-Regional Strategy on the Danube Region – EUSDR, the EU Macro-Regional Strategy on the Adriatic and Ionian Region – EUSAIR).

5. Acknowledgment

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[i] For additional info on the EUSALP see: https://www.alpine-region.eu/
[ii] For additional info on the Alpine Convention see: http://www.alpconv.org
[iii] Other projects recently funded in April 2018 are not included in this study due to the lack of complete data.

Usquare.brussels a resilient planning approach

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ABSTRACT:

Brussels-Capital Region acquired former barracks with a remarkable heritage and located in the heart of the city. The purpose is to convert them in an international university resilient district by incorporating the principles of circular economy and sustainability at all stages of the project.

Ambitions: localizing global Agendas for climate-proof and resilient cities

Climate crises, scarcity of resources, urbanization, social dualisation: our societies and our environment are in movement. Planning must anticipate these fluxes. It is no longer possible to underutilize land, waste resources or demolish and rebuild buildings.

It is essential for local authorities to engage in the fight against climate change by adopting resilient planning approaches. The Usquare project propose to tackle this issue.

Programming: combining heritage, circular economy, sustainable development and knowledge

Brussels-Capital Region will set the vision for the site, finance and supervise its conversion. Europe will also co-financed the creation of an inter-university cluster for sustainable development (ERDF program 2014-2020)

Use of the buildings will be maximized to be converted into:

600 housing for international students,

200 affordable housing,

a residence for university researchers,

a student counter,

a fab-lab / incubator for innovative young entrepreneurs

an inter-university research cluster for sustainable development ,

an interpretation center presenting university research on sustainability,

neighborhood facilities,

a cultural center.

Moreover the merry-go-round will be converted into an educational food hall hosting a local and sustainable food market and craft-food activities.

New resilient planning approach: linking spatial planning and circular economy

Brussels-Capital Region has decided to develop a new resilient planning approach by linking two new regional tools:

Spatial planning tool called PAD (Plan d'Amenagement Director / Master Development Plan). The innovativeness of this tool is to combine regulatory components with strategic ones. It is also a flexible planning tool able to evolve with the time and accommodate new uses and needs of residents, inhabitants and universities.

Circular Economy tool called PREC (Plan Regional d'Economy Circulaire- Regional Plan for Circular Economy). This tool has already received two European awards for its innovativeness by combining sectoral actions with territorial ones in order to implement this new economic model.

Strategic components for sustainability:

The Master Development Plan (PAD) defines program of assignments, structuring of roads and public spaces, characteristics of constructions, heritage protection, mobility and parking.

It intends to use this heritage as a factor of identity. The integration of the site in the city will be done via the planning of access from outside and two major public spaces with a social and environmental vocation (rainwater management, temperature regulation, biodiversity and vegetation mesh).

Regulatory components for sustainability:

The PAD requires reconversion to ambitious energy consumption objectives, local water management, and energy or agricultural production of roofs. It drastically restricts the presence of motorized vehicles and encourages active modes (maximized bicycle parkings, internal and external cycling routes).

Circular economy and sustainability approach

The PAD carries in its strategic part the main objectives of sustainability: circular economy of the building sites and the activities to be established, energy performance, integration of the publics, evolution of the buildings and modularity of the public space.

Moreover a project of transitional occupation of the site until all permits are delivered is being studied. Amongst other purposes, it would allow universities to make research on the circular economy model that could be used for the reconversion of the site itself

Conclusion:

We do believe the next ISOCARP Congress will be an appropriate opportunity to present our project and exchange with the participant on how spatial planning could help to fight against climate change.

Study on the Framework of Water Environment Layer in Urban Layer System

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Abstract
Many city issues have emerged during city development and environmental changes, which mostly are due to the weak organization among city elements, therefore affecting the city physical spatial morphology. Urban design therefore should comb the relationship among city elements. The contemporary urban design has additionally had the research in elements in recessive ecology, culture and civilization while the traditional urban design focuses on the external elements of city physical space. The era of big data, meanwhile, provides a large amount of data information about them. Urban design, as a kind of graphic language, should combine the graphic information with data information. In this paper, the concept of urban layer is proposed to determine its characteristics and content with an attempt to comb and integrate city elements using urban layer system. And the superposition of urban layers is also applied to analyze how urban elements affect city spatial morphology .
The key of this paper lies in the urban water environment layer in urban layer system with the structure of urban water environment layer. Based on the comb and summary of the existing urban design theories related to urban geography and water, the relevant elements and urban maps, which affect urban design, are selected, extracted and integrated to establish the framework of urban water environment layer and its content and elements.
Beijing, as the capital of China, has drawn worldwide attention in its construction. In this paper, environment layer in urban layer system is initially applied in general urban design projects of Beijing waterfront. The author has tried to guide urban spatial morphology and urban design project of Beijing waterfront through the analysis, comb, superposition and research of waters and waterfront water environment within Beijing downtown area.

Keyword
urban design; urban layer; urban water environment layer; Beijing City; waterfront urban design

1. Introduction

1.1 The focused research of urban connotation in contemporary urban design

The traditional urban design theory focuses on studying the urban spatial form. However, contemporary urban design is not only a study on the dominant urban physical space, and also studies the recessive urban ecological environment, urban cultural connotation and human needs. So that, it can make urban design more comprehensive.
City internal recessive attributes directly or indirectly affect the external urban spatial morphology. Urban design therefore should comprehensively consider the elements in each level, which affects urban development, with the analysis, research and integration. urban layer research framework of urban design is established to clearly comb each level, elements and their inner relationship ,which affect urban design.

1.2 Problems of relationship organization among urban elements

As city develops and environment changes, many city issues and contradictions have appeared. For instance, city construction has led to water depletion and urban ecological environment deterioration has caused microclimate issues. Many city issues are mostly due to the weak organization among city elements, therefore affecting the city physical spatial morphology. Urban design therefore should comb the relationship among city elements. Urban layer system framework is therefore established to analyze the specific content of elements, affecting urban design, and the dominant and recessive relationship between them, as well as the influence on urban physical space from urban elements, single superposition or superposition of multiple layers.

1.3 Combination of graphic and data urban design

As a graphic language, urban design is expressed and controlled through different types levels of diagrams. Because of the era of big data, many scholars from different areas have studied various urban maps by using data and urban geographic map, such as, urban climate map, urban block map, citizen ideology map, urban noise map, and so on. urban layer system is established to integrate all urban data, maps, elements, and layers so that data, information and graphic language can be more used systematically in urban design.

2. Urban design and urban layer system

2.1 urban layer and urban layer system

Urban layer refers to the elements and relationship among them in the city, such as physical space, ecology, economy and humanity. It includes the visual dominant information and hidden information of each urban element, a dynamic information carrier. Each urban layer is composed by certain elements. These layers constitute the entire urban layer system through the superposition. Each layer in layer system is a certain relatively independent variable, which may be relevant to other variables and can be shown in layer groups according to different requirements.

Urban layer system covers all kinds of elements which affect urban spatial morphology, which is controlled by each element of the city through the superposition of layers. In urban design, it's can be found how single urban layer or multiple urban layers affect urban physical space. The influence of urban layers on urban design can be single or overlapped.

2.2 Urban layer and urban subject map

Urban subject map is a graphic language which can perfectly display one or several urban natural or social elements, an map with specific content, such as urban functional zoning map and map of urban underground pipes. In urban design, urban subject map is a visualized urban element or geographical information carrier of a group elements, which express the instantaneous information, static information and visible relationship of this element or groups. It is the geographical identification of this element or groups in urban layer. In additional to the visible relationship from the urban subject map, urban layer also includes the hidden recessive relationship within or among elements, indicating the collection of urban subject map and internal relationship.

Urban subject map, as a collection of one or a group of elements of urban layer, is the graphic expression of its information relationship, which is usually show in urban geographical map for the convenient of analysis, superposition of layers and guidance for urban design project. Urban subject map may be specific only for one certain urban layers, not all urban layers.

2.3 Urban layer system and urban subject atlas

Urban subject atlas, as a kind of information evaluation tool, integrates geographical distribution, analysis and planning recommendation of one urban subject element. The conditions and relevant issues of one urban element are shown on two dimensional map, visualizing urban element information. Urban planners can easily obtain relevant urban element information through urban subject atlas and make right evaluation together with city land use and city development trend. Ultimately urban subject atlas could provide guidance for the practice of urban planning.

Comparing with the existing urban subject maps, urban subject atlas also include the analyzed map and planning recommendation map of the elements. Such as, the existing urban climate atlas contains urban maps of elements related to urban climate, urban climate analysis map, urban climate planning recommendation map. All maps are drawn on the basis of urban geographical maps.

Urban layer system include several urban subject atlas as well as the recessive relationship and dynamic changes among all the urban subject atlas. It's more complex in dimensions and relationships than two dimensional urban subject atlas. Figure 1 shows the relationship among urban elements, urban subject map, urban subject atlas, urban layer and urban layer system.

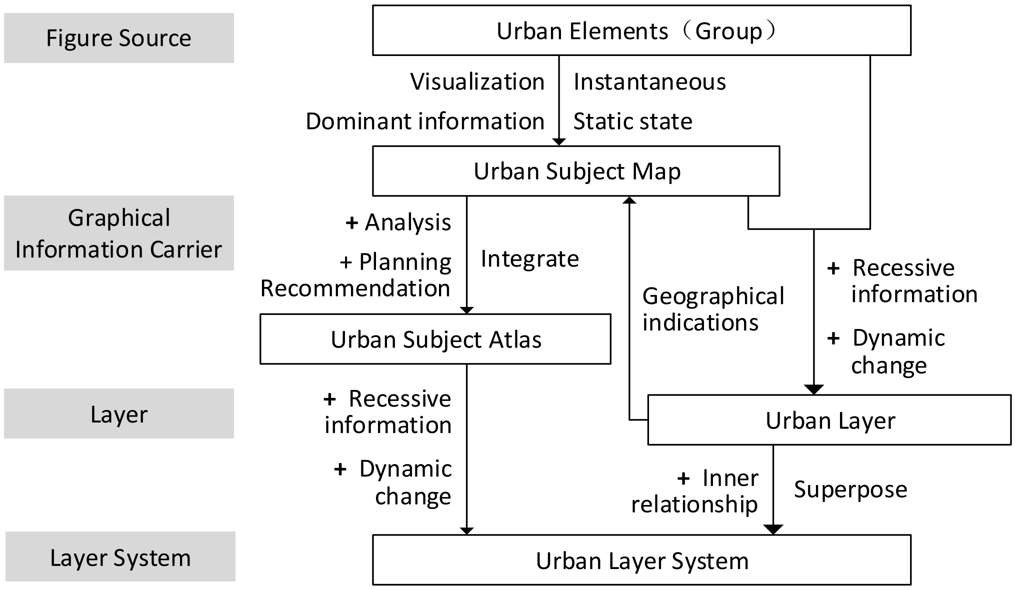

Figure 1: The relationship among urban elements, urban subject map, urban subject atlas, urban layer and urban layer system

Figure sources: drawn by author.

3. Multiple dimensional urban layer system

Most of the urban designs in China are vertically spatial planning and design. The temporal dimension usually takes into account of the construction order, namely phase planning of the future development and construction. But urban design should include more dimensions and contents. Urban layer system firstly should include the visible vertical space, which belongs to horizontal dimension and longitudinal dimension. Additionally, some recessive dimension and content should also be concluded. In temporal dimension, urban layer also should consists of the historical evolution rules except for the future development order. Urban space affords citizen life and spiritual demands, which also should include spatial symbolic dimension. So that, urban layer system should be a four-dimensional system. It contains horizontal dimension and longitudinal dimension, which are dominant. And also contains recessive temporal dimension and symbolic dimension, which are recessive (Figure 2).

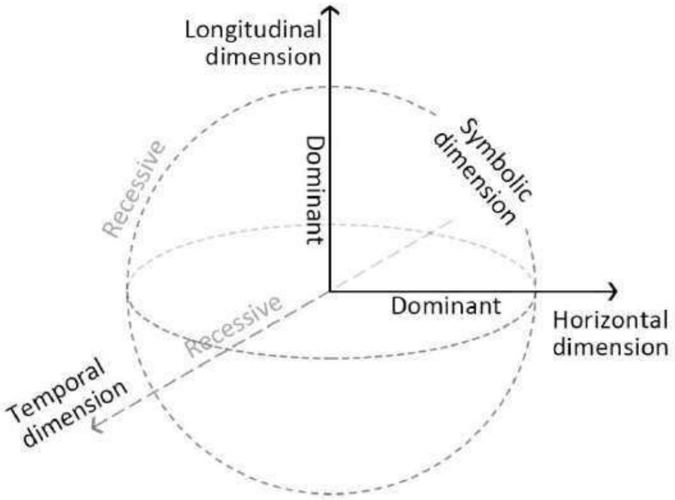

Figure 2: Four-dimensional analysis of urban layer system

Figure sources: drawn by author.

3.1 Horizontal dimension

Urban layer system should corresponds to all kinds of practical urban design projects. In China, urban design is generally divided into 4 levels: comprehensive urban design, district urban design, plot urban design and subject urban design. Urban layer system should consider the macro level, meso level and micro level, so that it can be able to cover all different scales of urban design projects (Figure 3). For different scales of urban design, urban layers and elements are different. Each level of urban layer and elements should have a certain degree of independence, so that they can adapt to the changes of urban design at this level. At the same time, in addition to considering the content of each level separately, it is necessary to link different scales. The layers of each level contain the elements and layers of the next scale, and the layer itself is integrated into a higher level of urban layer system as an element or layer. Urban layer system must be suitable for all types of urban design projects, such as, urban renewal, new district construction, subject urban design and comprehensive urban design, and so on. Every type of urban design project should has targeted selection of urban layers and elements, and they should be selected based on system relationships.

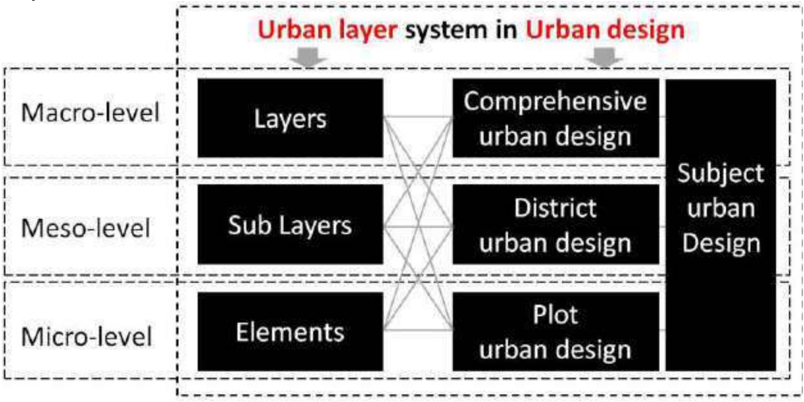

Figure 3: The relationship between urban layer and urban design levels in China
Figure sources: drawn by author.

3.2 Longitudinal dimension

Natural geographical environment of the city is the key aspect to affect urban design, therefore urban layer should consider each longitudinal geosphere, which affects urban design. Within geosphere, earth's crust is mostly close to urban design, which affects urban design through geology, geomorphology, topography, underground resources and geological hazards. Outside geosphere, the close elements include hydrosphere, biosphere and atmosphere (Figure 4). urban layer should consider the relationship between each longitudinal geosphere and urban spatial morphology. In urban layer, hydrosphere should focus on water environment. Biosphere affects urban design through different biological activities. It's emphasized that people's activities are also considered in biosphere in urban layer. The atmosphere should pays attention to the climate conditions in urban layer.

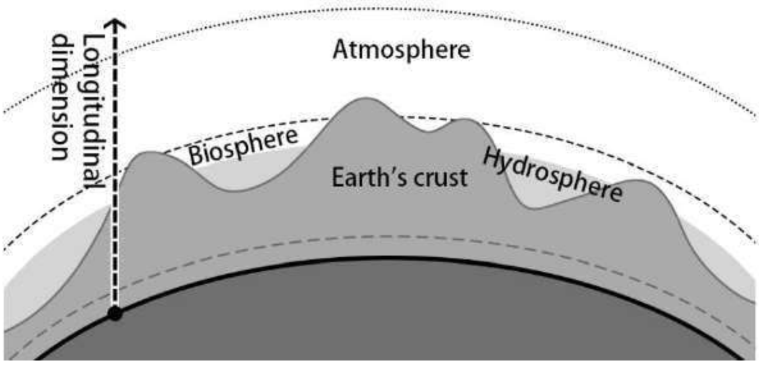

Figure 4: The relationship between the longitudinal dimension of urban layer and geosphere
Figure sources: drawn by author.

3.3 Temporal dimension
City develops gradually and urban layer should be dynamic, which is significantly different from other graphic language of urban design. Without a review to the past, it is impossible to recognize the future. Therefore urban layer should corresponds to the time changes as much as possible. Based on city history, the development rules of the city is combed and analyzed to find out the urban elements and layers with maximized influence on urban physical space as well as determine the dynamic elements. The relationship between single urban layer or element and time changes is discussed. Within several related layers, the changing trend of each layer and changes between layers are also discussed as time changes.
3.4 Symbolic dimension
Urban layer should also consider symbolic dimension besides the common urban physical space, buildings, ecological environment, infrastructure and other entity dimension. The essence of the layer is to express the symbolic information more conveniently through the signs and graphic information. Urban symbolic dimension mainly include sites, citizen's activities and their psychological assessment. Site doesn't develops through city while the city grows up through the site. Site, as meaning space of a city, constitutes most of external space with urban network. Urban layer system physically therefore requires to consider the physical relationship and symbolic connotation of urban sites. Urban design work should include the participants of all the city construction activities beyond the professionals and management staff. Urban design, based on urban geographical images, could express citizen' activities and their psychological assessment more simply, which is convenient to make suggestions to urban design.

4. Establishment of research framework for urban water environment layer
4.1 Idea to build the framework of urban water environment layer
From ancient to modern times, city construction and water are mutually influenced and constrained. Along the timeline of city construction, water is mutually coupled to city siting, development, spatial morphology and function. Urban water environment layer is thus gradually emerged and continuously upgrading as city develops. In urban design, urban water environment layer should be constructed based on the relationship between city and water from ancient to modern times during the city construction period (Figure 5). This paper will starts from city siting, construction and citizen's use and refines corresponding elements. The logic relationship of urban design is applied to integrate urban water environment layers in each period. Beijing waterfront space is taken as an example to further explain urban water environment layer.

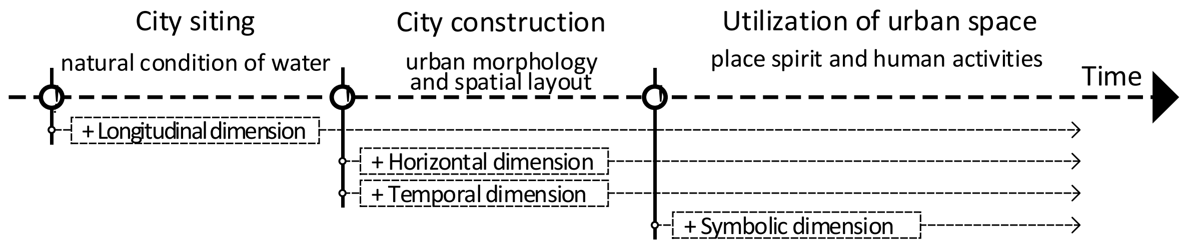

Figure 5: The relationship between urban water layer development and time
Figure sources: drawn by author.

4.2 Water environment layer during city siting period
Water source was undoubtedly the initial consideration when the ancestors decided where to live. Ancient cities almost were built along the water system to use the water conveniently. Water system functions as water source, materials' transportation, farmland irrigation and military defence while also bringing flood disaster and deposition of rivers and lakes. As said in a prose, "Guanzi Chengma", the relationship between water environment and city location is narrated. The capital of a country must be on top of mountain instead of at the foot of it. When living far away from the hills on the high terrain, there is sufficient water and when living far away from the water on the low terrain, there is no need to construct dykes. People

should take advantage of the existing environment and nature, without having to stick to the rules, to further create their own roads. Since humankind's settlement modes and location are related to water source, most of the ancient cities emerged from the water. Water condition will be considered for city siting, which promotes the longitudinal dimension in urban layer (Table 1).

Sphere	**Urban water environment layer**	**Urban design elements**
Earth's crust	Geological conditions	Flood, deposition, freeze and thaw, geological condition for suitable construction
	Terrain and landform	Embankment slope, height, block undulations
Biosphere	Flora and fauna	Vegetation, animals
	People's activities	Water and activities
hydrosphere	Underground water	Location and source of underground water
	Surface water	Water source site, underground basin, flowing direction and water yield
Atmosphere	Water and climate	Temperature, humidity and precipitation

Table 1: Urban water environment layer during the period of city siting
Table sources: drawn by author.

The earliest site for Beijing is Xi, which is the capital of Yan Country (337-370) during the Warring States period. The siting of Beijing City was located on the northwest of the Great Plains of North China, surrounding by mountains on three sides. It's Chexiang River to north and Leishui River to the south, forming a small plains adjacent to the water. Gaoliang River also flowed through the city. This siting mode just accords with the of one water with three mountains in ancient Chinese Fengshui (Figure 6). From the climate environment, Beijing city is one of the areas with most precipitation in North China also with suitable temperature and humidity. In sight of water environment, the underground water reserve of Beijing City is abundant . Water was accessible for digging wells, convenient. The surface water originated from the nearby Yongding River and more distant Chaobai River. All these have affected urban design elements and water environment layer of Beijing City siting.

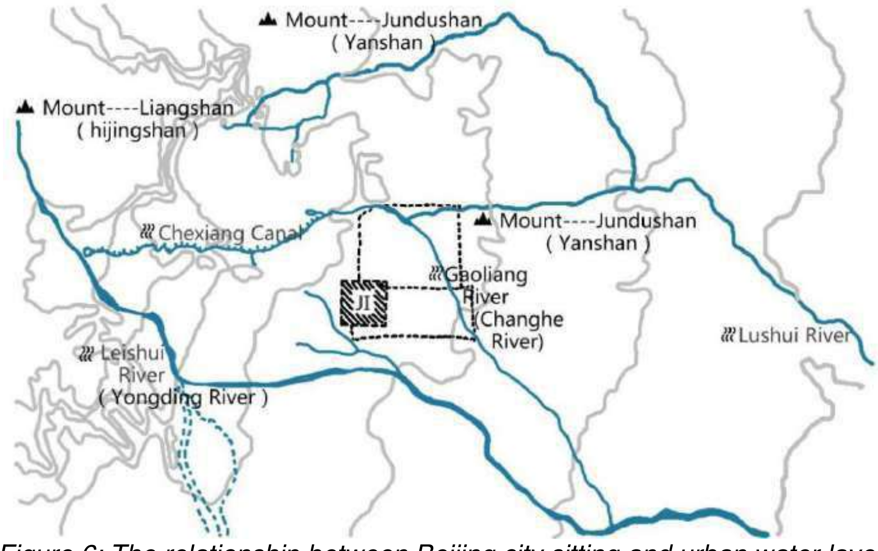

Figure 6: The relationship between Beijing city sitting and urban water layer
Figure sources: drawn by author.

4.3 Water environment layer during city construction period

Comparing with the city siting period, urban water environment has more influence on urban space during the city construction, during which urban water environment layers are mostly related to urban space. In early period, namely the construction process after siting, the influence on urban design from water environment are mainly shown in following aspects. The overall urban pattern is affected from the location of water source, the basin, flowing direction and morphology of the surface water at a macro level. Since urban waters in

different areas function distinctively in the city, the function and morphology layout of urban space surrounding the waters are relatively different as well on the meso level. The morphology pattern of waters and shoreline have affection o the spatial mode and blocks' structure within a certain distance from the waters. Therefore in the urban design of this period, horizontal dimensional urban water environment layers are added.
After city construction, city requirements continuously changes as time proceeds. City will be faced rounds of planning and design and urban renovation. During this long period of urban development, urban water environment will be endowed with corresponding time meaning and historical connotation, namely temporal dimension of urban layer. Therefore urban water system evolution layers and other water environment layers are included in urban design (Table 2).

Dimension	Urban water environment layers	Urban design elements
Horizontal dimension	General urban design The overall urban water pattern	Ecological security pattern of urban water environment , urban surface water basin, urban groundwater distribution, urban water function
	Zoning urban design level Waters and urban space	Water and urban space layout, water and urban ecological landscape space , water and sight
	Plot urban design level Waters and spatial structure	Block's pattern, waterfront space, shoreline and skyline surrounding water
Temporal dimension	Urban water evolution	Urban water function evolution, groundwater distribution evolution, underground water distribution evolution

Table 2: Urban water environment layers during city construction period
Table sources: drawn by author.

Jin Dynasty (1115-1234) moved the capital to now Beijing City from Chang'an City, which is the capital during Tang Dynasty, becoming Jinzhongdu. Starting from Jin Dynasty (618-907), Beijing City began its city construction. During Jin Dynasty, waters in Beijing City functioned as water supply, flood transportation and flood discharge. The water system pattern was set up for Yongding River and Gaoliang River. With the subsequent construction during each periods, the whole urban water pattern was relatively solid during Ming (1368-1644) and Qing Dynasty (1636-1912) for Beijing City, similar to the that of the current Beijing City.
During city construction, Beijing's waterways also have had certain influence on the whole spatial layout and blocks' spatial structure. The most characteristic of planning of imperial palace is that the water surface was taken as the center to determine urban pattern. The following urban planning for Ming and Qing Dynasty also continued this concept that water is taken to determine the city. Therefore Beijing' central axis and natural waters were complemented during Yuan (1271-1368), Ming (1368-1644) and Qing Dynasty (1636-1912), indicating the integration between urban planning and natural water as well as the urban layout with city adapting to the topography (Figure 7).

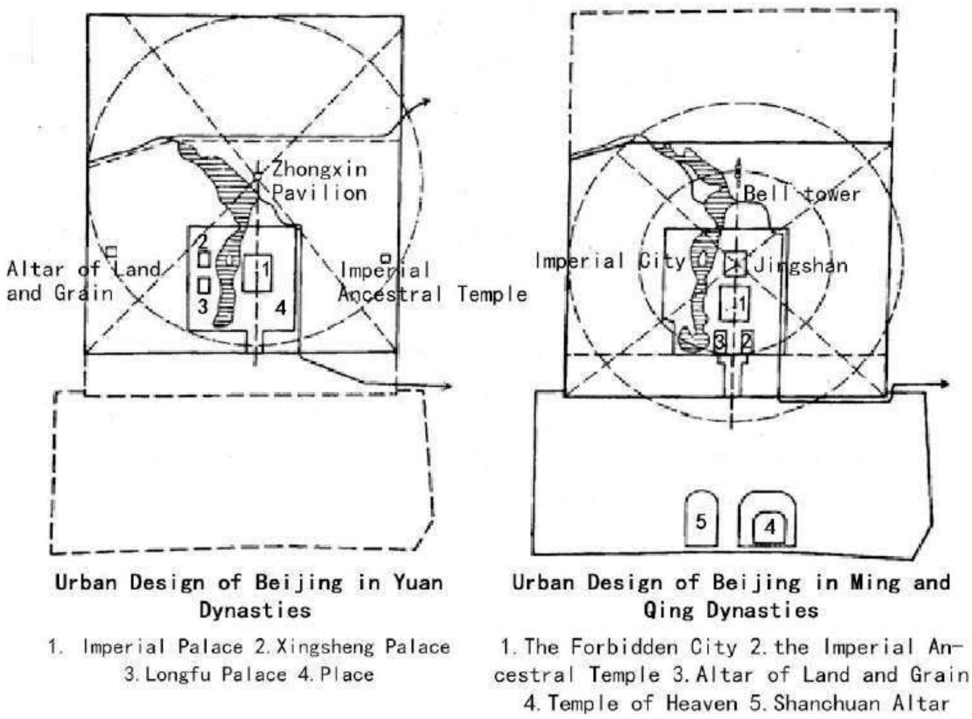

Figure 7: The relationship between the overall spatial layout of Beijing and the water in the Yuan Dynasty and the Ming(1368-1644) and Qing Dynasty (1636-1912)
Figure sources: drawn by author.

The blocks' layout of Beijing City is mostly rectangular in the north-south direction. But to in accordance with shoreline and topography, there are many inclined street in waterfront areas. It's can been the influence of water on urban spatial layout during city construction period (Figure 8). urban water environmental layers for Beijing City have taken urban layout and spatial structure into account.

Figure 8: The inclined street of Shichahai area in Qing Dynasty (1636-1912)
Figure sources: drawn by author.

4.4 Water environment layer during utilization of urban space

After city construction completion, urban space begins to be used by citizens. people and urban water environment interact through citizens' a series of activities in urban water and waterfront space. Then citizen's utilization has endowed urban water environment and its surrounding space with certain meaning of the place. Urban design begins to think out human activities and the spirit of the place in urban water environment. Urban water environmental layer begins to form the symbolic dimension. From the point of human activities, the urban water environmental layer should include urban design elements, such as waterfront activities, activities' facilities and space, service radius of activity space, and so on. The place spirit includes urban design elements, such as urban cultural connotation, historical significance, neighborhood relationship and so on (Table 3).

Urban water environment layer	**Urban design elements**
Human activities	Waterfront activities, activity facilities and space, service radius of activity space
Place spirit	Urban cultural connotation, historical significance, neighborhood relationship

Table 3: Urban water environment layer during utilization of urban space
Table sources: drawn by author.

The initial functions of Beijing's waters were irrigation, water supply and shipping with less activities between people and water. People's activities began to increase after the solid water pattern during Ming (1368-1644) and Qing Dynasty (1636-1912). From the Republic of China, citizens would use frozen rivers to access and make outdoor recreation. As Beijing's waterfront transformation, waterfront space has begun to have the spirit of place with increasing citizen' activities, such as fishing, running and visiting. The current waterfront areas of Beijing can afford the functions of urban cultural connotation, historical significance and neighborhood relationship (Figure 9).

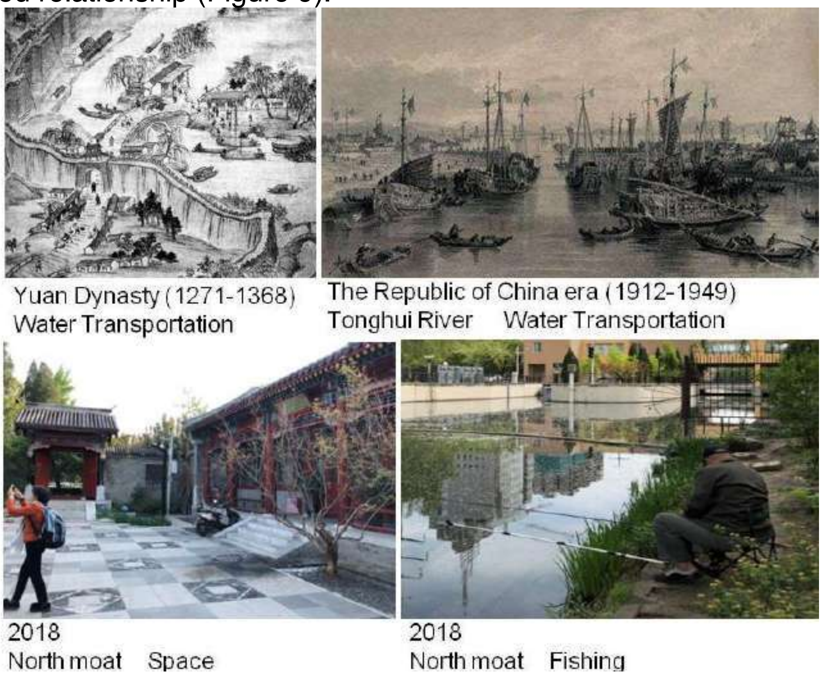

Figure 9: The use of Beijing waterfront in different periods
Figure sources: shoot by author.

5. Conclusion

In this paper, urban layer system is proposed to be set up in urban design, following by the concept interpretation of urban layer, urban layer system, the existing urban subject map, urban subject atlas and others. Meanwhile, the concept of urban layer is explored out from four dimensions: horizontal dimension, longitudinal dimension, temporal dimension and symbolic dimension. Ultimately, the author has attempted to establish the framework of urban water environment layer and Beijing waterfront urban design project is taken as an example to further illustrate the application of urban layer system and water environment layer in urban design from the practice perspective.

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Green Warsaw – the future of green vegetation

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1. Green vegetation on the buildings and its impact on the city

Living in a big, well developed city may be fascinating, but may also lead to a lot of health issues as well as other uncomfortable consequences for the life of its inhabitants.

The city, exposed to a quick, high level development in a very short time is facing problems of Modern civilization, causing around 3000 people dying untimely in Warsaw per year. Trying to solve the problem of the urban heat islands and air pollution taking as example the city of Warsaw I came up with a solution available for new developed buildings as well as a solution easily applicable for already existing buildings. Although green roofs and vertical gardens are artificially created by humans, they can be considered as patches and corridors necessary to achieve landscape continuity in heavily urbanized areas. Vegetation can be used to mask fragments or entire buildings for better correspondence with the surrounding landscape[1]. The research has been focused on 3 main problems in the modern city: How to reduce stress of habitants; How to reduce air pollution in the city; How to solve the problem of urban heat islands.

1.1 How to reduce stress of habitants

Reducing stress of habitants can be achieved by making space not feel overcrowded. Crowding - not density - is the reason of urban stress. With the proper urban planning the space can be designed in such manner that even the most dense areas are not going to feel overcrowded and not being a cause of stress for its inhabitants. Open spaces and park systems applied into the dense area can strongly minimize the stress and raise the livability level. Additionally, green cities equal good health: incite people to practice sport, increasing the possibilities to be close to nature, keep calm, restore the body, mind and soul; incite people to have social interactions. The research proves that green eliminates stress and high level of aggression, soothing the senses[2]. Emotional balance affects employee performance, which is why increasingly green roofs and living walls are used in buildings in which people work.

High density spaces can still remain dense, with the green elements designed on the pieces of architecture, which are not evident and very often forgotten. Top roofs, walls, balconies or terraces should be effectively used as green areas which are able to fulfill at least some of the functions the traditional gardens has.

Figure 1: Overlay on green balconies visualization

Overlay on green balconies have the advantage on green roofs and green walls, that does not necessarily has to be expensive. As an element of a private apartment is extremely easy to implement by independent private customer as much as the building developer. It interacts with the closest environment of the habitant, changing the view but also the air quality and temperature in the apartment. It does make the owner of the balcony feel responsible for his own prosperity and allow him to improve the life quality without necessary contracts, agreements, respecting building law and a structure requirement, which are very often a problem to implement a green walls or green roofs on already existing buildings.

1.2 How to reduce air pollution in the city

Air pollution is an environmental and social issue and, at the same time, it is a complex problem posing multiple challenges in terms of management and mitigation of harmful pollutants. Air pollutants are emitted from anthropogenic and natural sources; they may be either emitted directly (primary pollutants) or formed in the atmosphere (as secondary pollutants). They have a number of impacts on health, ecosystems, the built environment and the climate; they may be transported or formed over long distances; and they may affect large areas. Effective action to reduce the impacts of air pollution requires a good understanding of its causes, how pollutants are transported and transformed in the atmosphere, and how they affect humans, ecosystems, the climate, and subsequently society and the economy[3].

As we can read in the report written by the European Environment Agency (EEA), the air quality in Poland is not very satisfying. Many stations, also in Warsaw are reporting concentration of PM10 and PM2.5 above the EU annual limit value. That means that most of the habitants in big cities are very often exposed to pollutants in and around their homes, which may have very bad effect on their health.

Poland belongs to the countries with the most polluted air. In Europe every year, 45,000 Poles die prematurely due to air pollution, as carcinogenic and mutagenic substances enter the air. Breathing air contaminated with sulfur compounds, dust, benzo (a) pyrene and other harmful substances causes deadly diseases: lung cancer, chronic obstructive pulmonary disease and asthma. Health costs resulting from air pollution estimated for only city of Warsaw is from 6 billion - 18 billion PLN annually.

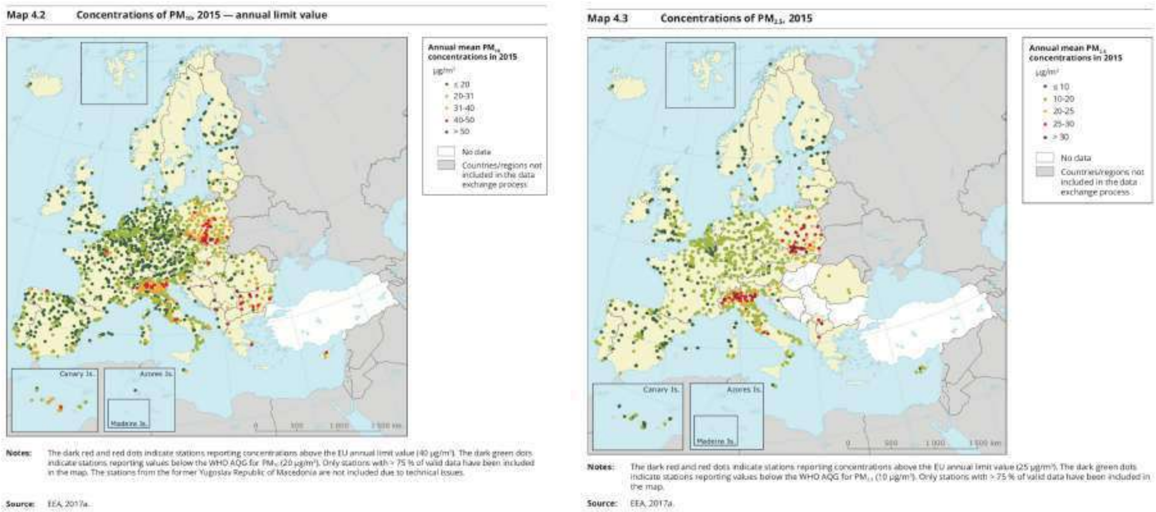

Figure 2: Concentration of PM10 and PM2.5 in Europe[3]

Green areas are not only useful as a space which brings people closer to the nature. It is also a place with plants. And those exact plants may be the solution for the air pollution. The research states that plant leaves as well as certain microbes are able to absorb air pollutants or transform them in less or nontoxic substances.

The average tree produces oxygen of an estimated value of over 30,000 dollars during the 50 years. Depending on the age and species of the tree, these benefits are different - for egzample 60-year-old pine can produce enough oxygen for 3 people, and 100-year-old beech can produce enough oxygen even for 10 people. The work of such a single tree is compared to the work of even 4-5 large air conditioners for 20 hours a day. Therefore, trees can be considered as friends of our wallets - they allow to save up to 30% per year on air conditioning, while in winter they can reduce heating costs by 20-30%[2].

Green infrastructure can directly influence air quality in three main ways: Increase in deposition of pollutants; Altering the wind flow; Emitting biogenic volatile compounds and pollen. Every one of these ways can influence air quality on different scales. The first and the third influence the air quality on a city scale, while the second influences the air quality on a local scale. In addition, there are also indirect side effects.

Studies assume that the deposition of a pollutant depends on the deposition velocity, the well mixed height of the pollutant and the concentration of the pollutant. The deposition velocity of green is in general higher than that of other urban surfaces due to the metabolic uptake by plants, the “stickiness” of the leaf surface, the large surface area of green, and the aerodynamic properties of green. The higher the deposition velocity, the lower the concentration of the pollutant will be and the more deposition.[4]

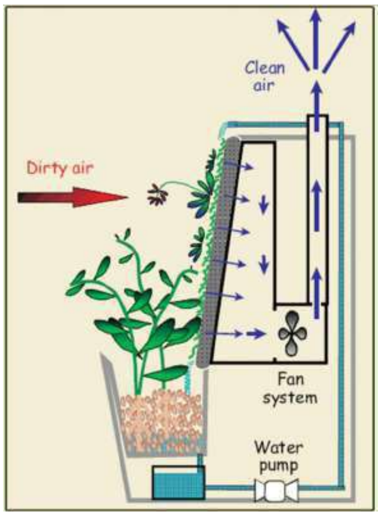

Figure 3: Scheme of cleaning the air by green walls

During past years several studies have been done to understand the impact of plants on the quality of the air. Two different consequences emerged: Phytoremediation and Biofiltration. Phytoremediation can be defined as the use of plants to remove pollutants from the air, water and soil. There are various techniques to do this process. Phytoextraction: the use of plants to clean up pollutants via accumulation in harvestable tissues; phyto(rhizo)filtration: the use of plants in hydroponic set-up for filtering polluted water; phytostabilisation: the use of plants to stabilise pollutants in soil by preventing erosion, leaching, or runoff, or by converting pollutants to less bioavailable forms; phytodegradation: the breakdown of pollutants by plant enzymes, usually inside tissues; rhizodegradation: the degradation of pollutants in the rhizosphere due to microbial activity and phytovolatilisation: the release of pollutants by plants in volatile form.
Biofiltration is defined as the process of drawing air into an organic material, such as soil or plants and removing in that way the gases.[5]

1.3 How to solve the problem of urban heat islands

The Urban Heat Island effect describes the tendency of urban areas to experience higher outdoor air temperature levels compared to their contiguous rural periphery. This phenomenon is mainly attributed to the special characteristics of the urban landscape, including building density, size and orientation, open space configuration, and the use of heat absorbing construction materials, irrespective of global warming. The design of urban landscapes and buildings, including intensive development leading to massive loss of vegetation and pervious surface cover, might increase the intensity of the Urban Heat Islands effect and thus compromise the thermal comfort of people at street level, exacerbate discomfort caused by the overheating of indoor spaces, and increase energy consumption resulting from cooling energy demand in buildings.[6]

Urban Heat Islands are present mostly in metropolitan areas, and are created by energy from people, cars, buses, and trains and other places which have lots of activity and lots of people. It is also connected to the crowding - density problem. Skyscrapers and other high density constructions tends to create a lot of heat which bypasses insulations and having nowhere else to go, ends up between the buildings creating a urban heat island. Again plants are the solution: they help to cool things down. Plants absorb carbon dioxide, a leading pollutant. They also produce a cooling effect on the environment thanks to the process of evapotranspiration: heat energy is lost as water evaporates and transpires from vegetation.

Thanks to the greenery we can lower the temperature in the closest area as a result of the evapotranspiration process in the summer even 2-11oC[7]. In winter, the construction of the vertical garden protects the façade against the impact of wind power, reducing energy consumption for heating. The research shows that green elements installed on the facades of the buildings improves also the microclimate inside the rooms. In rooms with green walls, the temperature is reduced by an average of 5oC, which significantly reduces the energy consumption for cooling by means of air conditioning[8]. Analysis of energy consumption in buildings with green roofs and walls indicates that this type of development allows reducing the cooling load costs in the range of 17-79% per year and 0.6-19.5% in the total energy consumption calculation in the building[9]. A 20 cm layer of soil substrate and 20-40 cm of plant cover has the same insulating properties as 15 cm of mineral wool.[9]

The sources emitting heat radiation are mostly the sun and the surroundings (buildings and ground surface). Some of the sunlight falling on plants and substrate are absorbed and some is reflected and transmitted[10]. The proportion of solar radiation absorbed, reflected, and transmitted varies across type of plants, their different leaf density and colors. Approximately half of solar radiation is absorbed in the plant and the amount of radiation reflection is nearly equal to that of transmission, which mostly ranges from 20 to 30% of solar radiation. The absorptance of plant leaves is strongly dependent on water content, leaf hairs and leaf thickness. Thick and waxy-leaves, such as conifer needles, absorb up to 88% of solar radiation[11]. Plants are an effective reflector and transmitter in long-wave radiation from their ability to reflect 50% of near infrared radiation and they are effective absorbers in the short-wave radiation, particularly photosynthetically active radiation (PAR), which can be absorbed up to 85%.[12] Additionally, heat transfer in the Living Walls is a result of heat exchange by convection between plants and air in the surroundings, plants and air in the canopy, plant and substrate, and substrate and air in the canopy. Conductive heat transfer mainly occurs between plants and substrate and also through the leaf. It is noted that the amount of heat exchanged from leaves to leaves is usually negligible. Apparently, substrate depth is one of the key factors in impeding conductive heat exchange.

Evaporation and transpiration are the important mechanisms to cool down the leaf due to the use of considerable heat absorbed in a leaf[10]. About 60% of the heat accumulated in a leaf can be dissipated by transforming it into latent heat. However, this ratio of latent heat dissipated from the plant to total absorbed radiation by the plant can be highly varied according to wind speed and moisture content of the air. [13]

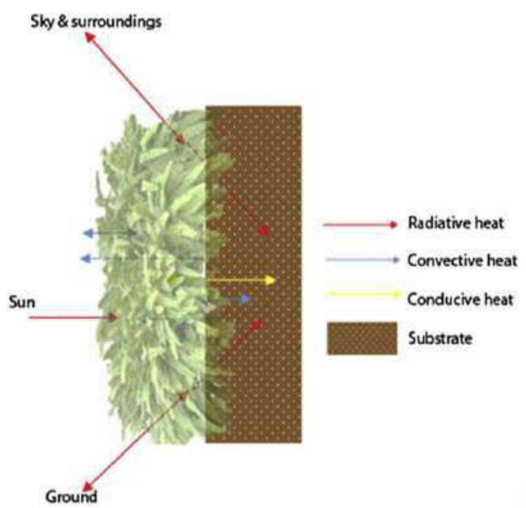

Figure 4: Radiative / Convective / Conductive heat[14]

2. The vision of green balconies as a future of modern cities

Taking into the consideration all the positive impacts of the green walls on the environment but also inhabitants the idea has been proposed to be implemented in some areas of buildings. Green balconies seems to be a great solution independently - or together with green roofs and green walls. It can be implemented by a private investor, which is willing to purchase a plants just for his own balcony, but also by a developer of the building which is willing to implement it to all existing balconies in the building.

Figure 5: Before and After - Ursynów visualisation

2.1 Technological solutions

Currently on the market available are three different systems which can be used for the construction of overlay on green balconies. Each of the solution is different and can be choosen respectively to the expectation of the client and his budget.

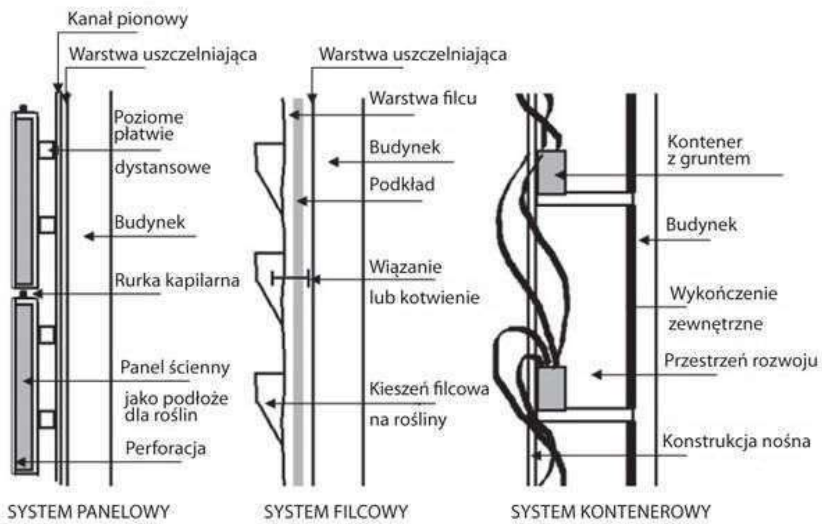

Figure 6: Scheme of three different systems of green walls[15]

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Nature based solution, green infrastructure and ecosystem services: a framework for understanding and creating resilient urban ecosystems

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Synoptic:

Climate-proof cities rely on Nature-based solutions, green infrastructures, ecosystem-based adaptation and ecosystem services to create resilient urban ecosystems. Nevertheless, the relation among these concepts is still not completely clear. This paper aims at providing a better understanding of these concepts and of their integration into urban planning, to support cities embedding those within their plans.

1. Introduction

'Everything you can imagine, nature has already created' (Einstein).

It is now widely recognized that human activities have reached a level that could result in abrupt and, in some cases, irreversible environmental changes detrimental to human development (Eggermont, H.et al., 2015). Societies face increasing challenges such as climate change, jeopardized food security and water resource provision, and enhanced climate related risks, such as floods, drought, cloudburst, heat waves, etc. In this regard urban areas, with around 60% of world population living in cities, will face even greater constraints due to overpopulation, social inequities, environmental challenges, and limited available resources. In this context, Nature Based Solutions (NBSs) can provide a valuable answer to environmental and societal challenges, and can contribute to increase urban resilience.

In the last years, NBSs have entered in the scientific and research vocabulary as an appealing term to define solutions that are inspired by nature and that are able to provide multiple benefit in a range of impact categories (water management, climate adaptation, food provision, urban regeneration, social inclusion, etc.). Although the concept of Nature Based Solutions strongly relies on green infrastructures, ecosystem-based solutions and ecosystem services, the relation among these notions is still under debate in current scientific literature. Moreover, the integration and implementation of those concepts within urban areas poses a great challenge to urban planning and policies, even if, at the same time, it provides decision and policy makers with a unique opportunity to shape future resilient urban ecosystems. The transition from traditional urban planning to an ecosystem approach planning process, sometimes called ecological planning, has been recognized in literature (Ygitcanlar, 2015 and Vasishth, 2008) but is still far from being systematically integrated into cities' plans and strategies. The shift from a mere preservation and conservation of urban ecosystems towards an integrated planning and management of nature based services and solutions is slow, but it will be crucial to develop liveable, health and resilient cities.

The aim of this paper is to present an overview of the different concepts (NBSs, green infrastructure and ecosystem services). First, starting from existing literature, the paper will provide a comparative analysis of the different definitions of the analysed concepts. Secondly, it will investigate an example of integration of such concepts within strategic planning (Greenspace quality, Scotland).

2. Definitions

The idea of finding solutions to the increasing societal challenges that are nature-based is gradually spreading into EU cities and regions. Nevertheless, different terminologies and concepts have been used in the last decades to define instruments, tools and solutions that refer to the use of ecosystems and nature to tackle a broad range of challenges and to improve humans' wellbeing and health. Within the scope of this paper, the focus will lie on the definition and integration of such solutions in urban and peri-urban areas.

2.1 Green Infrastructures (GIs)

Green and blue infrastructures have been identified in the last decades as one of the most interesting and promising strategy for achieving sustainability. One of the first definition of GI has been given by the Conservation Fund (2004) delineating them as 'the interconnected network of natural and semi-natural areas, features and green spaces that support native species, maintain natural ecological processes in rural and urban areas, and contribute to the health and quality of life for human beings' (The Conservation Fund, 2004).

The idea of planning those infrastructures in an integrated and interconnected way always support the concept of GI and the same conservation fund in 2006 renamed them as 'a strategically planned and managed network of natural lands, working landscapes, and other open spaces that conserve ecosystem values and functions and provides associated benefits to human populations, in order to link GI concept closely to its implementation'.

With the same vision and objectives in mind, the EU Commission proposes in 2013 the strategy on green infrastructure to enhance Europe natural capital. Within this strategy, GI are defined as 'a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services such as water purification, air quality, space for recreation and climate mitigation and adaptation. This network of green (land) and blue (water) spaces can improve environmental conditions and therefore citizens' health and quality of life. It also supports a green economy, creates job opportunities and enhances biodiversity. The Natura 2000 network constitutes the backbone of the EU green infrastructure'.

Compared with the previous ones, this definition strongly connects GI with the ecosystem services they can provide and it includes at the same level green and blue spaces; moreover, by mentioning Natura 2000 network as the main backbone of EU green infrastructure, the urban dimension of GI appears to be less evident than in the Conservation Fund definition, that was focusing on citizens' health and quality of life as the main impacts to be considered. Nevertheless, as also mentioned by Wang et Banzhaf (2018), the scale, the range, the extent and the implementation of such solutions can strongly vary from case to case as well as the benefits and the impacts they can produce on human wellbeing and health and on the environment. Thus, a strategic planning of such solutions is absolutely needed to maximize those benefits.

In the same line, the definition from the German Federal Agency for Nature Conservation in 2017 considers GI as a 'strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services. It incorporates green spaces (or blue if aquatic ecosystems are concerned) and other physical features in terrestrial (including coastal) and marine areas. On land, GI is present in rural and urban settings'. In this case, the concept of green and blue infrastructures is highlighted and their integration into planning strategies is strongly supported.

GI concept are also often mentioned in Chinese (Wang et Banzhaf, 2018) ad US (EPA, 2008, Fletcher et. Al, 2014, Coutts et Hahn, 2015) literature, being the concept operationalized at worldwide level.

2.2 Ecosystem services

The definition of ecosystem services (ES) and the huge work that has been done so far to evaluate and assess their values already give a clear idea of the power of this concept and definition. ES have reached a worldwide recognition and found their basis in 2005 with the Millennium Ecosystem Assessment (MEA), an impressive work that involved more than 1300 scientists worldwide. The definition that came out from that momentum summarizes the 'anthropocentric' conception of the term, stating that ES 'are the ecological characteristics, functions, or processes that directly or indirectly contribute to human wellbeing: that is, the benefits that people derive from functioning ecosystems (Costanza et al., 1997; Millennium Ecosystem Assessment (MEA), 2005).

ES have been categorized in 4 different types of services such as provisioning, regulating, cultural and supporting services, each of those providing a different kind of benefits to people. To support the relevance of this concept and reach decision and policy making, different approaches in the last decades have focused their attention mostly on the mapping, evaluation and economic assessment of such services. In particular, at EU level, the Biodiversity strategy requests Member States to map and assess the state of ecosystems and their services in their national territory with the assistance of the European Commission. They must also assess the economic value of such services, and promote the integration of these values into accounting and reporting systems at EU and national level by 2020 (Target 2, Action 5, Biodiversity Strategy). Although most of the attention is focused on evaluating and assessing ecosystem services, it is important to mention also the possible trade off generate by ecosystem to human being, called ecosystem disservices. Indeed allergenic pollen, spread of diseases, etc. should be considered whenever an ecosystem is evaluated.

2.3 Nature Based Solutions (NBS)

'Nature based solutions' is the youngest term introduced in this context and, most likely for this reason, currently the one on which there is less consensus. The first reference to the term nature-based solution can be found in the late 2000s in a report of the World Bank focusing on solutions to mitigate and adapt to climate change (MacKinnon et al. 2008). In this report, attention is mostly focus on nature, while biodiversity preservation and urban environment are hardly mentioned, and the proposed concept doesn't differentiate much from the previous definitions of GI.

In 2015, the EU Commission set up an expert group on Nature Based Solutions and re-naturing cities, which set the way towards a dedicated funding stream within the Horizon 2020 funding programme. In that context, NBSs have been analyzed with a strong focus on urban environment and have been defined as 'actions which are inspired by, supported by or copied from nature. Some involve using and enhancing existing natural solutions to challenges, while others are exploring more novel solutions, for example mimicking how non-human organisms and communities cope with environmental extremes. NBSs use the features and complex system processes of nature, such as its ability to store carbon and regulate water flow, in order to achieve desired outcomes, such as reduced disaster risk, improved human well-being and socially inclusive green growth. Maintaining and enhancing natural capital, therefore, is of crucial importance, as it forms the basis for implementing solutions. These nature-based solutions ideally are energy and resource-efficient, and resilient to change, but to be successful they must be adapted to local conditions'. Building on this report, the EU Commission in 2016 adopted the following definition: 'NBSs are solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions'. Within this definition, the role of NBSs as actual solutions to pre-identified societal challenges within cities assumes a strong relevance, while at the same time, the focus on mimicking, which was clearly mentioned in the expert group report, appear to loose relevance.

The IUCN definition, 2016, built on the idea of nature-based solutions as one of the possible strategies to tackle societal challenges defining them as ‘actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits’. Anyway, also in this case the focus looks broader than the urban scale stating that NBSs are applied at a landscape scale, thus not including punctual solutions implemented at a building level (i.e green roof), for instance. Again, this concept is quite similar to the GI definitions mentioned in the previous paragraph.

This EU Commission definition appears broader than the IUCN one, and could be further developed using a categorization made by DELTARES. In particular, they divided NBSs into two categories:

- The use of existing natural areas as NBS, where we can use one or more ecosystem services in addition to the conservation or promotion of biodiversity, mostly focusing on ecosystem preservation (i.e national and regional parks, earth biosphere, Natura 2000 sites)
- New NBS designed and installed to support one or more ecosystem services and to make a given contribution to biodiversity

The second category has been further subdivided into two groups. This differentiation assumes a great importance when referring to urban environments, since they requires different implementation strategies at the operational level:

- Hybrid NBS: combinations of hard infrastructure with soft or green elements, examples being green walls, green roofs, mobile plant containers, and so on. They often focus on one or two benefits in addition to the contribution they make to biodiversity. Effectively, they cannot exist without the hard structure. They are not connected to the subsurface and therefore not dependent on the nutrient fluxes or hydrological flows in the local system. As a result, their potential for replication is really high.
- Ecosystem-based NBS: re-installations of ecosystems or parts of ecosystems, examples being urban parks, natural embankments, urban wetlands, and so on. They are connected to the subsurface and are therefore highly dependent on local hydrological flows and nutrient fluxes. This consideration, and the fact that we expect them to deliver numerous ecosystem services, thus creating multiple impacts, makes the implementation of these solutions complex.

For the first time, in these definitions it is possible to find the reference to small scale projects, i.e green roofs, vertical walls, etc., which are increasingly spreading around cities. Those solutions provide ecosystem services and can be considered as a component of a broader green infrastructure vision, but that are not included, as such, in none of the other definitions.

3. Relation among the different concepts

Although the definitions of the three considered concepts in some cases appear to overlap and to be separated by vague borders, there is a need for a clearer differentiation.

Assuming that NBS are predominately an EU-based terms, not really spread in extra EU literature and practices, here below some relations among them are delineated.

3.1 Nature based solutions and Green Infrastructures

NBS and GI both represent solutions based on natural (green and blue) features and processes used to tackle clearly identified societal challenges. Both need to be carefully planned and strategically integrated with reference to urban, peri-urban and rural areas, being GI in EU mostly mentioned with reference to peri-urban and rural areas and NBSs for predominantly urban areas. Nevertheless, the main difference between the two, according to the authors' view, stands in the scale and the range of the project themselves. Indeed hybrid NBSs can be implemented in single, punctual and small scale projects (i.e green roofs and walls developed by private households), while ecosystem-based NBSs (i.e urban parks, lakes, floodplain) need much stronger financial, planning and administrative support and should be embedded in a broader vision of green infrastructures connection and network. Moreover, since ecosystem based NBSs are predominately embedded within urban projects and solutions, the social impacts they can create assume, sometimes, stronger relevance in comparison with other generated impacts.

3.2 Nature based solutions, Green Infrastructures and Ecosystem Services

ESs have sometimes been considered as a concept comparable to NBS and GI (Demuzere et. al, 2014, Maes and Jacob, 2015, Eggermont et. al. 2015), not clearly defining the different application of those concepts. In accordance with Pauleit et al, 2017, while NBSs and GI can be considered as more practical and solution oriented approaches, the concept of ESs is more abstract with a very strong focus on evaluation and assessment. Indeed ESs can be used in the evaluation of implemented NBS and GI infrastructure projects, providing decision makers with useful evidences regarding the environmental, social and economic benefit of such solutions. This approach could push forward the implementation and the integration of NBSs and GI within spatial and urban planning, assuming that those kinds of solutions create multiple impacts that traditional grey solutions don't.

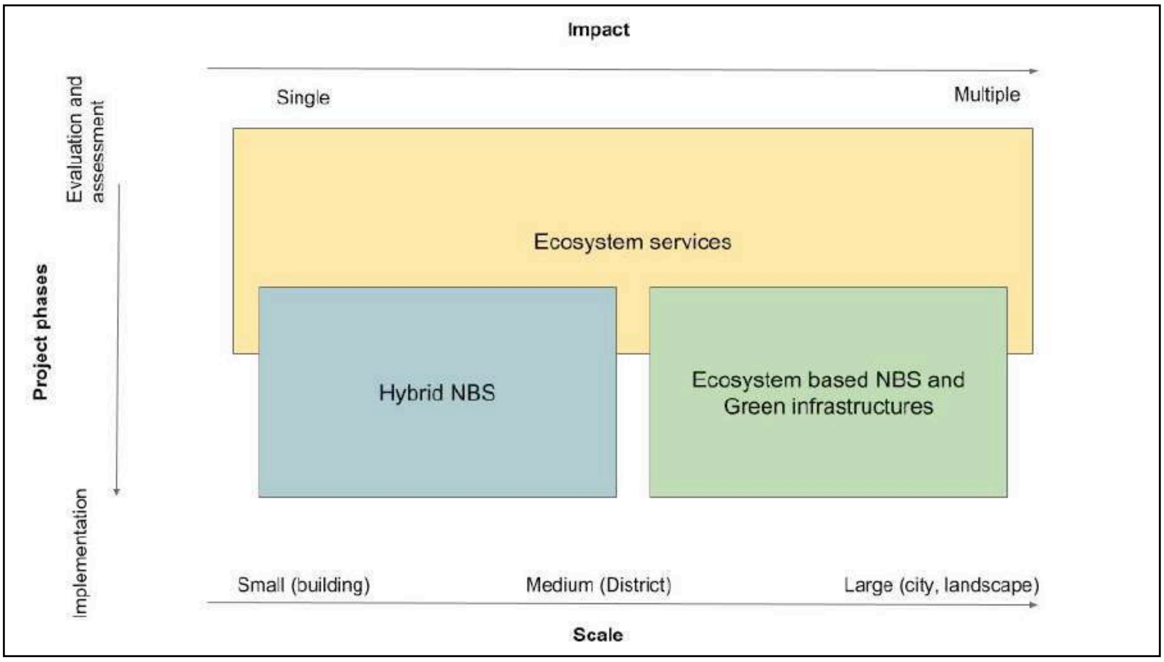

Figure 1 Relation among NBS, GI and ESs (Authors' elaboration)

Building on the conclusion of Pauleit et. al., 2017, Fig.1 summarizes the relations among the three described concepts. ESs can be considered as an assessment methodology while NBSs and GIs works at the implementation level. Hybrid NBS (i.e. green roof, vertical walls) are implemented at a smaller scale (building) and usually produce smaller impacts, if not integrated in a wider plan. On the other side ecosystem-based NBS and GI are implemented at wider scale (district, urban, regional) and produce a wider categories of benefits and impacts.

4. From theoretical definition to practice: challenges and good practices

As illustrated in the previous section, the concept of green infrastructures and NBSs has emerged as a way to secure the provisioning of ecosystem services in human-dominated landscape (Ahern, et al. 2014).

Beside the fact that ecosystems provide benefits to people also very far from the ecosystems themselves (i.e food provision, drinking water), a wide range of benefits (i.e. air quality, climate regulation services, soil permeability, recreation and cultural services) directly affect people living within or very close to a particular ecosystem. By 2050, the world's urban population is expected to nearly double, making urbanization one of the twenty-first century's most transformative trends (UN, 2017); for this reason, urban ecosystems, already established or newly created through NBSs, assume a crucial and fundamental role in improving people health and quality of life. In this sense, the interest of including NBS and GIs into strategic urban planning and ecosystem services as an assessment methodology of urban plans and projects is rapidly growing. Although the definition and the understanding of these concepts and their evaluation in terms of effectiveness and impact assessment is constantly growing in research and practices, their integration into 'business as usual' urban planning process still has to come. This issue is also at the centre of the Urban Agenda for the EU debate, as it is one of the issues tackled by the Sustainable Land Use and NBS partnership. The scope of this paper will be limited to present a good practice implemented in Scotland for the integration of functional and qualitative approach into planning strategies and assessment, even though a wider and deeper discussion on the opportunities and challenges presented by the topic is needed.

4.1 Greenspace quality guide: the case of Scotland

In 2008, Greenspace Scotland published a report "Greenspace quality- a guide to assessment, planning and strategic development", that detailed the steps to be followed to deliver a comprehensive greenspace strategy. In this context, greenspaces correspond to the above-mentioned ecosystem-based NBS and GIs referring mostly to urban parks, green corridors and urban farming.

The key measures of such spaces have been defined through the analysis of 3 different values:

- *Quantity*: "quantity in terms of the overall quantity of greenspace, its distribution spatially and in terms of differing types of greenspace (parks, green corridor, etc.)". The quantity criteria is currently the most used in urban planning standards and minimum requirements, probably due to its easy applicability and monitoring.
- *Accessibility*: "accessibility in terms of how well connected, accessible and inclusive greenspace is to the communities". Accessibility, as well a quantity, is a common indicator used in urban planning and it is easy to monitor and evaluate.
- *Quality*: "quality in terms of how well a greenspace or a wider network of greenspace assets addresses the varied functions need and aspirations of its users and other stakeholders".

This definition of quality recalled the idea of functions and services that a particular ecosystem – greenspace in this report- can provide to the community. The core role of the community in the greenspace planning appears even more relevant in the quality definition; indeed "quality of greenspace is a relative term and is best understood in terms of fitness to purpose". The idea of fitness to purpose implicitly includes the identification of targets to be reached and/ or final consumers to satisfy. The process of quality definition suggested in this guide is indeed built on the customers/users' and the stakeholders/local authorities quality definition. Even though the responsible local authorities should delineate the general plan towards the final targets and requirements, also in line with regional, and national objectives to be reached, quality needs also to be discussed and agreed by local actors. Indeed quality parameters and perceptions are embedded in and dependent on the local and climatic conditions and circumstances, different cultural background and local needs.

5. Conclusion

Social inequalities are likely to increase in our cities in the following years, due to overpopulation, migrations and increasing disparities. At the same time climate change effects will make our settlements more and more prone to extreme events such as drought, floods, fire, etc. Re-naturing cities is one of the most promising solutions to tackle social and environmental challenges and to make urban ecosystem more livable and resilient.

NBSs and Green Infrastructures, through the ecosystem services they provide, will strongly support the creation of climate proof cities, improving, at the same time, wellbeing and quality of life of citizens. In this context, this paper reviewed 3 concepts -Nature Based Solutions, Green Infrastructures and Ecosystems Services - to compare and relate those with current planning approaches. In this sense, ESs can be considered an assessment methodology while NBSs and GIs are operational solutions at strategic and implementation level. A further differentiation of NBS has been discussed: hybrid NBS (i.e. green roof, vertical walls) as solutions implemented at small scale (building) provide narrow impacts, if not integrated in a wider plan. On the other side ecosystem-based NBS and GI are implemented at wider scale (district, urban, regional) and can generate a wider categories of benefits and impacts. In both cases, that to be as effective as possible both NBSs and GI should be carefully and strategically integrated into urban regional and national plans and strategies.

To generate multiple impacts and benefits NBSs and GI have to be carefully planned and designed. Indeed the services that a particular solution can provide strongly depend on how this solution has been planned and designed (i.e type of vegetation used, interconnection with other NBSs, etc.), and are not directly related with the extension of the implemented solution. In this sense the quality of those solutions assume a great value, criteria which is not included in minimum planning requirement so far.

This concept of quality and performance indicators can push forward the integration of NBS and GI into urban environment. In this sense this paper mentioned an interesting case in Scotland where a shift towards a more qualitative approach in planning is being performed. Through this case the authors wanted to focus the attention of one of the possible approaches to relate NBSs and ESs with urban strategic planning, but further research on the topic is needed.

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Soil Ecosystem Services (SoES) in Urban Planning

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Abstract

Urbanization as a global transition process of socio-economic dynamics has been the burning issue of spatial science related disciplines for the last few decades. The complex system of urban mechanisms and the changes in population patterns have provided scientists from various domains a multi-dimensional research lab where land use and land cover change (LULCC) has become one of the most important issues affecting natural systems at different scales (Bajocco et al., 2012). All among the problems caused by anthropogenic activities and ongoing urbanization process, climate change came into prominence as one of the most critical environmental concerns due to its widespread effects threatening species, ecological systems and the sustainability of urbanizing landscapes. The relationship between urbanization and climate change has been most notably articulated by the greenhouse gases emit due to human activities and fossil fuel consumption. Herein, the study presented in this paper intends to focus on another variable that was not highlighted clearly in the process of fighting and adapting to climate change, yet, play an important role in climate regulation on surface and subsurface layers. Soil, as a defining component of ancient and recent cultures provides critical ecosystem services (ES) that enables life on Earth. Its role in climate and water regulation systems has tremendous effects on ensuring the equilibrium between surface and subsurface interactions. However, likewise other natural systems in urban areas, soil has been exposed to critical human intervention and lost its characteristics temporarily or irreversibly. This paper, at that point, aims to reveal the significance of soil ecosystem services (SoES) in adaptation and mitigation to emerging environmental challenges on the basis of climate change and stormwater management in urban areas. In accordance with this purpose, the scientific literature examining the relationships between urban planning, LULCC and SoES will thoroughly be analyzed to identify the research gaps and develop strategy options for making the integration of SoES into urban planning mechanisms possible.

1. Introduction

'Land, then, is not merely soil; it is a fountain of energy flowing through a circuit of soils, plants, and animals' (Aldo Leopold, A Sand County Almanac, 1949).

Soil is a vital part of the natural environment and it is essential for the continuity of life. The United Nations Food and Agriculture Organization (FAO) has declared 2015 as the International Year of Soils, "paying tribute to the life-giving ground beneath our feet" (Pantsios, 2014). Similarly, United Nations Sustainable Development Goals (2030 Agenda) has highlighted the importance of land, soil and water relationship through land and soil degradation, flood risk and integrating ecosystem values into national and local planning processes under the Goal-15: Life on land. Soils are also given an earlier emphasis in the Millennium Ecosystem Assessment (MEA) Report (MEA, 2005a), which popularized the term 'ecosystem services' and inspired by a number of researchers. The report provides a clear nomenclature for ES framework under 4 major function groups (provisioning, regulating, supporting and cultural) and assesses the consequences of ecosystem change on human well-being. Divergences of opinions regarding the most suitable classification of ES has brought some revisions made by the 'Economics of Ecosystems and Biodiversity (TEEB)' committee and 'European Environment Agency (EEA)' under 'Common International Classification of Ecosystem Services (CICES)' in 2009. However, both in the MEA Report and the studies in literature regarding the definition and classification of ES, very little attention was devoted to soils and insofar they often left out many of their common uses and services (Baveye et al., 2016). As Dominati et al. (2010) mentioned, a large-scale ecosystem approach was adopted by the MEA Report in which soil received little or no attention (Figure 1) apart from its role in soil formation. From this point of view, this research aims to emphasize the significance of 'below-ground mechanisms' as much as the services provided by above-ground systems and it particularly focuses on the SoES with a special attention to stormwater management and climate regulation in urban areas.

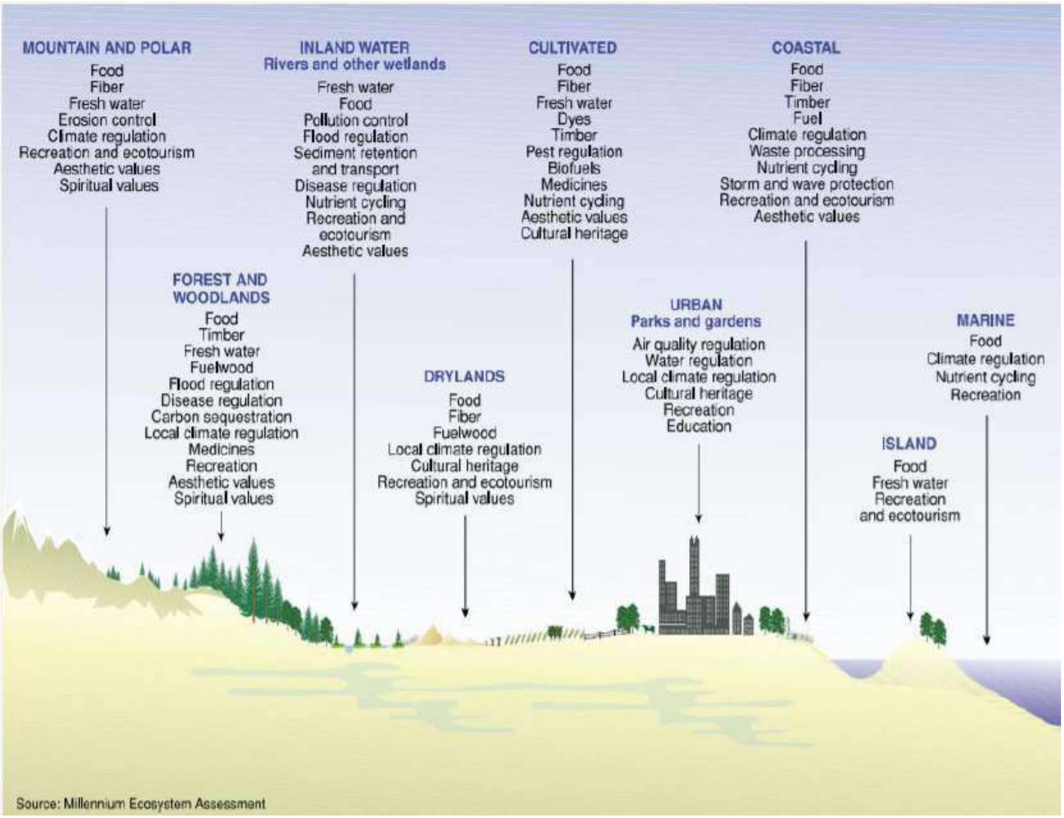

Figure 1: Multi-contexts of Ecosystems and Their Basic Services (MEA, 2005b)

2. Human-dominated Landscapes

We are living in a rapidly urbanising world. This has been revealed once again by the findings of United Nations indicating the rate of urban population which was 30 % in 1950 has reached 55 % of the world population today and it is expected to increase 68 % by 2050 (UN, 2018).

Urban areas are innovative catalysts and frontrunners of development. They provide greater access to social, educational and medical services, commerce and economic activity, public transportation network and enhanced opportunities for cultural and political participation for their citizens. However, at the same time, they are the hubs for environmental conflicts where natural hazard risks and environmental disturbances have accelerated. The process of urbanisation is defined by Mosel et al. (2016, p. 9) as:

> the increase in the proportion of the population living in urban centers that is overwhelmingly the result of net rural to urban migration caused by economic growth and industrialisation, political and social conflicts, rural impoverishment, and natural disasters

which stimulates dramatic changes on land. The expansion of urban areas due to rise in population and economic growth increases the additional demand on natural resources thereby causing land transformations especially in megacities and peri-urban areas. According to CBD Report (2012), the land area occupied by cities increases at a higher rate than the increase in urban population. Likewise, a global sample of 120 cities observed between 1990 and 2000 shows that while the population grew at a rate of 17 %, the built-up area grew by 28 % (NYU, 2015). Rapid urbanization and inadequately managed urban expansion lead to urban sprawl and unplanned urban patterns (UN, 2014), where the communities become more vulnerable to water and climate-based problems (Tezer et al., 2012).

2.1. Transitions in Land use and Land Cover; A Growing Threat for Natural Capital

Land use and land cover (LULC) are one of the key determinants of landscape's structure, functions, and dynamics in all around the world (Wu and Hobbs, 2002). Land cover defines the '*biophysical state of the earth's surface and immediate subsurface, including the soil material, vegetation, and water status*' while the land use differs from land cover as a result of anthropogenic behavior to change land cover to their benefit (Verheye, 2006, p. 337). The Food and Agriculture Organization (FAO, 1995, p. 21) describes land use as *'the human activities which are directly related to land, making use of its resources, or having an impact on them*'.

The negative environmental impacts associated with urbanization, such as loss of cultivated land, habitat degradation, biodiversity loss and urban flooding are linked to the unplanned changes in LULC caused by poorly designed and coordinated urban sprawl (Pauleit et al., 2005). Today, urbanization is among the most important land-use change trends globally and the conversion of land to built-up is often considered as one of the most problematic trajectories of LULCC (Elmqvist et al., 2013) due to its distinct impacts. The urban-growth driven changes in LULC have direct or indirect impacts on urban ecosystems including air quality, habitat and landscape fragmentation (Sala et al., 2000), soil degradation (Tolba et al., 1992), flood/drought risk (Carlson and Arthur, 2000), surface runoff and consequently the hydrological cycle with an influence on climate processes at local, regional and global levels (Chase et al., 2000). The interactions between urban ES and the response of ES bundles to the changes in LULC are complicated and variable. Therefore, the research intends to highlight the services provided by soil and the consequences of LULC on the regulative (climate and water regulation) soil services in rapidly urbanizing landscapes.

2.2. Soil in Urban Landscape

Soils are complex mixtures of minerals, water, air, organic matter, and countless organisms (FAO, 1985) which interact and contribute to the global cycles that make all life possible (Govers, 2015). However, due to changing consumption patterns, global demographical dynamics, population growth and urbanization, soil is coming under increasing pressure resulting in physically, chemically and biologically altered characteristics in comparison to nonurbanized soils (Pavao-Zuckerman, 2008).

Soil as a dynamic and multifaceted life support system is affected by five major factors (climate, organisms, relief, parent material and time) interact to create different soil types (Brady and Weil, 1996). Recently, human activity is accepted as the sixth factor has an influence on soil formation (Pickett and Cadenasso, 2009) due to direct anthropogenic disturbance and indirect impacts of urbanization. Previously, Jenny (1941), described soil formation in the absence of humans, while Effland and Pouyat (1997) and Pickett and Cadenasso (2009) considered the anthropic factor influence to modify natural soil formation processes (Figure 2). Indeed, the term 'Urban Soil' can be defined as:

> a soil material having a non-agricultural, man-made surface layer more than 50 cm thick, that has been produced by mixing, filling, or by contamination of land surfaces in urban and suburban areas (Craul, 1992, p. 86)

which indicates a disturbed soil structure by human interference. Jim (1998) identifies the characteristics of urban soil as: modified soil structure (compaction), presence of a surface crust on bare soil, restricted aeration and water drainage, interrupted nutrient cycling, modified soil organism activity, anthropic materials and other contaminants and modified soil temperature regimes. According to BIO Intelligence Service Report (2014), soils in urban system are mostly compacted, sealed, and modified. Their characteristics are temporarily or irreversibly lost and their biophysical properties such as structure, soil temprature and organism activity are partially or completely interrupted due to critical human intervention.

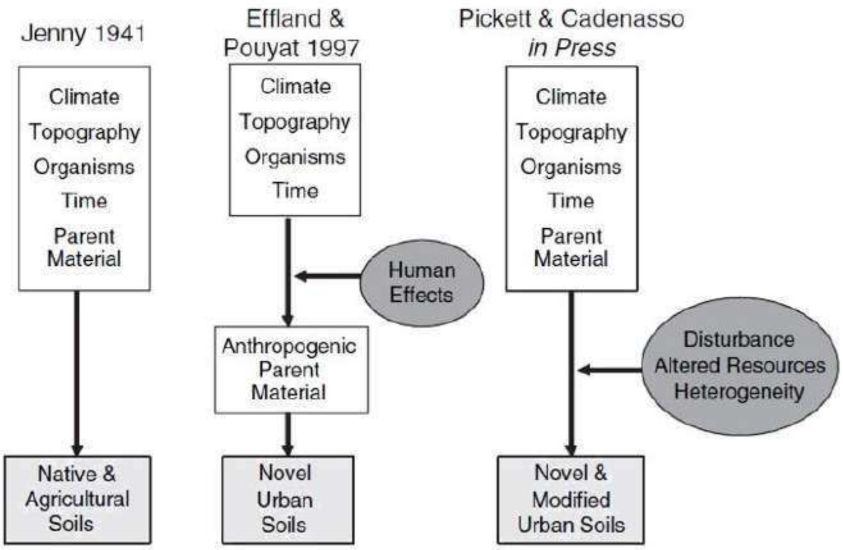

Figure 2: Factors Effecting the Modification of the Soil Formation Process (Pickett and Cadenasso, 2009).

Although soils in urban landscapes are predominately altered, they still can provide many of the same ES as unaltered soils (Pouyat et al., 2010). The potential of ES provision by modified urban soil has been confirmed by the studies conducted under Baltimore Ecosystem Study (BES) (2010) as well. The study revealed that urban effects on soils occur at multiple scales. Yet, urban landscapes are biologically active in pervious areas and still have a high potential for water filtration, carbon storage, and nitrogen retention which are significant for, thus climate and water flow regulation.

3. Ecosystem Services (ES) Provided by Soil

Ecosystem services are defined as '*the benefits people obtain from ecosystems*' in the Millennium Ecosystem Assessment Report (MEA, 2005a) with an emphasis on the dependency of human well-being to the Earth's natural capital (Costanza et al., 1997) including the most biologically active zones of soil (Barrios, 2007).

Soils are one of the species-rich habitats and the foundation off all terrestrial ecosystems (Finvers, 2008; Jónsson and Davíðsdóttir, 2016). They moderate the majority of ecosystem processes while providing a range of ecosystem goods and services mostly driven by the soils biotic community. Healthy soil contains a myriad of organisms (microbes, fungi, bacteria, invertebrates), whose activity in soil is central to support and moderate nutrient balance, biogeochemical recycling, primary production, water regulation and biomass production (Brady and Weil, 1996; McKinney, 2002; Jónsson and Davíðsdóttir, 2016). Soil Thematic Strategy (EC, 2012) identifies soil biodiversity as the key component of soil quality and sustainability. Although soil microbial diversity has a critical role in ecosystem processes, key functions of soil are not limited with the services provided by its microbial community. Due to environmental interactions take place among the surface and sub-surface layers of the land, soil serve as a gene pool and source for food and other biomass production. It constitutes a physical support for man-made structures while regulating Earth's fundamental processes (retaining carbon, water and nutrients, regulating greenhouse gas emissions, global and local climate, hydrological cycle, air purification etc.) and contributing to cultural heritage (Barrios, 2007; Dominati et al., 2010; Pereira et al., 2017).

The role of soil in providing these crucial services is mostly neglected in ES framework, which has been formed in various classifications (Costanza et al., 1997; de Grooth et al., 2002; MEA, 2005a; CICES, 2009; TEEB, 2010) and still could not formulate a consensus regarding the classification and valuation of SoES (Robinson et al., 2009). In Figure 3, the services provided by soil is illustrated based on the categories defined by MEA (2005a).

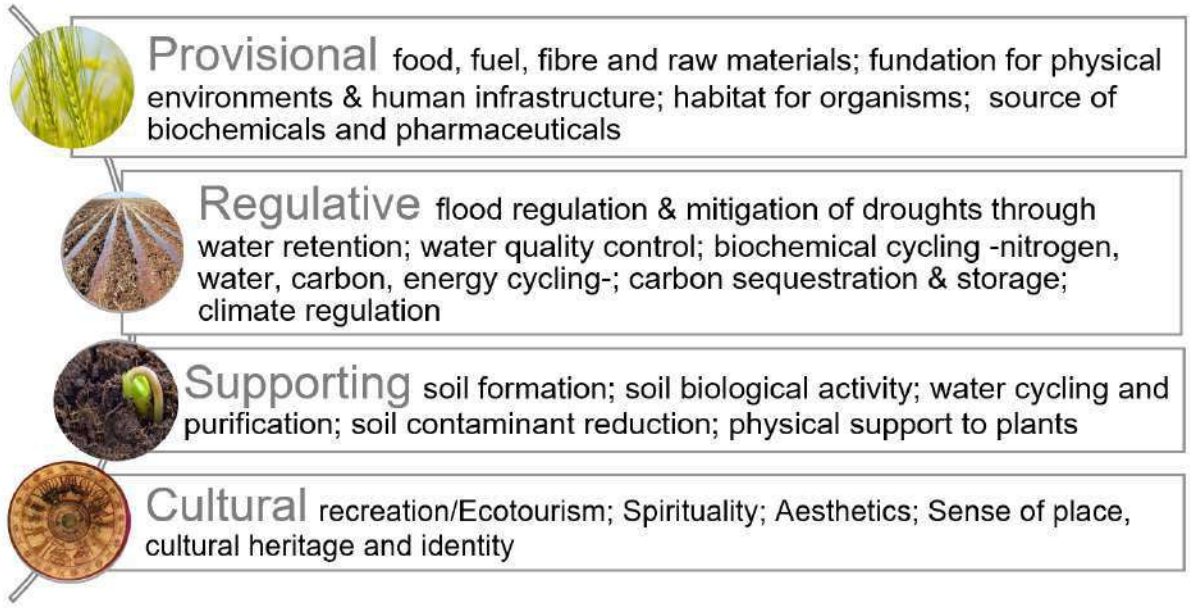

Figure 3: ES Provided by Soil (compiled from Daily et al., 1997; Dominati, 2013)

According to Jónsson and Davíðsdóttir (2016), recent developments have underpinned the importance to include multiple aspects of SoES in ES framework due to their critical role in to climate change mitigation and flood risk management in urban areas. As such, soils can function in urban landscapes by reducing the bioavailability of pollutants, storing carbon and nutrients and moderating the hydrologic cycle through absorption, storage, and supply of stormwater (Pouyat et al., 2010)

3.1. Soil in Hydrological (Water) Cycle

Soil and water system are inherently connected. They directly or indirectly affect each other and contribute to the continuity of life. The continuous and vital movement of water on, above, and below the surface of the Earth is defined as hydrological cycle (USGS, 2017), where soil play a critical role.

Soil is responsible for the infiltration, transpiration, storage, percolation and distribution of water flow in the hydrological cycle. According to BIO Report (2014), soil retains 67 000 km^3 of water globally that is mostly used for root uptake, plant growth, groundwater recharge and soil organisms (Quinton, 2015). Altough infiltration and storage of water in soil media mainly associated with gravity, precipitation, hydrological characteristics (saturation level, moisture content, capillarity etc.), soil texture and structure (particle size, porosity etc.) (FAO, 1985), the condition of soil surface regarding the land cover, vegetation type and human activities is one of the primary determinants of water-soil relationship (Mangala et al., 2016). In the context of the natural flow of hydrological cycle, water naturally seeps down by gravity during the precipitation/irrigation while there are no physical barriers such as impermeable layers at soil surface. In urban landscapes, however, sealing of soil and the conversion of land pattern from permeable surface to impermeable cover surfaces (roads, pavements, buildings, asphalts etc.) is closely associated to soil's capacity to store and infiltrate water (Veerbeek et al., 2011; Quinton, 2015), which increase the surface runoff and flash-flood risk.

The causes of antropogenic interventions on soil can be summarised as: decrease of water infiltration and chemical activity; reduced storage of water and carbon; cut down of soil evaporation; increase in local temprature (surface and sub-surface) and water erosion; biomass and organic matter loss; pollution; impeding soil water and atmosphere exchanges (biochemical cycling) together with the negative affects on the functions of soil organims, groundwater replenishment and natural water balance in urban areas (BIO, 2014; Pouyat et al., 2010; Scalenghea and Marsan, 2009; Pavao-Zuckerman, 2008; Grimm et al., 2008). In natural systems, permeable surfaces prevent or limit runoff by capturing part of the rainwater, while reduction of this ability (soil sealing, compaction, saturation) and the existance of impervious surfaces reduce the amount of water infiltrates into soil (Figure 4). This can lead to high levels of stormwater runoff resulting in fluvial (river overflowing) or pluvial (urban) flooding with higher magnitude and frequency (Rambaldini, 2009; Bacchin et al., 2013) mostly in poorly planned urban settlements.

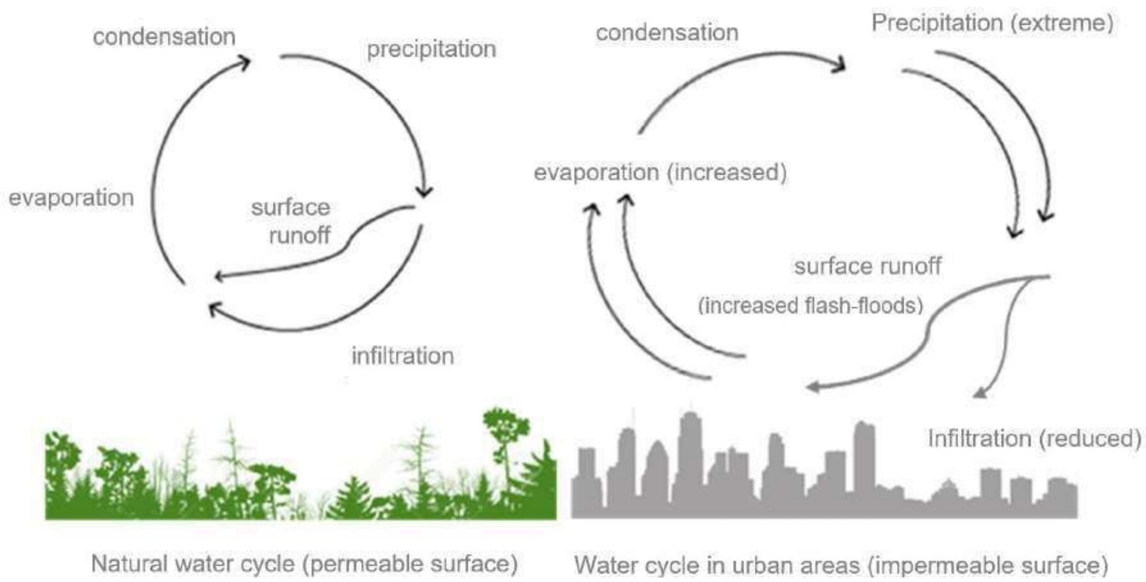

Figure 4: Hydrological Cycle in Natural and Urbanized Areas (adapted from Bacchin et al., 2014)

3.2. Soil in Climate Regulation

According to UNEP (2012), urban areas comprise only around 3% of the land surface of the earth, but they use approximately 75% of the earth's natural resources and emit 60% to 80% of greenhouse gas emissions. Greenhouse gases (GHGs) play a vital role by trapping the solar energy in the atmosphere and influence the climate of the planet; known as 'greenhouse gas effect' (EPA, 2017). This naturally occurring process is vital and provides higher and livable temperature ranges on the Earth. However, the increase of atmospheric GHGs in exponential ratios intensifies GHG effect, alters the energy balance and cause an increase in Earth's temperature, which threatens the continuity of human welfare and ecosystems health.

The Intergovernmental Panel on Climate Change (IPCC) defines climate change as *"statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer)'* and it emphasizes the distinct influence of human on climate change (IPCC, 2013). Due to greater amounts of GHGs emissions mainly caused by energy generation, vehicles, industry, biomass use and human alteration on LULC (EPA, 2017), the global surface temperature in the past decade was detected 0.8 °C higher than the beginning of the 20th century (Carter et al., 2015). According to NOAA (2018), carbon dioxide (CO_2) is of greatest concern in all of the GHGs, since it contributes the most to the climate change. Atmospheric CO_2 levels in 2009 were measured higher than at any time in the past 800,000 years and currently, it is continuing to increase at an accelerating rate (EPA, 2017). Scharlemann et al. (2014) indicated that carbon emissions resulting from changes in LULC are the second largest source of human-caused carbon emissions to the atmosphere after emissions from fossil fuel combustion. Researches conducted under the Global Carbon Project (GCP) (Le Quéré et al., 2016) also revealed that the global CO_2 emission sources have grown in the industrial era primarily from fossil fuel combustion, cement manufacturing, and land-use change from activities such as deforestation (Figure 5).

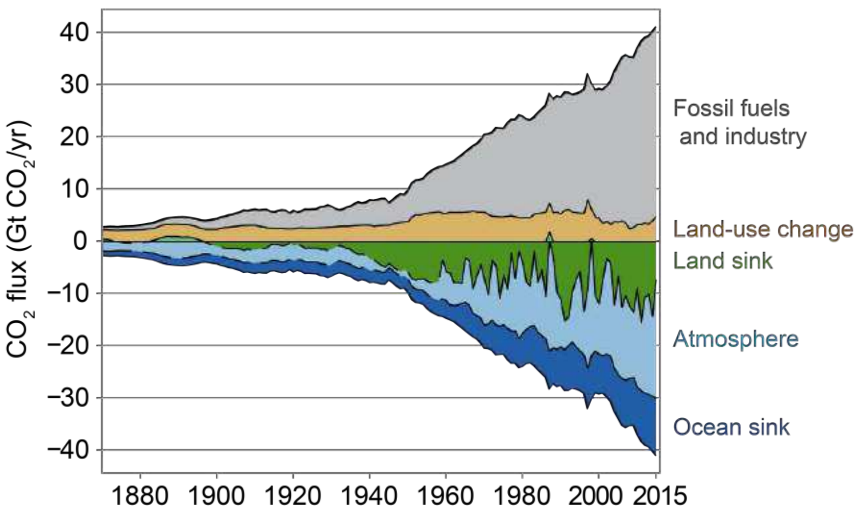

Figure 5: The Global Carbon Budget (Sources & Sinks) (Le Quéré et al., 2016)

CO_2 naturally emitted by the oceans, plants and land, where 80 % of the total carbon in the terrestrial ecosystem is found in soil (Lal, 2008). Soil as the second largest carbon reservoir after oceans (EPA, 2017) captures and stores the carbon in the form of soil organic carbon (SOC). Sequestration of carbon by healthy soils and vegetation is an important part of continual (exchange) cycle of CO_2, and crucial for key soil functions such as stabilization of soil structure (erosion control), flow of plant nutrients (productivity) and water infiltration and storage in soil (Pereira et al., 2017). SOC supports soil organisms to perform in biogeochemical cycles and help soil to regulate the microclimate (surface and sub-surface) as well (FAO, 1995).

The significant role of soil in climate regulation could be a critical link to mitigate climate change particularly in urban areas, where the transition of land cover in the form of built-up or paved-over areas leads to modifications in surface microclimatic and hydological conditions including urban heat island effect and changes in surface runoff pattern (Jiang et al., 2015). Currently, unsustainable land management practices and increase of urbanization-driven LULCC alter soil carbon balance while endangering the capability of soil to store and sequestrate carbon (FAO, 1995). Nevertheless, in addition to the strategies imposing to reduce the dependencies on fossil fuels, it is also critical to contribute to carbon dioxide-driven climate change mitigation efforts by increasing the carbon stocks in urban areas.

4. Discussion: Considering SoES in Urban Spatial Planning

Traditionally SoES have not been thoroughly studied in urban planning. Hence, tools are needed to incorporate SoES into urban land management and spatial planning processes.
The purpose of this paper is to reveal the significance of SoES in urban planning and spatial decision-making process through the following objectives: (1) analyzing the effects of urban growth-driven LULCC on soil; (2) identifying the role of urban soil in climate change mitigation and urban stormwater management; (3) proposing a conceptual framework illustrates the basic stages for building SoES-friendly urban planning and design strategies.

In accordance with this purpose, scientific literature examining the relationships between urban planning, LULCC and SoESs is systematically analyzed. The results obtained illustrate that although subsurface system has not been fully incorporated into ES framework, recent studies (e.g., Pavao-Zuckerman, 2008; Robinson et al., 2009; Pouyat et al., 2010; Dominati, 2013; Baveye et al., 2016; Silva et al., 2018) several international organizations (e.g., United States Environmental Protection Agency, United Nations Environment Programme and Food and Agriculture Organization) and some relevant policies (e.g., United Nations Sustainable Development Goals, European Commission Soil Thematic Strategy) have pointed out the great influence of SoES on urban sustainability. Particularly, the critical role of soil in urban climate regulation and flood risk is explicitly underlined with an urgent need for adaptive, comprehensive and multi-disciplinary spatial planning process. From this point of view, a ‘multi-layered’ approach has been adopted in this study (Figure 6) based on the ‘Dutch Traditional Layer Approach’ introduced in 1998 (Van Schaick, 2011). The perspective classifies the land basically under three layers; substratum, networks and occupation patterns, where the natural subsurface systems are incorporated with aboveground urban development as a part of ‘human’ and ‘natural’ system connections. The framework proposes to understand the status quo at the first stage. Following studies investigate the ES potentials of the area and reveals the critical zones of selected SoES provision. Herein, the permeability of the surface (soil) and subsurface (geology/hydrogeology) layers are crucial for water infiltration -and accordingly circular movement of stormwater- while the areas with high capability to store carbon are critical for carbon sequestration to combat climate change. At the last stage, the critical zones of substratum are overlapped with the occupation and network layers (spatial configuration and the changes in LULC) to detect the areas necessitates protection and/or improvement.

The framework illustrates a generic perspective and necessitates tailor-made strategies for the area/region to be studied. Accordingly, the results obtained need to be translated into spatial planning practices with an overall aim to integrate SoES-friendly measures into current urban planning processes at different scales. Thus, the framework can provide normative principles guiding for future studies, which intends to increase the resilience of urban environments to emerging environmental problems. Considering the functions of soil in climate and surface runoff regulation within the constructed environments should be taken into account in planning processes of both existing or future developments. Developing and implementing SoES-based urban spatial planning approach is significant to enhance (i) functioning of SoES in urban landscapes; (ii) resilience of urban areas to climate change and storm water runoff problems; (iii) sustainability of urban ecosystems and related services in long-term.

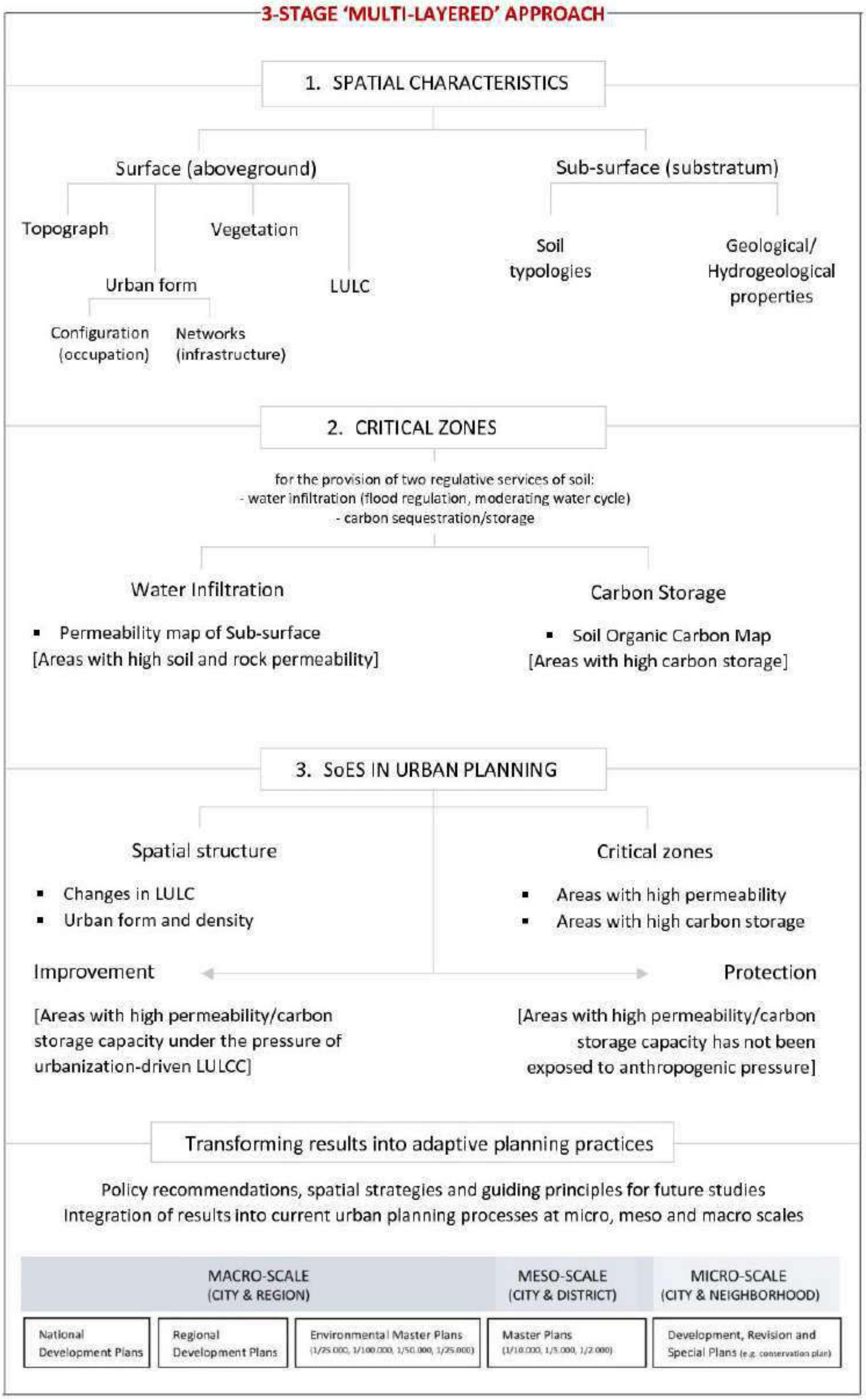

Figure 6: Flowchart of the Conceptual Model Framework

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Green Infrastructure for Metropolitan Areas in Mexico

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Abstract
Mexicans have decided to live in large metropolitan areas, this is a fact since the year 2000, when most of the country's population lives in one of them. However, this change in population distribution was not paired with key components for sustainable development, such as large green areas which could define metropolitan level green infrastructure (GI). Metropolitan areas should include a network of strategically planned and managed natural areas to preserve living ecosystems, build resilience for climate change and at the same time provide the population with the benefits associated to living near GI.
This study aims at defining the main features of Metropolitan GI, how it should look like and what criteria should be considered in order to face climate change. Although neighborhood and urban green areas are well specified in planning literature, there are no references for the metropolitan scale; therefore, to address this gap the article elaborates an inventory of the GI in place in one actual Metropolitan Area. The selected case study is the second largest city in Mexico with 4.8 million inhabitants, but with little information about its GI: the Guadalajara Metropolitan Area (GMA). In order to understand how the existing GI helps climate change mitigation and adaptation, the urban ecosystem services actually provided are highlighted. This services include provisioning (urban agriculture and water sources), regulating (climate regulation, water infiltration, erosion control), cultural (tourism and recreation), and supporting and habitat (habitat for species and diversity).
The study uses existing plans, images and local sources as inputs for spatial analyses, which are complemented with field visits to monitor and calibrate the information. By assessing the services provided by existing GI, as well as conducting a suitability analysis of the metropolitan territory, this article also shows the potential areas which could help enhancing/ building a comprehensive GI system for the GMA.
The article concludes with recommendations that could help consolidate and enhance the Green Infrastructure of the GMA. These recommendations could be considered for future cool Metropolitan planning and resilience.

Key words: Green Infrastructure – Metropolitan Planning – Guadalajara.

1. Mexican Metropolization

Mexico has gone through an urbanization process of several stages (Unikel, Ruiz Chiapetto, & Garza Villarreal, 1976) which has led the population of the country to live predominantly in cities since 1980. Within this process, it is required to point out the phenomenon of metropolization: a tendency to the physical articulation of localities that formerly operated independently, but that now are integrated forming a single unit, in such a manner that they add up to a population of 50,000 inhabitants, whether they are localities of a single municipality or, alternatively, localities that are based in two or more municipalities that show a degree of physical and functional integration (SEDESOL - CONAPO - INEGI, 2012).
Large metropolitan areas became the predominant form of population concentration in Mexico from the year 2000 on, when more than 50% of the population was already settled in 55 metropolises (idem, 2012). This phenomenon continues to be a trend and will probably last for a few more years (see Table 1).
In 1980, there were already 26 Metropolitan Areas (MAs) in the country, of which Mexico City, Guadalajara and Monterrey stood out; by the year 2010 there were 56.8 million inhabitants in 59 MAs.
The substantial concentration of people in MAs -mainly due to migration from other cities, has caused the territory to be occupied without regard for the most sensitive natural areas that represent the potentiality of bringing nature to the metropolis, leaving the environment out of the urban structure and therefore, failing to reach the global target of a sustainable urban

development (UN-Habitat, 2009, United Nations, 2015). It is even possible to affirm that the system of open green spaces has yet to be recognized in the metropolises as a fundamental element of the networks/infrastructure systems of a city.

Indicator	1980	1990	2000	2010
Metropolitan areas	26	37	55	59
Districts and metropolitan municipalities	131	155	309	367
States	20	25	29	29
Total population (millions)	26.1	31.5	51.5	63.8
National Population Percentage (%)	39.1	38.8	52.8	56.8

Table 1. Indicators of the metropolization process 1980-2010. Adapted from SEDESOL - CONAPO - INEGI, 2012.

The environment thus, is a fundamental system that has been affected by the urbanization process, and which is necessary to attend given that all the changes made by the human being in metropolitan territories have ecological and socioeconomic effects. Among the first, we count the loss of natural areas that are replaced by the development of housing, roads and other city needs; this development has also caused the fragmentation of natural spaces, which in terms of biodiversity limits the possibility to preserve existing resources; as well as the degradation of water resources when rivers are erased with earthworks and when aquifers are overexploited; overall, nature's ability to respond to changes is diminished. Among the latter, it stands out the loss of "free" natural services such as flood control and at the same time, the risk of floods increases, which leads to great economic losses as well as the loss of human lives; additionally, the uncontrolled urban growth in the distant peripheries of the cities causes disproportionate expenses for the introduction of infrastructure for mobility, water and electricity (Benedict & McMahon, 2001).
Despite this situation, when reviewing the metropolitan public agenda it is evident the great concern that exists to know and to plan the infrastructure for mobility, for the supply of electricity, for the provision and treatment of water, or even for rainwater (gray infrastructure); but it is also evident the lack of a commitment to understanding and planning for a system of metropolitan green spaces to support the natural environment, particularly to increase environmental sustainability (Benedict & McMahon, 2001, Vásquez, 2016, IMEPLAN, 2016).
Just as in other urban/ metropolitan infrastructures systems, a multi-scaled approach is necessary in which a specific recognition of the relationship between patterns and processes carried out in the territory can be accomplished. This approach implies the establishment of main and secondary systems in order to achieve an efficiency at a regional / metropolitan level but also at a local, intra-urban level. The observance of an order of hierarchy as established in the planning of the most recognized urban systems (roads, water, sewers, electricity, among others) must also exist in the way we plan green spaces; namely, green infrastructure.
Like any system, existing and potential nodes and links should be identified where there are important connections in order to interrelate the different hierarchical levels, which in urban contexts are multiple scales such as the regional / metropolitan, the districts / neighborhoods and the plots or individual sites (Ahern, 2007).
These elements are present in the territory through a spatial language that according to Ahern (2007), is distinguished as a "Mosaic Model". This model uses the following three elements of the landscape to define its structure: patches, corridors and the matrix. Patches are homogeneous polygons of the territory that differ from their surroundings (they provide multiple functions, including wildlife habitat, aquifer recharge areas, or sources and sinks of species and nutrients). Corridors are areas with an elongated shape such as pathways for the flow of animals, nutrients, and wind. The matrix refers to the dominant land cover in terms of area, degree of connectivity and continuity (see Table 2).

Urban Patches	Urban Corridors	Urban Matrix
Parks	Rivers	Residential Neighborhoods
Sportsfields	Canals	Industrial Districts
Wetlands	Drainageways	Waste Disposal Areas
Community Gardens	Riverways	Commercial Areas
Cemeteries	Roads	Mixed Use Districts
Campuses	Powerlines	
Vacant Lots	Poliducts	

Table 2. Elements of the urban landscape as classified in the model Patch - Corridor Matrix. Adapted from Ahern, 2007.

2. Biophilic Cities: Between Sustainability and Resilience

Sustainability has already been extensively addressed by the existing urban planning literature. It is appointed as a holistic frame of reference to guide the development of cities, and to simultaneously improve their performance among the three dimensions of sustainable development: economic development, social equity and the protection of the environment (Campbell, 1996, Farr, 2007, UN-Habitat, 2009).
In addition to sustainability, another concept that has been incorporated into theoretical discussions about cities is that of resilience. The impacts of global climate change (i.e., an increasingly volatile climate and the large number of disasters and the consequent damages that have occurred around the world) have turned resilience into an urban and metropolitan aspiration (Metropolis Observatory, 2017). What started as adaptation to disasters and damages, has currently expanded to discussions about resilient cities, which take into account in a wide range the potential impacts and stress that cities will most likely face in the future: water scarcity, rise in food prices, and increasingly high temperatures during the summer, among others (Newman, Beatley, & Boyer, 2008). Resilience can be defined in several ways; in this study it is understood as the ability to successfully adapt and to respond to those impacts. The word resilience is derived from Latin *resiliere*, which means to spring back or to rebound. Godschalk (2003) describes resilient cities as ones "capable of withstanding severe shock without either immediate chaos or permanent harm... While they might bend from hazard forces, they would be able to adapt and would not break. Composed of networked social communities and lifeline systems, resilient cities would become stronger by adapting and learning from disasters”.
Resilience does not imply a return to dysfunctional or unsustainable conditions, but adaptation to dynamic social and ecological conditions in ways that protect and enhance quality of life, long-term ecological productivity, as well as public and personal health of the inhabitants of the MAs. Resilience is not only a matter for cities and metropolises, but has important implications for both individuals and families, which is precisely at the level where the stresses, pressures and shocks of modern life will come to bear (Beatley & Newman, 2013).
In order to improve sustainability, but above all to increase resilience, cities may become biophilic, and there are several paths through which biophilic urbanism can make it happen. Some of them have already been thoroughly studied, but others are still experimental and require extensive analyses (see Table 3).
One of the clearest paths is biophysical, the resilience benefits provided through the protection and enhancement of the natural systems and features in and around a city (Beatley & Newman, 2013). The natural systems in a city and region provide essential services that help cities and urban regions respond to and spring back from climatic and natural events. Cities with large natural wetland systems will be better able to absorb flood waters from hurricanes and storms, for instance. Protecting and restoring these great ecological systems is a key strategy that allows cities to be more resilient in the face of disasters.

Biophilic Conditions and Infrastructure
-Percentage of population within a few hundred feet or meters of a park or greenspace; -Percentage of city land area covered by trees or other vegetation; -Number of green design features (e.g., green rooftops, green walls, rain gardens); -Extent of natural images, shapes, forms employed in architecture and seen in the city; -Extent of flora and fauna (e.g., species) found within the city.
Biophilic Behaviors, Patterns, Practices, Lifestyles
-Average portion of the day spent outside; -Visiting rates for city parks; -Percent of trips made by walking; -Extent of membership and participation in local nature clubs and organizations.
Biophilic Attitudes and Knowledge
-Percent of residents who express care and concern for nature; -Percent of residents who can identify common species of flora and fauna.
Biophilic Institutions and Governance
-Priority given to nature conservation by local government; percent of municipal budget dedicated to biophilic programs; -Existence of design and planning regulations that promote biophilic conditions (e.g., mandatory green rooftop requirement, bird-friendly building design guidelines); -Presence and importance of institutions, from aquaria to natural history museums, that promote education and awareness of nature; -Number/extent of educational programs in local schools aimed at teaching about nature; -Number of nature organizations and clubs of various sorts in the city, from advocacy to social groups.

Table 3. Important elements (indicators) of a biophilic city. Adapted from Beatley, 2011.

Large wooded areas provide ecological benefits that will make cities more resilient -including effects such as moderation of air pollutants, cooling through evapo-transpiration and shading as well as flooding reduction.
Protection and restoration of rivers and urban streams reduce the vulnerability to floods, provides important cooling benefits and helps to moderate the weather and temperature changes predicted as a result of climate change. That is why cities with extensive networks of parks and green spaces are also likely to fare better in the face of long term climate change (idem, 2013).
Biophilic urbanism can help to protect or strengthen favorable climatic and micro-climate conditions in cities, which also helps them become more resilient in the face of a host of emerging resource scarcities likely in the decades ahead (idem, 2013).
“Greening” cities can significantly reduce energy consumption for heating and cooling by the function of trees as climate regulators. In promoting modes of urban mobility other than automobiles (walking, bicycling) there is the possibility of greater resilience in the diminished oil supplies. Additionally, the principles of biophilic urbanism can achieve significant water conservation, but also, through the protection of peri-urban farms and agriculture and by promoting urban agriculture, might help to ensure the food security of a city (idem, 2013).
A biophilic city is one with abundant biodiversity, full of nature, a place where residents see, feel and experience the richness of plants, trees and animals in the course of their lives, and do so in their homes, in their jobs, in the spaces where they perform recreational activities, as well as they commute. The components of nature, large and small, from the tops of trees to the invertebrates and even microorganisms that are part of larger natural elements and ecosystems, define a city and provide it with character and meaning (Beatley, 2011).Biophilic

cities are not simply green cities; the abundant presence of nature is a necessity but it is not a sufficient condition. In biophilic cities, the residents are directly and actively engaged in learning, enjoying, and protecting the nature that surrounds them and with which they have developed an important emotional connection (idem, 2011).
The possible indicators that should be integrated in a city in order to be considered biophilic are composed by the conditions and infrastructure, behaviors, patterns, practices and lifestyles, attitudes and knowledge, as well as institutions and governance (see Table 3).

3. Green Infrastructure (GI)

Green Infrastructure (GI) is a strategically planned network of high quality natural and semi-natural areas with other environmental features which must be designed and managed to provide a wide range of ecosystem services and to protect the biodiversity in both rural and urban settings (EEA - European Environment Agency, 2011).
The GI is a tool to deal with environmental problems through different solutions based on natural processes. Biodiversity acts as its central axis, since the functioning, resistance and quality of ecosystem services depend directly on the richness and abundance of the species that house the elements that make up the system. It also promotes the creation of ecological networks at different scales, requires spatial and temporal planning as well as an adequate design and is based on collaboration between citizens, managers and politicians (idem, 2011).

Habitat Services	Biodiversity and species protection.	-Wildlife habitat. -Migratory species permeability. -Habitat networking.
Regulating Services	Adaption and mitigation against climate change.	-Mitigation of the urban heat island effect. -Reinforcement of the resilience of ecosystems to climate change. -Retention of water and decrease of runoff to reduce flood risks. - Carbon seize and storage. -Encouragement of sustainable traveling. -Reduction of energy consumption to heat and cool buildings. -Encouragement of renewable energies. -Promotion of sustainable mobility.
Provisioning Services	Water regulation	-Sustainable drainage systems –reduction of runoff. -Increased water infiltration. -Water treatment.
	Food production and security	-Food supply and production of raw materials in agricultural areas, orchards, among others. -Maintenance of the fertility of agricultural land. -Development of the soil and the cycle of nutrients. -Prevention of soil erosion.
Cultural Services	Recreation, wellness and health.	-Recreational activities. -Aesthetic appreciation of nature. -Clean air. -Tourism / Ecotourism.
	Land value.	-Positive impact on the land and its property.
	Culture and sense of community.	-Local identity. -Opportunities for education, training and social interaction. -Opportunities for tourism.

Table 4. Ecosystem services provided by green infrastructure. Self-elaborated with information from Millenium Ecosystem Assessment, 2005 and European Environment Agency, 2011.

According to the classification of ecosystem goods and services, the benefits of the GI are classified into four groups: habitat services, regulating services, provisioning services and cultural services (idem, 2011). The first ones refer specifically to the habitat of species of flora and fauna; the second are those that generate benefits from the regulation of ecosystem processes; the third to products that are generated directly in the ecosystem; and the cultural ones are intangible benefits that people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation and aesthetic experiences (see Table 4). The incorporation of these services into a public policy instrument at the metropolitan level is fundamental. For this reason, “The Economics of Ecosystems and Biodiversity – TEEB” (2011) a global initiative focused on making nature’s values visible, establishes a six-step methodology for ecosystem services to be included in the processes of developing public policies for the creation of a GI network. The first step is to develop the problem; what it means and what the lack of green infrastructure can mean, what should be discussed together with the stakeholders, then the most relevant ecosystem services of the metropolis should be identified, as well as determining valuation methods for them, and then the valuation must be made. Once the management alternatives have been identified, the impact of the options that are available to the stakeholders will be assessed, so that they are included in a public policy instrument that can be a Metropolitan GI Plan (see Figure 1).

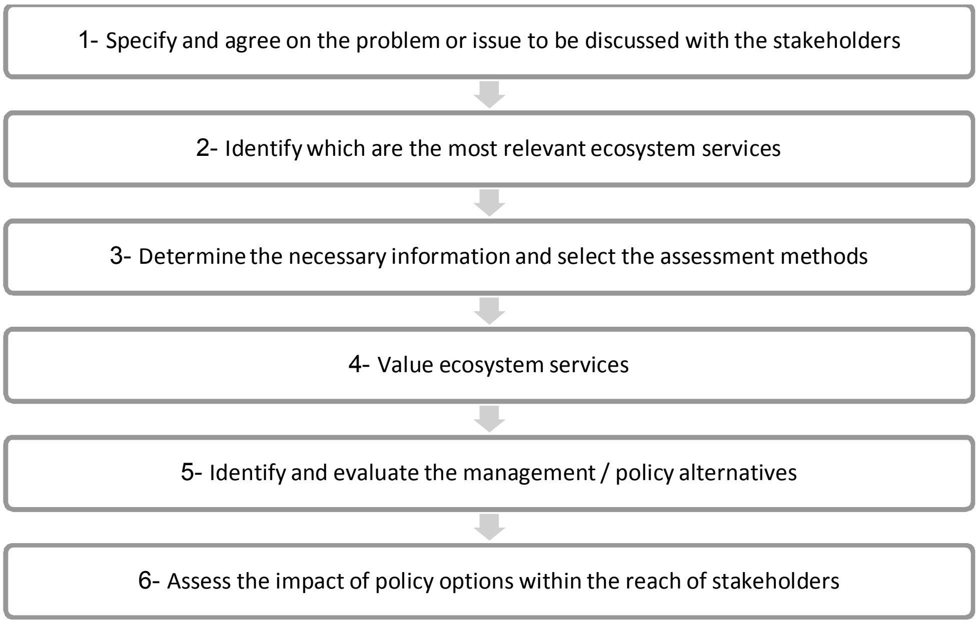

Figure 1. Methodology to include ecosystem services in public policy decision making. Adapted from The Economics of Ecosystems and Biodiversity, 2011).

The ecosystem services must be valued in order to be able to assign to each green space that integrates a GI network the importance and the hierarchy that corresponds to it according to its scope, so a set of indicators must be determined for each type of service. As part of the indicators of habitat services, there is the abundance of birds, butterflies and other species valued for their aesthetic characteristics. Among the supply services is the production of food, expressed in tons per year (T/year), as well as water supply, expressed by spending in cubic meters per year (m^3/year). While on those of regulation, there are the infiltration capacity, measured by the percentage of impermeable surface in relation to the permeable surface in hectares (Ha); the regulation of the urban temperature can be measured by the *leaf area index*; the reduction of noise by the leaf surface (m^2) and the distance to the roads (m) and the reduction of noise (dB (A)) / unit of vegetation; the purification of the air by means of the measurement of polluting particles O_3, SO_2, NO_2, CO and PM_{10} (g/cm^2/s) multiplied by the arboreal coverage (m^2). With regard to water treatment, the suggested indicator is the amount of Phosphorus, Potassium and Magnesium in mg/kg compared to the averages of soil and water; for climate regulation the amount of CO_2 absorption by trees (carbon multiplied by 3.67 to convert to CO_2). Among the cultural ones, the key indicator is the surface of public green spaces (Ha/inhabitants) and its proximity to the districts or neighborhoods of the Metropolitan Areas.

Some of the services provided by urban green spaces are the regulation of air quality, the regulation of water in floods, the regulation of local climate, as well as direct services such as recreation and environmental education, particularly when these spaces have witnessed historical events to become cultural heritage (see Table 4). The elements that make up the urban landscape and constitute the Green Infrastructure (GI) of urban areas are classified according to their scale of service. This scale is related to the frequency of use of the facilities and the distance to which these should be located. The service scales considered in Handbooks for Urban Design Criteria such as SEDESOL standards (1999) are: neighborhoods, districts and cities, but there are other sources that also address scale issues (see Table 5) and which refer to the neighborhood, city and regional scales (Vásquez, 2016).

Planners, and governmental authorities should be aware of the services provided by GI in Metropolitan Areas; but even more important is that ordinary citizens recognize their value and how they can generate opportunities for sustainable development, but they can also serve as evidence for environmental policies in any governance setting. Some ecosystem services such as air cleaning and noise reduction are regulatory services which are often not recognized even by the planners or by the citizens themselves (Kabisch, 2014).

Neighborhood Scale	City Scale	Regional Scale
Wooded streets	Rivers and flood plains	Wild protected areas
Green roofs and walls	Inter-communal parks	National parks
Neighborhood squares	Urban channels	Coastline and beaches
Private garden	Lagoons	Strategical and long distance pathways
Open institutional spaces	Suburban forests	Forests
Ponds and streams.	Natural parks	Protective belts in high voltage lines
Walkways rights	Continuous water fronts	Network of roads and railways
Pedestrian and bike paths	Municipal squares	Designated green belt
Cemeteries	Hills	Agricultural lands
Sport tracks	Large recreational spaces	Rivers and flood plains
Ditches	Estuaries	Canals
Small forests	Deserted lands	Open-fields
Playground areas	Community forests	Mountain range
Streambeds	Deserted mining sites	Common territory
School yards	Agricultural lands	Aqueducts and gas pipelines
Orchards	Wastelands	Geological faults
Deserts		Lakes

Table 5. Green Infrastructure Scales. Elaborated by Vasquez, 2016, based on EEA - European Environment Agency, 2011 and Landscape Institute, 2009.

This approach based on ecosystem services -which includes green spaces for the sustainable development of metropolises, could benefit metropolitan planning instruments such as urban development plans.

The literature determines a series of approaches for Green Infrastructure planning: the need for a holistic design as it occurs with other infrastructures such as the one for mobility; the comprehensive planning, as it happens with the electric power network attending to social, economic and environmental issues; strategic territorialization including various jurisdictions and government levels; public planning and implementation, which refers to the generation of the GI with public participation; multidisciplinarity, because it must be based on science and should be strengthened with knowledge of professional disciplines, including landscape ecology, ecological economics, urban and regional planning, and landscape architecture (Benedict & McMahon, 2001). In addition to these, it is essential that the GI is financed through specific funds as happens with the other sectoral programs, and not only be a recipient of residual monies.

4. GI in Mexico and the Guadalajara Metropolitan Area (GMA)

Because it has not been adopted as a public policy concept yet, Mexico lacks regulations for GI implementation. However, there is a legal framework that allows to include GI.
Article 4 of the Political Constitution of the United Mexican States (Spanish: *Constitución Política de los Estados Unidos Mexicanos*) establishes that every person has the right to an adequate environment for their development and well-being. The National Development Plans (NDP) have included principles to protect natural resources and to guarantee their permanence in the future. For example, in the NDP of 2007-2012, a strategy was specified so that the preservation of ecosystems and biodiversity could be achieved under schemes of conservation, management and sustainable use. Despite the fact that the need to protect natural resources is recognized as a goal in the NDP for the current administration (2013-2018), the strategies to achieve it are not in place.
Within the territorial environmental policies that have been implemented in Mexico, we can include the designations of protected natural areas, the ecological planning of the territory, the environmental impact assessment, and the payment for environmental services (Quadri de la Torre, 2006). Among these, the Protected Natural Areas (PNAs) are defined as "zones of the national territory and those on which the nation exercises its sovereignty and jurisdiction, where the original environments have not been significantly altered by human activity, or those which require preservation and restoration" by the General Law of Ecological Equilibrium and Environmental Protection (Spanish: *Ley General del Equilibrio Ecológico y la Protecció al Ambiente* - LGEEPA). The PNAs are usually established by presidential decrees whose main purpose is the conservation of biodiversity. The PNAs can also be constituted by states and municipalities through decrees that must be approved in state congresses.
The determination of PNA of state or municipal nature, has among its objectives the preservation of representative natural environments to ensure the balance and continuity of the environmental processes, and the assurance of the sustainable use of ecosystems and their elements.
There is also more specific legislation: Law for the Protection, Conservation and Promotion of Trees and Urban Green Areas of the State of Jalisco and its Municipalities (Spanish: *Ley para la Protección Conservación y Promoción del Arbolado y Áreas Verdes del estado de Jalisco y sus municipios)*, which aims to establish the provisions for expanding, protecting, managing, preserving and restoring urban green areas, palms and trees that are located over non-forest areas of the state. For its effects, the following are considered as public green areas: parks and gardens, wooded or gardened squares, planters, median strips, groves, outdoors sport courts with natural vegetation of public property, and areas or structures with any vegetal cover on public spaces.
In the V Volume of the National System of Urban Facilities (Spanish: *Sistema Nacional de Equipamiento Urbano*), the Ministry of Social Development (SEDESOL, for its initials in Spanish) makes recommendations for recreational and sport spaces, which are considered as areas that "promote communication, interrelation and social integration, as well as coexistence with nature and its conservation inside the urban areas, contributing to their ecological improvement". This regulation dates back to the 1970s, and it has been used as a standard for the design of urban facilities; however, it is not mandatory, since its implementation is optional for the stakeholders interested in urban development.
The Guadalajara Metropolitan Area (GMA) includes 9 municipalities: Guadalajara, Zapopan, Tlaquepaque, Tonalá, Tlajomulco de Zúñiga, El Salto, Juanacatlán, Ixtlahuacán de los Membrillos and Zapotlanejo, where a population of 4’865,122 inhabitants is settled.

Year	Guadalajara	Zapopan	Tlaque-paque	Tonalá	Tlajomulco de Zúñiga	El Salto	Juanacatlán	Ixtlahuacán de los Membrillos	Zapotlanejo	Metro Guadalajara (GMA)
1970	1,199,391	155,488	100,945	24648 NA	35145 NA	12367 NA	5501 NA	10652 NA	31819 NA	1,455,824
1980	1,626,152	389,081	177,324	52158 NA	50697 NA	19887 NA	8081 NA	12310 NA	35588 NA	2,192,557
1990	1,650,205	712,008	339,649	168,555	68428 NA	38281 NA	10068 NA	16674 NA	39902 NA	2,870,417
2000	1,646,319	1,001,021	474,178	337,149	123,619	83,453	11792 NA	21605 NA	53461 NA	3,665,739
2010	1,495,189	1,243,756	608,114	478,689	416,626	138,226	13,218	41,060	63636 NA	4,434,878
2015	1,460,148	1,332,272	664,193	536,111	549,442	183,437	17,955	53,045	68,519	4,865,122
*2020	1,549,200	1,414,972	689,659	568,367	601,122	169,212	15,009	59,435	73,931	5,140,907
*2025	1,594,291	1,479,949	725,621	601,034	644,641	179,921	15,711	63,459	77,814	5,382,441
*2030	1,632,307	1,535,393	758,905	630,810	683,952	189,981	16,355	67,015	81,459	5,596,177

*Table 6. Population 1970 - 1980 AMG. Source: INEGI and * CONAPO, 2017*

With regard to the footprint of the city, this has experienced a stronger and disproportionate increase in relation to the population, which is evident in the period of 15 years comprised between 1990 and 2015. While the population of the GMA went from 2'870,417 in 1990, to 4'865,122 in 2015 -that is, an increase of almost two million inhabitants (1.59 times); the footprint of the city increased 1.9 times its size (IMEPLAN, 2016). This data allows us to determine that the occupation of the territory is more accelerated than the population increase up to 21% (see Table 6).

Consolidated	Potential Consolidation
Parque Agua Azul	Bosque urbano Miravalle
Parque Metropolitano	Cerro El Gato
Parque González Gallo	Parque Lomas del Cuatro
Parque Solidaridad	Parque Cerro del Tesoro
Parque Natural Huentitan	Parque Las Liebres
Parque Morelos	Cerro Santa María
Bosque Los Colomos	Cerro del Cuatro
Bosque Pedagógico del Agua	Parque Lomas de Aztlán
Parque Revolución	Cerro San Martín de las Flores
Parque El Dean	La Piedrera
Parque Alcalde	Parque San Rafael
Parque Eca Do Queiros	Parque Roberto Montenegro
Parque Agroecológico Ixtépete	Bosque urbano El Palomar
Parque Tucson	Cerro de la Reina

Table 7. Urban Forests in the Guadalajara Metropolitan Area (IMEPLAN, 2016).

At the metropolitan level, there is a recently created planning instrument: the Metropolitan Territorial Plan (Spanish: *Plan de Ordenamiento Territorial Metropolitano* - POTMet). This plan must define a metropolitan structure to be developed along with the municipalities within the GMA. This is why the inventory of GI that currently exists is fundamental. The POTMet (IMEPLAN, 2016) tries to determine this infrastructure of metropolitan scale and character under the concept of urban forests. These are considered as ecosystems composed of trees and other vegetation with a dense tree mass, which provide different ecosystem services to cities for the well-being of their inhabitants (idem, 2016). As a result of a mandatory national policy to favor the development of compact cities (H. Congreso de la Unión, 2016), the POTMet itself establishes the need to inhibit urban development in areas far from the boundaries of

already existing urbanized areas, however it doesn't include a strategy to increase green spaces that at least correspond proportionally with the number of new inhabitants that are expected to return to the central city as a result of this policy.
POTMet considers two sets of green open spaces: consolidated and with potential for consolidation (see Table 7). Although they are already presented as strategic urban forests should also be valued according to the particular ecosystem services they provide. For this purpose, assessments of those green spaces should be based on the existence of evidence of the provision of ecosystem services.
The assessment proposed refers to a rating of 1-10, and considering the services that are ideal for the improvement of the quality of life conditions of the inhabitants of the GMA; or simply considering the existence of any evidence that proves that the green space is actually providing the service (see Table 8).

	Mobility	Provisioning services		Regulating services								Cultural services				Habitat services	
Space	Mobility Corridor	Food	Water	Urban weather regulation	Noise regulation	Air purification	Extreme weather moderation	Runoff decrease	Water treatment	Polinization, pest control	Global climate regulation	Recreation	Landscape/ Aesthetics	Education	Social cohesion and values of the place	Biodiversity	TOTAL
Bosque Urbano Miravalle	0	0	0	1	0	1	0	1	1	1	0	1	1	1	1	1	10
Cerro El Gato	0	0	0	1	0	1	0	1	0	0	0	0	1	0	0	1	5
……… ……																	

Table 8. Assessment of Urban Forests. Evidence of provision of Ecosystem Services. Self-elaborated with criteria from (EEA - European Environment Agency, 2011).

In order to calibrate the criteria, it is necessary to establish ideal objectives considering the opinion of the citizens, because as it has already been said they are the ones who may or may not legitimize the priority character of the elements of the GI network.
According to the legal and regulatory framework in the state of Jalisco, where the Metropolitan Area of Guadalajara is located, the State Law of Ecological Equilibrium and Protection of the Environment consigns as protected natural areas within the competence of the state government: state parks, natural formations of the state interest and state areas of hydrological protection. And as a competence of the municipal governments: the municipal ecological parks, the ecological preservation zones of the population centers, and municipal areas of hydrological protection.
POTMet states that within the GMA there are five decreed natural protected areas: one is federal (Bosque de la Primavera), two state (Cerro Viejo - Chupinaya - Los Sabinos and Colomos) and two municipal (Bosque el Nixticuil y Barranca del Río Santiago), which altogether occupy an approximate area of 73,330 hectares. The adequate conservation of these areas is relevant for territorial planning, since it helps to maintain the quality of ecosystems and their biodiversity, as well as their provision of environmental services which are achieved through their conservation and sustainable management (IMEPLAN, 2016).

5. Recommendations

As previously explained, not only the presence of nature in abundance is needed for a city to qualify as biophilic, since it must also be one that holds green infrastructure and adequate governance and institutions. The latter would favor the development and strengthening of the other dimensions that make up a city of this kind: behavior, patterns, practices and lifestyles of its inhabitants, as well as attitudes, and the generation of knowledge about nature.

Metropolitan Scale
-Rivers and flood plains. -Lagoons. -Urban forests. -Natural parks. -Continuous water fronts. -Large recreational spaces. -Deserts. -Wild protected areas. -National parks. -Coastline and beaches. -Strategical and long distance pathways. -Forests. -Protective belts in high voltage lines. -Network of roads and railways. -Designated green belts. -Agricultural lands. -Canals. -Open-fields. -Mountain range. -Common territory. -Aqueducts. -Gas pipelines. -Geological faults. -Lakes.

Table 9. Metropolitan Green Infrastructure. Based on EEA - European Environment Agency, 2011; Landscape Institute, 2009; Vasquez, 2016.

In addition to urban forests, some elements of a metropolitan scale could be considered to be integrated into the GMA's Green Infrastructure (see Table 9). These elements must be assessed to confirm their relevance based on criteria such as the one described in the previous section. That is the reason why it is recommended that before establishing a proposal for the GI system, this evaluation should be carried out.

It is foreseeable that some elements are left out of this classification, but they should be integrated into the urban or neighborhood scales, and will continue to be part of the large GI multi-scale system.

Among the recommendations we could consider the proposal of Valdes and Folukes (2016) that refers specifically to mobility, safety, recreation and sports as well as to the economic, environmental and management issues, such as the sectors in which it is opportune to influence in order to define a strategy for generating a GI network.

In terms of mobility, it emphasizes green corridors or linear parks for cyclists and pedestrians that interconnect public places such as squares, parks, schools, libraries, workplaces, even shopping centers, including universal accessibility for these corridors to guarantee its utilization to every user. In Mexican metropolises, security is also fundamental, so the system should take into account both lighting and space monitoring. The use of the GI as recreational spaces, which allows outdoor exercises (depending on air quality), to lead a healthy lifestyle. The GI should also be used to educate and raise awareness about the importance of green areas, particularly by making the value of spaces known; it is advisable to use maps with information such as physical characteristics, and services that are provided inside of them. In the economic aspect, the GI must be considered to attract tourists to urban areas; it must recognize the increase of surplus value of the properties located in the vicinity and that the citizens through the authorities are able to capitalize it; there must be an annual operating budget that ensures continuity in the maintenance of green spaces. It is also recommended the application of tax

incentives to encourage both individuals and companies to donate land destined to increase the GI network, as well as considering as a generator of transfer rights, in order to obtain compensations for the maintenance of properties with the potential to increase floor area ratios (FAR). On environmental matters, spaces in the GI network should be considered as part of the flood reduction strategy in the metropolises, and simultaneously as aquifer recharge areas. About management, it is necessary to prepare, as part of the metropolitan planning instruments, a GI network that includes its implementation through an organizational structure for the planning of the metropolitan territory; an organization must also be created in order to launch a public awareness campaign, integrating volunteer programs, and encouraging fundraising to manage green infrastructure in the Metropolitan Areas.
Although this study concludes that GI is necessary for metropolitan resilience, ultimately, the participation of citizens and their recognition is the only essential element for the GMA to have a GI system/network suitable for their needs.

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Case Study: Urban Green Belt Planning in Foshan City, China

Xin Feng, Yunfeng Jin[1]

Abstract
We examine how Chinese planners proposed a green belt to make Foshan resilient to climate change while enhancing recreational opportunities and conserving open space. This effort is noteworthy as the accelerated urbanization in China has created a series of environmental problems.

Introduction

Foshan is a prefecture-level city (herein after also referred to as a municipality) located in central Guangdong Province in southeastern China. The entire prefecture covers 3,848.49 km2 and has an urban population of about 7.2 million. The local government has made substantial investments into technological innovation and its strong support to face environmental challenges has been widely recognized in China.

Green space also plays an important role in urban ecosystems and provides significant ecosystem services with environmental, aesthetic, recreation and economic benefits. Their natural resources and river valleys provide flood protection, fresh water, clean air, local food, and the enjoyment of nature to rural and urban residents. As the population and urbanization of the region expands, the economic, environmental and quality of life solutions delivered by the greenbelt become more important. Through a climate mitigation and adaption lens, the health of the greenbelt and its river valleys is essential to improving resilience in the region.

In recent years, green belts have incorporated the principles of landscape planning into city design, giving predominance to green structures where the relationship between the environment, nature and the landscape are not merely spectators but are key players in the design of cities. These principles were set out in 1988 at the UNESCO Environment and Biosphere Conference which established the need to work jointly on a systematic and collective description for the green areas in a city and suggested that green belt plans must respond to the union between function and design as an integral and active concept. In China, it is possible to find plans based on criteria, but it is difficult to find references to projects which cover all these aspects at once.

In the late 2000's, planners in Foshan developed a greenbelt strategy focused on building a resilient living system which addressed multiple objectives such as recreation, protection, conservation and landscape preservation[i]. As land in China is owned by the government, there is a great deal of potential to conserve the landscape and enhance a resilient ecological strategy.

The overview of Foshan and its existing greenway system

GIS maps of natural and man-made features were created and analyzed. Below are the major findings revealed because of this process.

The administrative region of Foshan had an unbalanced urban construction (Figure 1), by which we mean that there was a greater concentration of high density development in the

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eastern urban area than found in the Western and Northern urban areas. The sprawling urban pattern occupied and split the original “green” natural system with blurred cluster boundaries.

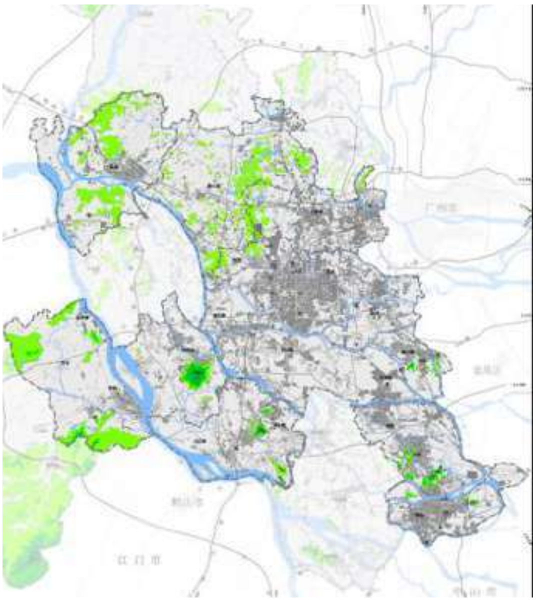


Figure 1 The overview of greenbelt resources in Foshan

Foshan also had unequally distributed forest resources that were mainly located in the Gaoming District in the West (69% of all forests) and the Sanshui District (17% of all forests) in the North (Figure 2). The more developed Nanhai District and Shunde District had fewer forest resources with 9% and 5% of the total Prefecture’s resource respectively. South Asia tropical vegetation accounted for 17.6% of the forest coverage.

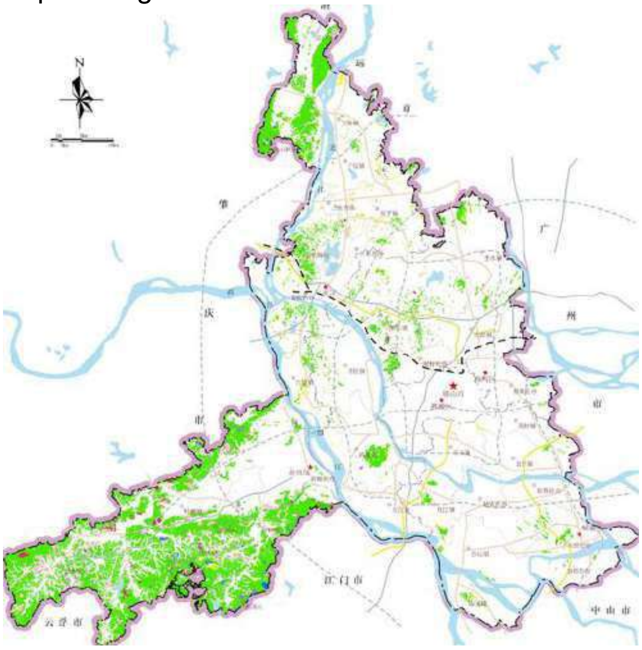


Figure 2 The forest resources of Foshan

Located in the hinterland of Pearl River Delta, Foshan is traversed by the Xijiang and the Beijiang rivers. Both have large flows and boast networked river branches, including the tributary Lubaoyong, Xinanyong and Jiliyong rivers. The land along these rivers is characterized by a typical crisscross water network and a flat terrain. The rivers and their associated wetlands occupy 347.04 square kilometers, or 9.1% of the municipal area (Figure 3). Dike-ponds and farmland cover an area of 731 square kilometers, accounting for 19% of the municipal area. Foshan had three more-than-medium sized water reservoirs.

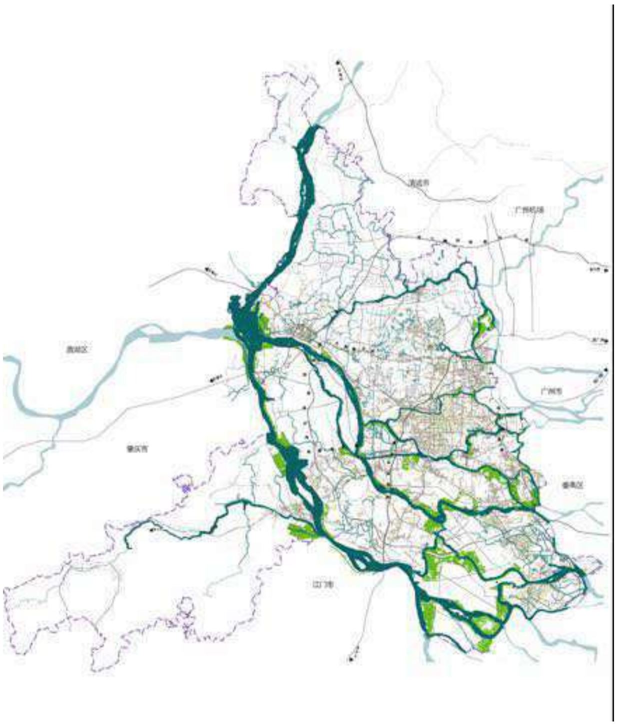


Figure 3 The riverfront green space of Foshan

We also found that although existing regional greenways connected some places of interest, such as forest parks, scenic attractions, and suburban parks, they mostly only connected recreational green spaces. In addition to linking recreational lands, greenways should also serve other purposes, such as eco-conservation and natural feature protection, if they are to become a resilient system.

Our strategy

A regional greenbelt system concept was adopted. Our strategy was to develop a regional greenbelt system which would: 1. include essential ecological elements; 2. reinforces the functions and processes in our current land use plans; and, 3. guarantee the conservation and restoration of key ecological systems. We adopted the concept that the regional green belt is a living system. To keep a healthy green belt, connections with the main supplying areas and natural corridors must be insured.

In landscaping, and specially in large green areas, it is fundamental to maintain a tension which features contradictory characteristics. Therefore, Greenbelts must be flexible, adaptable, socially dynamic, and revive environments that are absent from the city. They must be 'resilient' spaces. In other words, our green belts must be capable of responding to changes or disruptions without modifying their fundamental state (Ahern, 2011). To build up a resilient system, we adopted the recommendations of Jack Ahern (2011) who suggested the following greenbelt characteristics. First, greenbelts must have a multifunctional perspective which brings an integrative ecological-social view. Secondly, the design must prevent functional redundancy and fragmentation, while promoting the diversification of mechanisms, solutions and interlocutors which offer more options for assimilating ecological and social changes. Finally, the project should incorporate adaptive planning and design and be used as a laboratory of ideas which can offer dynamic solutions.

We worked with local government officials to increase public benefits from Foshan's greenbelt and regional resiliency. Our work plan started with an analysis of ecological, social and spatial information at regional and urban scales to offer responses based on resilience. Based on our analysis the following objectives were established:

1. Enhance social wellbeing and identity. The planned greenway should reflect the existing communities and their life styles, related to the prior use of the land and at the same time contribute to the wellbeing and improve of the quality of life, by means of increased accessible and by creating recreation subsystems within the larger project area.

2. Create regenerative and resilient systems and boost the landscape's capacity for recovery, promotion of biodiversity and mitigation of risks. This would be achieved by designing green wedges to penetrate urban boundaries with regional eco-green spaces and by establishing a continuous conservation corridors system to leverage the natural green space resources, ensure the provision of future natural resources, and fight against climate change in urban area.

Background: Management and execution by level

As an of this subordinate green space system planning, *The Master Plan of Foshan* (2008-2020) provided important guidance for developing regional and urban parks and established criteria for establishing the overall area for green space development. That plan called for 9,349 hectares of urban green space, 11.6 m2 of per capita urban green space, and 6,803.5 hectares of urban public green space (8.44 m2 per capita). In total green spaces were to account for 8.3% of urban construction land and an urban greening rate of 48%. Urban green space planning indicators were determined based on the demands and possibility of urban construction and holistic considerations covering short term & long-term development, the development rate, and the special need for urban greening.

Development control of municipal green space were planned to adhere to the regulations of level-based management control and be subject to more specific planning related to the subordinate downtown or the requirements of single green spaces as appropriate.

The programs for new urban green spaces were mainly considered on a case by case basis considering their relationship to existing facilities and in compliance with recreational green space subsystems or landscape green space subsystems criteria. Residential areas and quarters were to be provided with access to municipal park, regional park, residential district park, residential quarter park based on service radius and quantity criteria. For landscape-based subsystem, the instructions on the planning and layout of overall landscape, building and green space areas; greening style and tree species selection were defined in standards and should be executed in the urban design to the scale of detailed single block green spaces and architectural design of subordinate level.

The regional green space system and subsystems

Common to many open space and park systems, the plan envisioned a hierarchy of facilities ranging from regional to neighborhood in scale. This concept was referred to as one consisting of a use classification system and a sub-system based on the function of the facilities.

The regional green spaces were divided into 5 classes and 15 sub-classes (Table 1). Except for the water surfaces of the main rivers, the green space delineated totaled 114,318.35 hectares, accounting for 29.70% of Foshan area. The delineated areas of main rivers and reclamation land reached 30,685.46 hectares (excluded from the statistics).

Table 1 The 5 classes and 15 sub-classes of the regional green spaces

Based on an in-depth survey regarding the diversified functions and inherent connections among regional green space systems, the organization and planning of regional green subsystems (Table 2) was divided into three categories: regional conservation green space subsystem; regional recreational green space subsystem; and, regional protective green space subsystems. This system is displayed in Table 2.

Table 2 Regional green space subsystems

<table>
<tr><td colspan="2">Regional green space types</td><td>Type code</td><td colspan="2">Types of regional green space</td><td>Type code</td></tr>
<tr><td rowspan="4">Eco-conservation zone</td><td>Nature conservation zone</td><td>G-E1</td><td rowspan="4">Sightseeing green space</td><td>Forest park</td><td>G-L1</td></tr>
<tr><td>Water-source conservation zone</td><td>G-E2</td><td>Sightseeing attraction</td><td>G-L2</td></tr>
<tr><td>Basic farmland conservation zone</td><td>G-E3</td><td>Resort (only green space part)</td><td>G-L3</td></tr>
<tr><td>Soil erosion prevention zone</td><td>G-E4</td><td>Suburban park</td><td>G-L4</td></tr>
<tr><td rowspan="4">Coast green space</td><td>Coastline protection forest</td><td>G-C1</td><td rowspan="4">Buffer green space</td><td>Green beltway</td><td>G-B1</td></tr>
<tr><td>Coastal wetland and mangrove forest</td><td>G-C2</td><td>Infrastructure separating belt</td><td>G-B2</td></tr>
<tr><td>Aquaculture farm and reclamation district</td><td>G-C3</td><td>Disaster preventive green space</td><td>G-B3</td></tr>
<tr><td>Marine life breeding zone</td><td>G-C4</td><td>Public hazard preventive green space</td><td>G-B4</td></tr>
<tr><td rowspan="4">Riverfront green space</td><td>Branch river and reclamation area</td><td>G-R1</td><td rowspan="4">Special green space</td><td>Geological and geomorphologic landscape area</td><td>G-S1</td></tr>
<tr><td>Large pond and swamp</td><td>G-R2</td><td>Natural disaster sensitive zone</td><td>G-S2</td></tr>
<tr><td>Large-medium reservoir and water source forests</td><td>G-R3</td><td>Historical heritage protection entity</td><td>G-S3</td></tr>
<tr><td>Dike-pond system</td><td>G-R4</td><td>Traditional landscape zone</td><td>G-S4</td></tr>
</table>

Subsystems	Types of regional green space
Regional recreational green space subsystem	Scenic attraction
	Resort
	Forest park

	Suburban park
	Wetland park
Regional conservation green space subsystem	Natural conservation zone
	Water source conservation zone
	Basic farmland conservation zone
	Large and medium reservoirs
	Dike-pond system
	Geological and geomorphologic landscape area
	Natural disaster sensitive zone
Regional protective green space subsystem	Green beltway
	Infrastructure protection

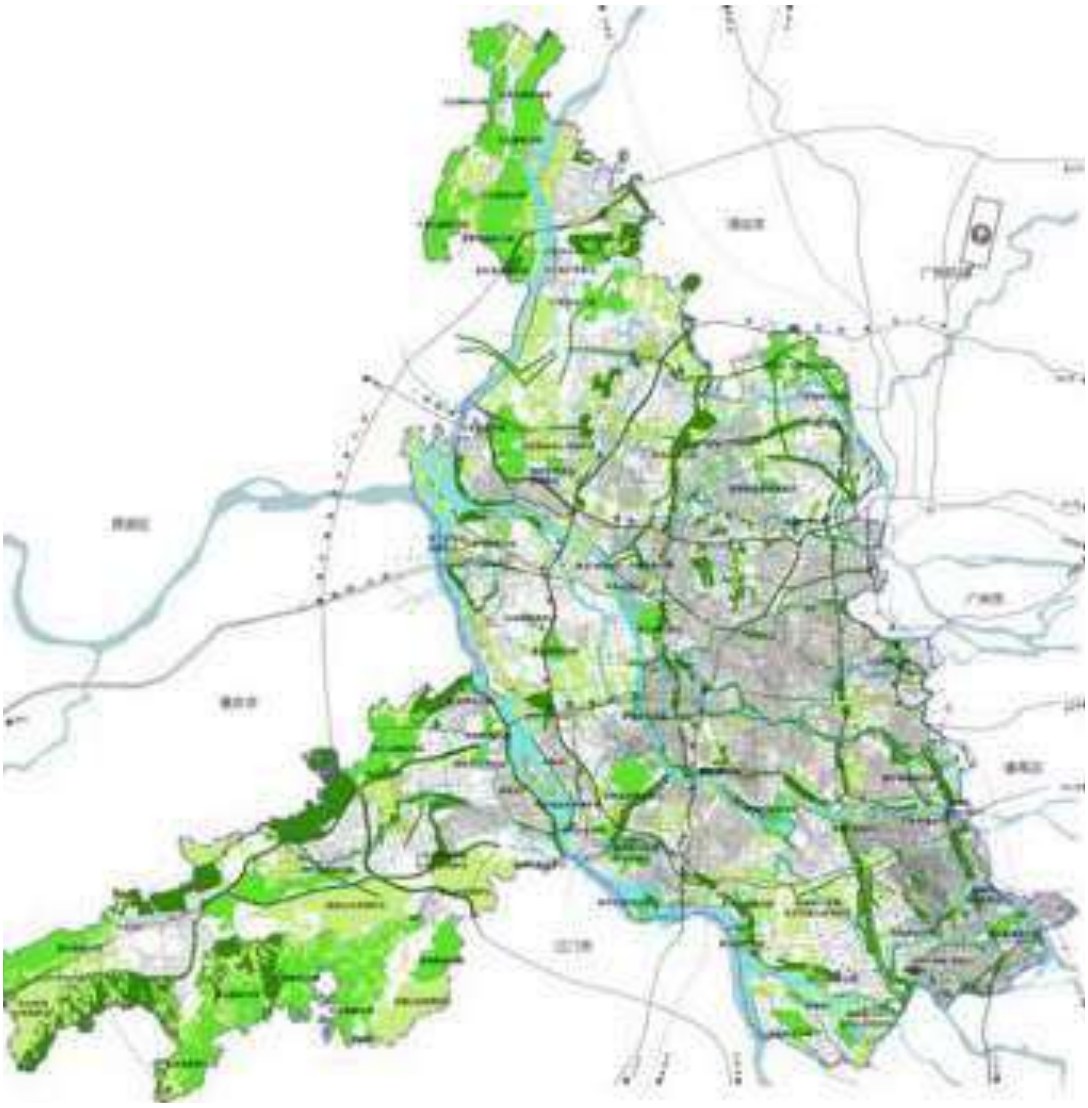


Figure 4 The regional green space system

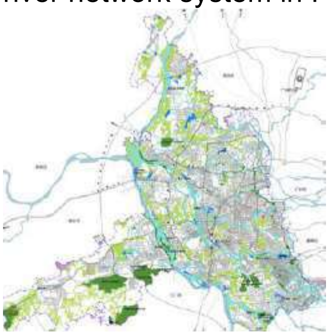
Regional recreational green space subsystem

The planning of municipal recreational subsystem (Figure 5) was arranged based on scenic attractions, forests parks and resorts along greenways, and was integrated with the green space resources, cultural relics and road traffic throughout the municipality.

Figure 5 Regional recreational green space subsystem

Regional conservation green space subsystem

The municipal conservation green space subsystem (Figure 6) covers water source conservation zones, natural conservation zones, seedling nurseries, flower nurseries, grass nurseries and basic farmland conservation zones. It is planned and organized based on the river network system in Foshan.



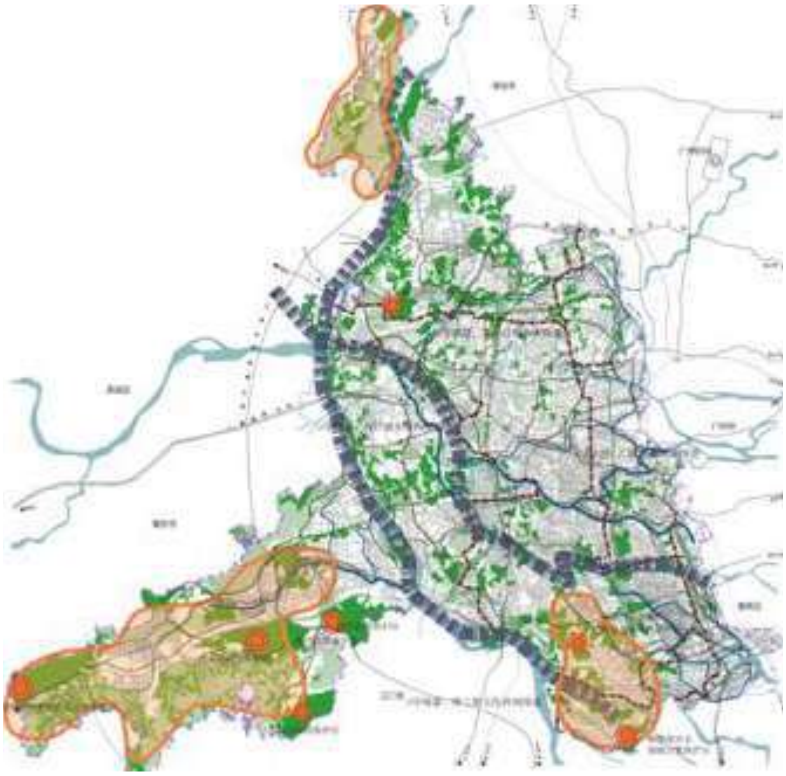


Figure 6 Regional conservation green space subsystem

Our strategy: The urban green space system planning
The principles used to define green land system planning in the urban area (Figure 7) were: first, reflection about the basic structure and layout of regional green space system, and maintenance of the constancy and completeness of natural eco-system; second, defining and coordinating the functions of green spaces and organize the green spaces with similar functions into a subsystem; and third, to ensure a fair and convenient public access. We tried to distribute green spaces evenly.

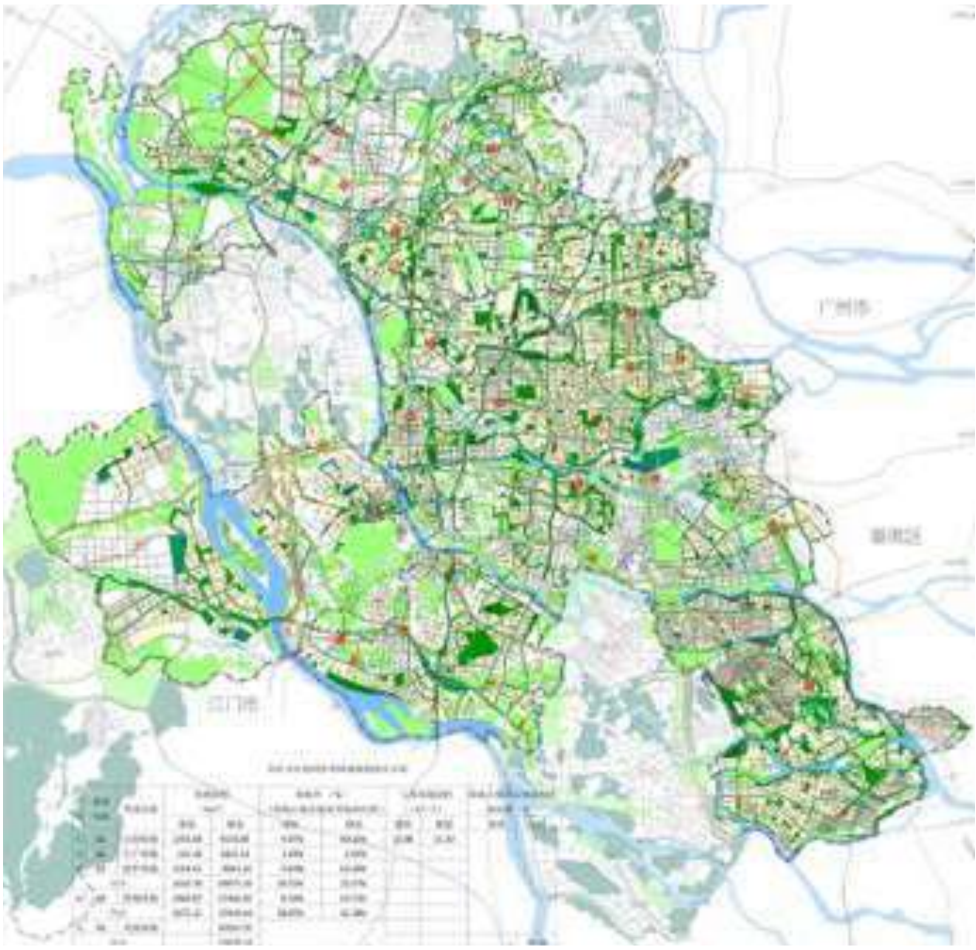


Figure 7 The Urban Green Space System Planning

The layout of green spaces in Central cluster

The layout of green spaces in the central cluster (Figure 8) could be described as **“Four-ring, five-wedge, and multi-axis”. “Four-ring”** refers to the relatively independent, but related, four small clusters formed by Jiliyong Water Branch, Tanzhou Waterway and Dongping waterway. The urban green space forms a ring boundary around all the clusters to protect the landscape system in the cluster. **“Five-wedge”** refers to the municipal green-space-composed broad green belts that connected the periphery and centre of clusters and further divide the cluster interior. The green wedges of clusters were arranged in the same positions of the green wedges in the municipal green space system structure. **“Multi-axis”** refers to the North-South landscape axis of the central zone and its roads. Due to the dense development in these central clusters, the axis planning along with the prevailing wind direction helped a lot to improve urban climate and landscape development.

Figure 8 The layout of green spaces in Central cluster

The layout of green spaces in Daliang-Ronggui

The green space layout of Daliang-Ronggui could be described as **“one-ring, one-core, and two-corridor”**. **“One-ring”** refers to the 200-500 m wide green beltway of Shunde composed of the Shunde, Ronggui, Hongqili, Guizhou, and Jiya Waterways and their waterfront green spaces. Shunde Waterway runs along the North, the Lijiasha Waterway headed to the East and then the West front; relocated No. 105 National Highway and the waterway along Lungui Road extend to the West;and, Guizhou Waterway approached the South. “**One-centre**” referred to the urban green centre surrounding Shunfeng Mountain and the extensive lake. The centre consists of a large-scale area connected with the small waterways and green belts that run through clusters to define a closely interconnected green space system. It is the most prominent recreational and landscape system in the cluster. **“Two-corridor”** referred to the areas consisting of waterways and 400-800 m green belts which separate each cluster. The corridor between Lunjiao and Daliang was formed by municipal buffer green spaces (more than 200 m) along Guangzhou Ring Expressway and that between Daliang and Ronggui is established with Ronggui Waterway and riverfront green space (including the Shunfeng Island and Dashan Island in Desheng River). These two broad corridors separated Daliang-Ronggui Cluster further to form a relatively independent yet interconnected urban land structure.

Figure 9 The layout of green spaces in Daliang-Ronggui

The layout of green spaces in Shishan Cluster

The layout of green spaces in Shishan Cluster (Figure 10) could be described as **“a big green spot+ a large green corridor**” following the green space systematic structure positioning of Shishan Cluster in the Master Plan. The “**big green space**” referred to the concentration of shallow hills, reservoirs and fish ponds, including the extensive hills, lakes, plantation and waters (as part of the Green Centre in municipal green space system) between Nanguo Peach Garden Tourist Holiday Resort, Emperor's Tomb (Tianzimu) Scenic Spot, East of Shishan, Songgang, Dali and Luocun. If we interpreted the whole cluster as a figure-ground diagram, the municipal serves as the ground, and the construction land, the figure. Shishan Cluster worked as an essential urban green core in the overall structure of municipal green space in Foshan.

“**Large green corridor**” referred to the channels consisting of the the scattered water branches and fishponds. This corridor brings waterfront green spaces in the cluster. It could separate the construction land blocks and buffer each eco-blocks and serve a crucial eco-corridor to connect with the Big Green Spot, contributing to a conservation system featuring eco-diversity.

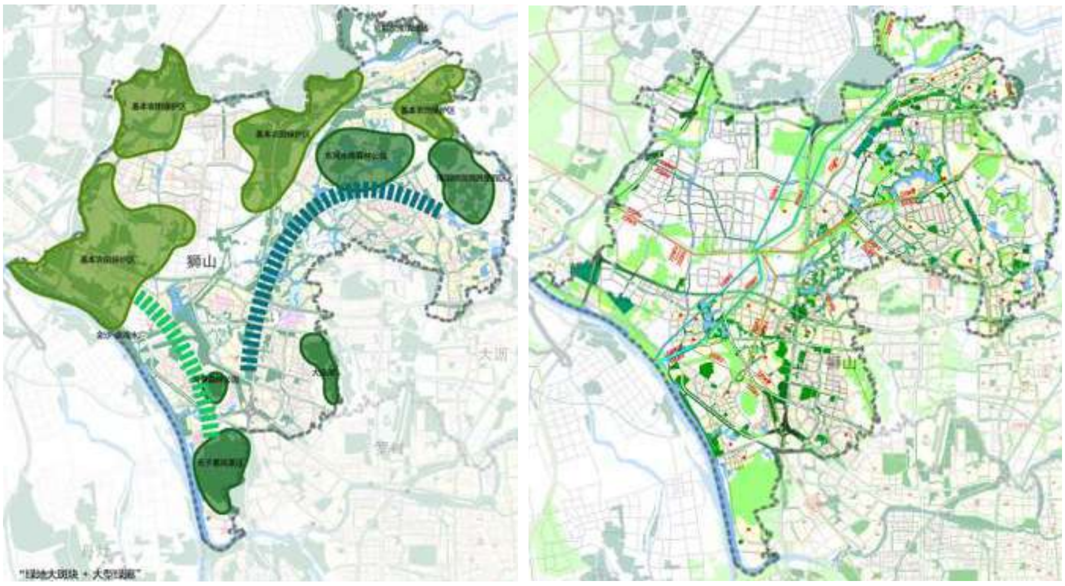


Figure 10 The layout of green spaces in Shishan Cluster

The layout of green spaces in Xi’nan Cluster

The layout of green spaces in Xi’nan Cluster (Figure 11) could be summarized as “**one-axis, two-belt and three plots**”. “**One-axis**” referred to the city axis, composed of various urban green spaces, that connects Yundonghai and Ma’angang,. This cluster connected two important large green spaces in the Xi’nan Cluster, the Yundonghai Wetland Conservation and the Ma’angang Suburban Park. It serves to make the urban green space landscape more consistent, holistic and enhances city ventilation with its North-South orientation. **“Two-belt”** referred to the trunk streams of the Xijiang and Beijiang Rivers as well as the buffer green spaces along the rivers and riverfront green space. It protected city water resources and shapes the urban waterfront landscape. “Three-plots” referred to the three large green spaces which serve as the cardinal conservation system in the cluster. One green space is an essential area for wetland conservation that featured a special geographic landscape located at an estuary. It is the intersection of two rivers, where a group of concentrated islands could be found. The other two green spaces are Yundonghai Wetland Conservation and the South-extending hills of Ma’angang; both important municipal green spaces. Located in the North and South of the city along the dominant wind direction, these Green Spaces helped to improve the climate and environment of the city.

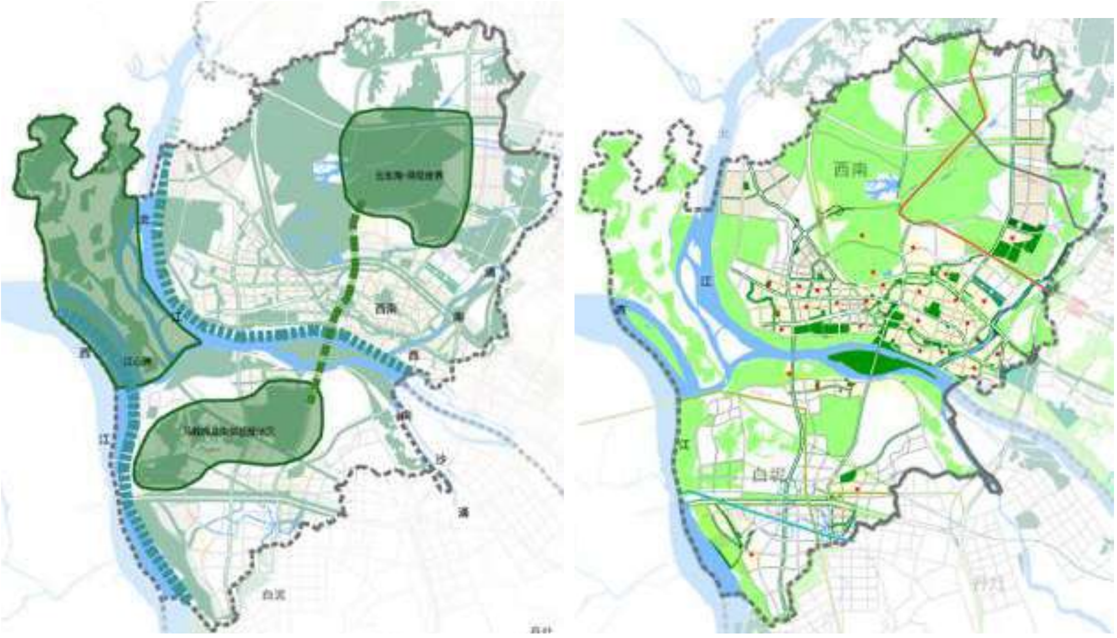


Figure 11 The layout of green spaces in Xi'nan Cluster

The layout of green spaces in Xijiang Cluster
The layout of green spaces in Xijiang Cluster could be described as **"One-river, multi-corridor and three-spot"**. "**One-river**" refers to the Fuwan trunk of Xijiang Riiver. The flat shoal in this section was planned as a suburban park themed for wetland conservation. "**Multi-corridor**" referred to the green beltways along the Guangzhou Ring Expressway and the green belts on, or along, the water system across the cluster. The green belts along traffic paths and water branches, constituted eco-corridors that run through the cluster and connect green spots and Gaoming Forest in the West. The criss-cross pattern of the corridor and green spot helped to organize urban recreational and landscape system.**"Three-spot"** referred to the Xiqiao Mountain Scenic Spots and its dike-pond system agricultural conservation zone, the West Bank Conservation Zone, and, the Lingyunshan Forest Park recognized by UNESCO.

Figure 12 The layout of green spaces in Xijiang Cluster

The layout of green spaces in Dali Cluster
The layout of green spaces in Dali Cluster (Figure 13) could be understood to be **"One-ring, two-corridor and two-axis"**. The term "One-ring" referred to the intersection between Huangqi, Yanbu and Guangzhou set aside for water resource conservation forests; the intersection between Northern & Western Songgang, Luocun and Shishan (dense hills and reservoirs are distributed in the junction of Western Dali, Luocun and Shishan); and the

waterfront green space which is an important buffer green space separating the cluster and central cluster. These water resources areas consisting of conservation forests, hills, reservoirs, waterways, and waterfront green spaces constituted a green beltway for Dali Cluster. **"Two-corridor"** referred to two eco-corridors. Dali Cluster was planned with a North-South green corridor to link the forest oxygen source, where the Nangou Peach Garden Tourist Holiday Resort is located (in the north of the cluster) and the Dali Cluster, intended to improve the domestic environment in the Cluster. Another eco-corridor, combined with the Southern green space resources form a wider green belt which serves as the wind inducing forests and a buffer between industry and residence. For the **"two-axis"**, one axis referred to the urban landscape axis, an extension of the green axis in Nanhai centre landscape which is an essential urban public green space for sightseeing and recreation. The other axis, a road green axis formed with the green belts of Foshan ring by ring, which provided a green open space between the urban areas and North of Foshan.

Figure 13 The layout of green spaces in Dali Cluster

The layout of green spaces in Jiujiang-Longjiang Cluster

The overall layout of green spaces in Jiujiang-Longjiang Cluster could be defined as "**a green beltway, a cross-shaped green corridor and multi-spots**". The "**green beltway"** referred to the ring green belt enclosed by the Jiujiang-Longjiang Section Xijiang (in the North-South boundary of the Cluster); the Shatou-Longjiang Section of Dongping Waterway, and the extensive farmlands in the eastern and western boundaries. The "**cross-shaped green corridor**" referred to the protective green spaces that transverse the middle of cluster, W-E extending along Guangzhou Ring Expressway and those running along Foshan-Kaiping Expressway in North to South direction. Since the area is an important traffic hub, we planned to delineate a nearly 200 meter wide buffer green spaces along the key traffic path at both sides (including Guangzhou Ring Expressway and Foshan-Kaiping Expressway) and establish a reserved right of way for regional traffic. "**Multi-spots**" referred to the massive green spaces, Huangji Heron Conservation Zone, Longfengshan Forest Park, Dajinshan Forest Park and the concentrated farmland in the west, and southeast of Longjiang area.

Figure 14 The layout of green spaces in Jiujiang-Longjiang Cluster

Our strategy: Urban Green Subsystem Planning

The planning of urban green space subsystems
Besides the **quantitative** demands to be fulfilled, the urban green space system should be provided with defined urban **functions** and a **rational layout**. An urban green space system, can be divided into four subsystems: the green space for recreation, the green space for protection, the green space for conservation; and, a landscape preservation green space.

The urban green space should be arranged based on the land use pattern of the urban master plan. It should highlight the functions of urban green space system to the whole city, maximize the connections to other functional green space, balance the distribution of greenway activities and rationalize the spatial arrangement for each green space type.

Recreational green space is provided for the daily activities of citizens and should be fully integrate into the urban areas, such as residential land, commercial land, and road and river system. To integrate urban recreational green space resources, it was necessary to establish green network for people’s daily and holiday access. Therefore, the green space with recreational as major function will become an independent system for such outdoor leisure activities as sightseeing, exercise and social intercourse to enhance urban life quality (Figure 15).

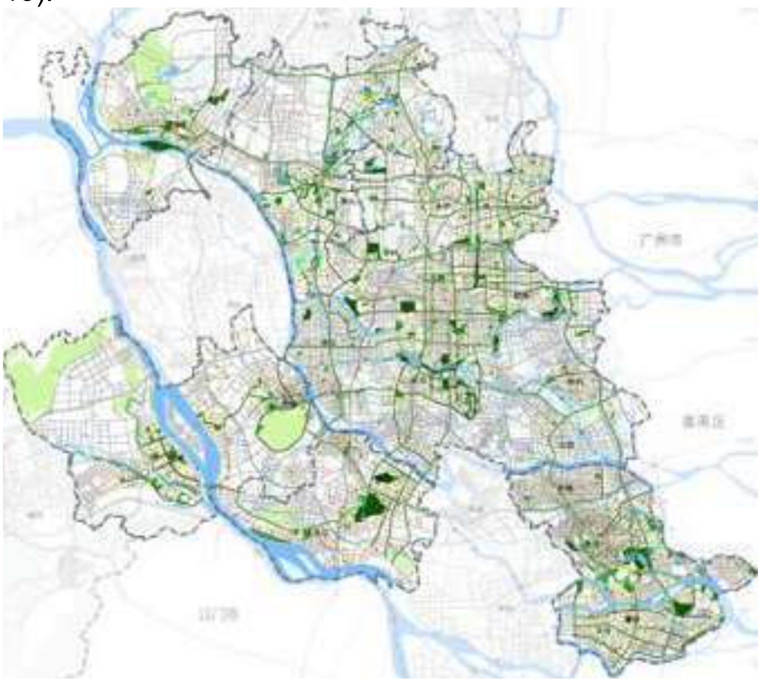


Figure 15 The urban recreational green space subsystem of Foshan

Recreational green space subsystem was divided into two factors (Table 3): planning for recreational spots and recreational corridors. The former mainly consisted of the planning of green space for holiday, daily recreation, and theme recreation. The planning of recreational corridors integrated the planning of **greenway and greennet with the layout of recreational spots**, and provide corresponding classification.

Table 3 The components of urban recreational green space subsystem

	Subsystem components	Planning contents	Types of green space	Notes
			Municipal park	Area ≥45 hm^2

Recreational green space subsystem	Recreational spot	Planning of holiday recreational green space	Suburban park	Excluded from indicator statistics
		Planning of daily recreational green space	Regional park	Service radius: 1,600 m, area: 5-20 hm^2
			Residential district park	Service radius: 600 m, area: 1.5-3 hm^2
			Residential quarter park	Service radius: 350 m, area: 0.5-1 hm^2
			Roadside green space	Determined base on road traffic organization and community park distribution
		Planning of theme recreational green space	Children's park, botanical garden, historical legacy park, scenic attraction park, playground, other theme park	Determined base on green space resources and historic legacy of Foshan
	Recreational corridor	Planning of municipal recreational corridor	Planned based on roadside Greennet and Greenway	Connecting municipal park
		Planning of district recreational corridor	Ditto	Connecting regional park
		Planning of community recreational corridor	Ditto	Determined on regulatory planning
		Planning of theme recreational corridor	Planned based on belt park, river net, etc.	Connecting theme recreational green spaces or comprehensive recreational green spaces

The planning of protective green space subsystem

The planning of protective green space should be arranged based on the local climate and the priority of urban hazards and other disadvantages. A protective green space should not only protect the city from flood, fire or pollution, but also can improve the natural environment by inducing wind, a crucial factor to improve urban residence given Foshan's climate features.

Moreover, the protective green space system provides post-disaster a sheltering system that can accommodate people after evacuations. The planning of protective green space system mainly includes the planning of wind-inducing forests, separating green space, disaster prevention green space and sheltering green space (Table 4).

Table 4 The components of urban protective green space subsystem

Subsystems	Subsystem component	Types of green space
Protective green space subsystem	Green space with wind-inducing forests	Urban wind-inducing forest in North-South direction
	Separating green space	Traffic separating green space (including protective green space for railway, expressway, urban freeway and urban main road), sanitary separating green space
	Disaster prevention green space	Waterfront protective green space, green space along high-voltage grid corridor and other hazardous protective green space
	Sheltering green spaces	Sanctuary and escape passage

Figure 16 The urban protective green space subsystem of Foshan

The planning of conservation green space subsystem
In this planning, conservation green space contains resources to be protective and nourished and includes natural zones and the eco-rehabilitating lands crucial for the integrity of urban ecosystem. These areas should maintain and enhance the stability and continuity of local natural eco-system. Based on the natural characteristics of Foshan, planning of the subsystem consists of four parts (excluded from indicator statistics): planning for protective green space, for rehabilitating green space, for productive green space and for conservation corridor.

Subsystems	Subsystem components	Types of green space
Conservation green space subsystem	Protective green space	Riverfront green space (medium reservoir, dike-pond system) Eco-conversation zone (natural conservation zone, water resource conservation zone, water resource conversation zone and basic farmland conservation zone)
	Rehabilitation green space	Natural disaster sensitive zones, soil erosion prevention zone, water &soil conservation zone, landfill rehabilitation land, etc.
	Productive green space	Seedling nursery, flower nursery, grass nursery, etc.
	Conservation corridor	Green beltway and infrastructure separating zone

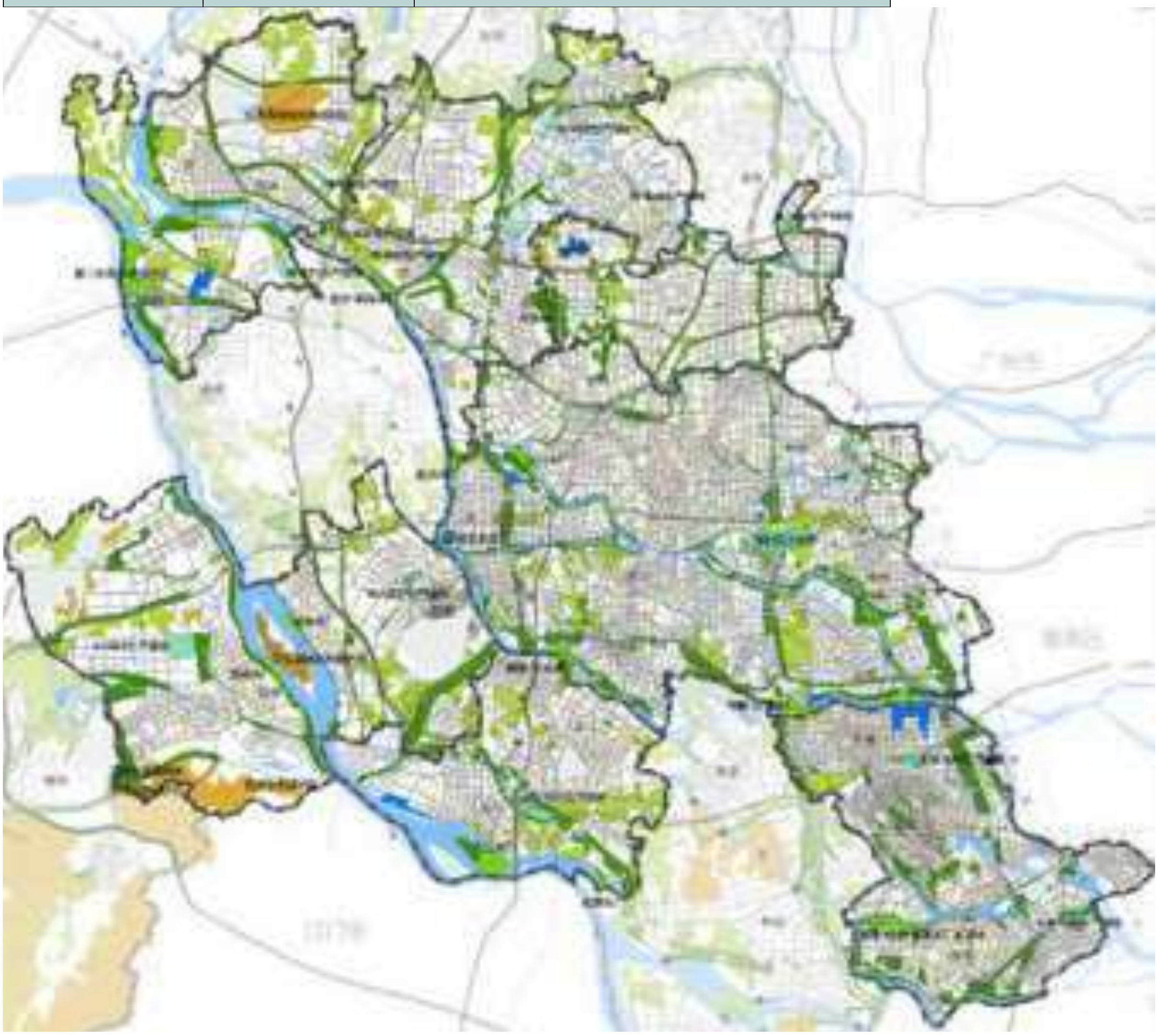


Figure 17 The planning of urban conservation green space subsystem

The planning of landscape green space subsystem

The green space crucial for a city's characteristics and identity is called the urban landscape green space. A landscape green space should focus on the holistic urban arrangement, organize the link between natural and artificial environments, and enhance the key segment to establish a subsystem by planning and integrating. We divided the landscape green space subsystem planning into the following three parts: Planning of landscape guiding control cluster, planning of landscape nodes and planning of landscape corridor.

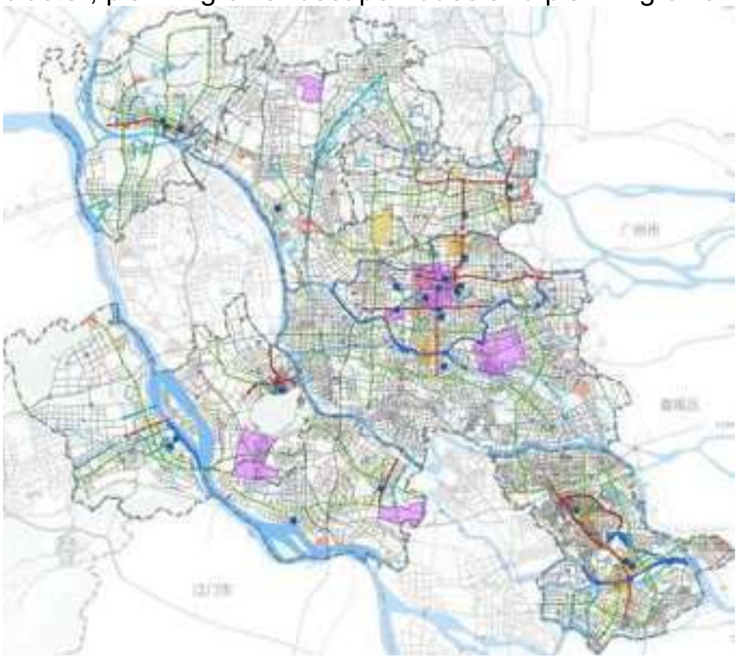


Figure 18 Urban landscape green space subsystem

The planning of urban disaster preventive & sheltering green space

The development of **s**heltering bases, passage and waterfront facilities are the key factors of the urban disaster preventive and sheltering green space system. The location of such green spaces should established where most people live and dwell. The size of a sheltering urban green space should be 1-2 m^2 per capita with an average area of 5-10 hectares.We have identified several types of sheltering green spaces.

1) A **temporary shelter** domestic green space is generally no less than 1 hectare and desgned to accommodate at least 500 people. Its service radius is about 600 meters and travel distance to the shelter should be no more than 10 minutes of walk, including residential district parks.

2) A **fixed shelter** domestic green space should be more than 10 hectares, with a short edge of more than 300 meters. Its service area ranging from 1 to 2 km and it should be accessible with about a 1 hour walk, including regional parks.

3) A **central shelter** domestic green space should cover an area of nearly 50 hectares, with a short edge of more than 300 meters. The service radius extended to 2 to 3 km, and it should be accessible with less than a 2-hour walk. Such facilities would be mainly included in municipal parks and suburban parks.

(II) A **disaster preventive corridor** is a network connecting disaster preventive spots with urban main roads. We plan to divide the disaster preventive corridors into ones for cars and ones for walking access. To ensure smooth and accessible corridors, the buildings along the road should be set-back from their property lines by 5 to 10 meters. High-rise buildings should set-back more. Both sides of the main corridors should be planned with green belts with width ranging from 10 m to 30 m.

Figure 19 The planning of urban disaster preventive & sheltering green space

Tree species planning
Urban tree species planning is the foundation and basis to achieve diversity of garden plants, to upgrade the ecological functions of urban green space system, and develop the eco-network of urban open space.

Foshan has a South Asia tropical and subtropical humid monsoon climate. Foshan's local forests consist of South Asia tropical evergreen broad-leaved species. However, there is only a small block of natural secondary evergreen broad-leaved forests and other plantations are mostly artificial forests. Most lower slopes serve as fruit orchards, while the plain is dominated with cultivated plants. The common garden trees in the municipal area total 116 families, 333 categories and 546 species.

The Basic principles of tree species planning were: 1. develop an urban greening landscape dominated with South Asian tropical plants with local charm; 2. plant mainly evergreen trees in embellished with deciduous trees, combining slow-growing trees with those growing fast and bring together the landscapes of short-term, medium-term and long-term performance; 3. highlighting the diversities in species and genetic inheritance; and, 4. developing the green space mainly with arboreous species, auxiliary areas with bushes & vines, and combine the bio-benefits with landscape performance

Discussion

The condition of green space underpins the functioning of urban ecosystems, which plays a key role in supporting biodiversity and providing important ecosystem services in urban areas. We added the new features of using green development to mitigate heat sinks and moderate summer temperatures, and the use of greenways to provide emergency shelter in the event of disasters. The provision of urban green belt systems and subsystems has given a permanent counterthrust to regular urban planning. The strategy of developing green belts has attained social acceptance and successfully resolves environmental issues while balancing ecological and economic development.

The greenbelt is indeed a physical reality today, but it is also 'a way of doing things'. We believe that this should be a desirable and feasible step towards making real progress

References

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[i] For example, in Foshan, the wind is an important factor to mitigate climate change impacts and therefore our greenbelts include a wind induced forest. These green belts can also serve as evacuation locations and provide shelter after disasters.

A Climate-Adaptation Based Study on Comprehensive Planning Strategy of Urban Water Systems

—Taking the Comprehensive Planning of Water Systems in Xiangyang City, Hubei Province as an Example

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1. Introduction

The United Nations Intergovernmental Panel on Climate Change (IPCC) predicts that there will be a 90-100% probability of experiencing the increase of precipitation frequency, precipitation intensity and heavy rainfall in the global mid-latitude and tropical humid regions in the late 21st century (2081-2100) and a 66-100% probability of experiencing the increase of drought intensity and duration from the regional scale to the global scale.[1] Climate change has become a big issue concerning the destiny of mankind. The city, as a gathering point of human beings, accounts for only 2% of the total surface of the Earth, but the greenhouse gas emissions account for 70% of the total. [2] Hence, the effect on city's "Carbon Reduction & Carbon Sink Increment" largely determines the success or failure of climate change. Meanwhile, the global climate change also greatly affects cities and urbanized areas that the adaption of city and its respond to other disruptive events have been greatly reduced. Therefore, it is urgent to introduce the climate impact factors to the city and retard and adapt to the impact of poor climate on cities with urban factors.

Urban water system, as an important city element, mainly includes aquatic ecosystem, aquatic environment system, aquatic resources system and aquatic security system, which is a significant component to maintain the normal operation of city. Under the influence of climate change, the urban water system is characterized by sensitivity, vulnerability and adaptability. It is susceptible to the disturbance and causes the damage to aquatic ecosystem and aquatic environment, the reduction of aquatic resources and the decrease of aquatic security index.[3] At the same time, the urban natural water system, as an important cold source of city, is also one of the important ways to alleviate the urban heat island effect. Therefore, it is of great significance for the improvement of the urban climate adaptability to study the adaptation and mitigation of climate impacts on the urban water system. In this paper, the rich water system in Xiangyang City is selected as the research object to explore the water system planning strategy that is suitable for the climate adaptability.

2. Overview of Planning Scope

2.1 Natural Conditions within the Planning Scope

Xiangyang City, located in the northwestern part of Hubei Province, the middle reaches of Han River that is the largest tributary of the Yangtze River, and the Qinling Daba Mountain, is a national historical and cultural city known as the "Landscape City of Chinese Hinterland". The urban water system in Xiangyang City is unique endowed by nature and its central city is divided into four areas, namely Xiangcheng, Fancheng, Xiangzhou and Dongjin, by the natural division of Han River, Tangbai River and Xiaoqing River. There are four rivers passing through four cities respectively, namely Xiangcheng's Nanqu-City Moat, Fancheng's

Dali Moat, Xiangzhou's Lianshan Moat and Dongjin's Haoran River, which constitutes the city map of "one river and eight streams" for the reason that Dongjin is surrounded by Chunhe River and Gunhe River (Figure 1). The urban water system is still difficult to bear the future development of city despite the dense current urban water network and the rich water body. Main reasons are as follows: ①Seasonality of water flow exacerbated by climate change: only Han River, Tangbai River and Xiaoqing River are the flowing water in the urban area and others are changed by natural conditions and become the city inland rivers. Some rivers have the seasonal dryness due to the lack of fixed water sources. ② Serious pollution: all rivers pass through the urban built-up area and the imperfect sewage system in the initial stage of urban construction has led to serious water pollution in that a lot of water body has become urban sewage drains, so it is urgent to carry out the water environment remediation. Furthermore, the limited assimilative capacity has also become an important factor to restrict the urban development. ③ Insufficient carrying capacity of water sources: the average annual rainfall of Xiangyang City is 869.2mm, the average annual runoff depth is 217.1mm and the average annual evaporation is 1,430.7mm. In addition to the seasonality of rainfall and water pollution, Xiangyang City is still a relatively deficiency area of water resources.[4]

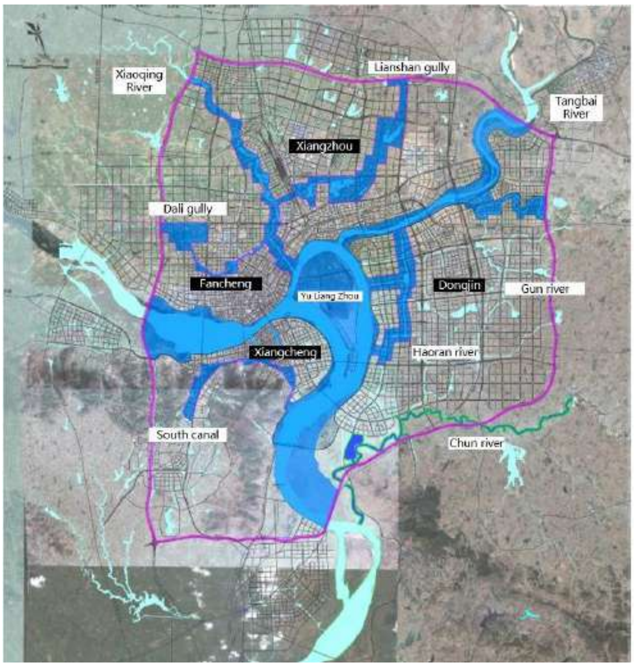

Figure 1: The pattern of ecological water system in Xiangyang City (drawn by the author)

2.2 Regional Climate Characteristics and Variation Trends

Xiangyang City, located in the transition zone from subtropical monsoon climate to temperate monsoon climate, is characterized by four distinct seasons and large temperature differences in winter and summer. The perennial measurement statistics of Xiangyang meteorological station shows that the extreme maximum temperature in the region is 41.1 ℃, the extreme minimum temperature is -14.8 ℃, the average annual temperature is 15.6 ℃, the annual sunshine hours are above 1800h and the frost-free period is 318d. The regional heavy rain mainly occurs in summer, with the highest in July and August, accounting for 40% of annual precipitation. The uneven temporal distribution of rainfall leads to the exuberant ecological water network in the summer, but in other seasons, except for Han River, Xiaoqing River and Tangbai River, the remaining water systems basically dry up.

With the global climate change, the extreme climate in Xiangyang City has happened in the recent years frequently. In 2017, the city's average precipitation was 1,176mm, which was 30% more than the average year and the distribution trend of precipitation was on a diminishing scale from the south to the north and from the east to the west, among which the urban precipitation had reached a record high. From August 25th to October 19th, 2017, the total number of rainy days was as high as 40-50 days and it was rare for rainy and sunless days. The overall precipitation was sudden and local, and the rainfall distribution was uneven, which caused the severe urban waterlogging and the several overflow disasters.

3. Comprehensive Planning Strategy of the Climate-adapted Urban Water System

Based on the goal to mitigate and adapt the climate, the climate-adapted urban water system planning adopts the corresponding planning techniques to increase the resilience of urban water system and maintain the normal operation of aquatic ecology, aquatic environment, aquatic resources and aquatic security system. The planning of “Nourishing City with Nine Rivers” in Xiangyang City relies on the above-mentioned principle to focus on the path and technical means of water system planning to resolve the climate change from the perspective of problems and targets. [6, 7]

3.1 Pre-planning: Establish the “Pre-assessment” System of Climate-adapted Urban Water System

Based on the assessment of the current capacity of water system in the planning area, “pre-assessment” refers to the targeted assessment for adapting and offsetting the climate change’s impact on the urban water system to enhance the flexibility of cities to cope with climate disasters. It mainly includes basic information collection, current situation and ability assessment and targeted goal setting (Figure 2).

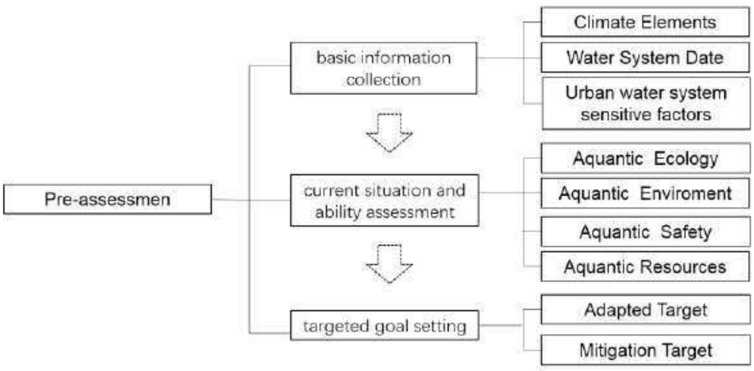

Figure 2: “Pre-assessment” system （drawn by the author）

The basic data for climate-adapted water system include not only the traditional water system planning data, but also the data of urban climate and urban water system sensitive factors. In Xiangyang City, the recent extreme climate is dominated by high temperature, drought and heavy rainfall, and the high-intensity development and traffic load around rivers and lakes have become important factors in urban water systems. Under the impact of climate change, the urban aquatic ecology, aquatic environment, aquatic resources and aquatic security system are faced up with the potential risks.(Table1)

The basic data on nine natural water systems and artificial municipal pipelines in the planning area are collected and comprehensively evaluated, which can be included in the impacts on the climate change and urban water sensitive factors. Meanwhile, the planning target is proposed from two aspects of mitigating and adapting the climate. From the perspective of mitigation, the urban development path, surrounding land utilization and transportation mode are guided to reduce the pollution and carbon dioxide emissions from the source combined with water system planning; and from the perspective of adaption, the planning for natural water system and artificial water system can improve the capability of water system to cope with the climate disasters and enlarge the carbon sink area to alleviate the urban heat island effect and reduce the adverse effects of climate.

Table1：The pre-assessment based on the climate-adapted water system in Xiangyang City

（drawn by the author）

Main Climate Characteristics	Aquatic Ecology	Aquatic Environment	Aquatic Resources	Aquatic Security System
Seasonal Temperature Difference, Obvious Summer Heat-waves	Increased water metabolism required for plants and animals	Water blackening and smell	It causes the outbreak of algae and the water quality is hypoxic. Increased consumption of evaporation and urban and tight water supply.	Increased sludge treatment capacity and difficulty, difficult sewage plant work.
Uneven Spatial and Temporal Distribution	Seasonal dryness, unable to guarantee ecological base flow, declined groundwater level.	Seasonal dryness leads to the water blackening and smell.	Increased the concentration of pollutants, decreased water quality.	Seasonal flood control and difficult sewage discharge.
Short-term Heavy Rainfall	Damaged ecological landscape and serious soil erosion.	Serious non-point source pollution.	Increased the turbidity of water source and decreased water quality.	Urban waterlogging and frequent dam-break.

3.2 Interim Planning: The Utilization of "Interim Technology" Strategy to Copy with the Climate Change

3.2.1 Water System Restoration: Construct the Urban Healthy Water Ecological Structure

The "pre-assessment" of climate-adapted water system shows that the water system in Xiangyang City is faced up with the severe climate change situation and the poor current status of water system. Several inland rivers in the city have the function of urban flood control and drainage, while some ditches need to be discharged. Meanwhile, the unstable water source leads to the poor water quality and serious polluted rivers. It is urgent to establish a set of systematic positive cycle of urban water system to prevent the external shocks such as floods, droughts, pollution, etc., which is incapable of endangering other systems and can meet the requirements of water system's function and safety. The current status of regional water system shows that it is the primary task to carry out the flood control and drainage, water diversion into the city and water system connection.

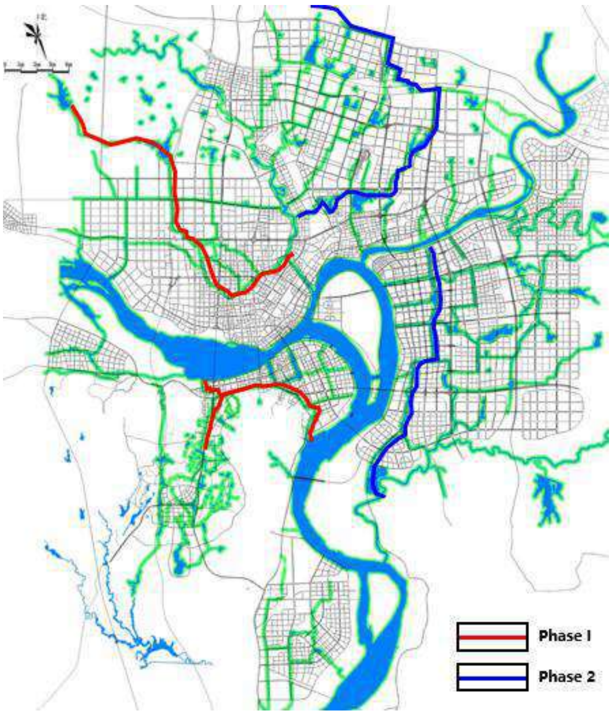

Figure 3: Implementation of the water diversion period（drawn by the author）

The relevant research shows that the

running water in cites is of great significance to realize the connection of water system: ① Balance the uneven spatial and temporal distribution of precipitation; ② Enhance the capacity to cope with the global climate change and prevent the floods and droughts; ③ Achieve the new situation of water resources development and utilization on the wet-dry season diversion and multi-source complementation by the smooth water system network; and ④ Utilize the connection of water system to maintain the health and long-term stability of rivers and lakes, exert the ecological comprehensive benefits, enhance the stability of regional natural ecology and environmental systems, and realize the positive cycle of drainage basin. Furthermore, the relevant technical results show that the temperature of flowing water body is low and the surface temperature can be taken away during the flow process. Meanwhile, the natural air passage can be formed by the open river channel to reduce the urban heat island effect effectively. [5]

Therefore, the urban water system can be restored by three methods of “Water Diversion, Communication and Interception”. On the basis of maintaining the basic trend of water system, the issue of no running water source aiming at three urban inland rivers (Dali Moat, Lianshan Moat and Nanqu Moat) has been analyzed to determine the water source, waterway, water volume and the short-term and long-term water diversion plan (Figure 3). Meanwhile, the “Three Rivers Connection” project will be carried out in the unconnected Han River, Nanqu Moat and City Moat (Figure 4), which not only can alleviate the flood prevention problems caused by the lack of sections of Nanqu Moat and City Moat, but also can lay a good foundation on building the “Clear Water and Green Shore-side” ecological landscape, cultural scenery and waterfront leisure area of Nanqu moat. On the basis of respecting the status, the sewage system is optimized by the water system aiming at the problems of sewage discharge to collect the sewage from the source and prevent the untreated sewage from being directly discharged into the water body. Meanwhile, the serious polluted rivers can be treated to remove the sludge and purify the water quality of urban water system, and the aquatic ecological system can be restored radically by the measures of introducing aquatic animals and plants and improving the regional water environment, which can construct the water ecological system of “Nourishing City with Nine Rivers” with Han River as the main line.

Figure 4: Three rivers connection project

(drawn by the author)

3.2.2 Nourishing the City with Rivers: Construct the Strategy of Urban Water System Carbon Sink and Green Net

As an important way to reduce the urban heat island effect, the urban water system is a significant measure to cope with the climate change by combining with the urban water system and the low-carbon green net of water system. Taking the “Nourishing the City with Nine Rivers” as a key strategic goal, this planning utilizes the water system’s ecological corridor to build up the green net and form the green carbon sink network by the connection of urban artificial green land and natural ecological base, thus reducing the urban heat island by plants, water areas and soil carbon pool.

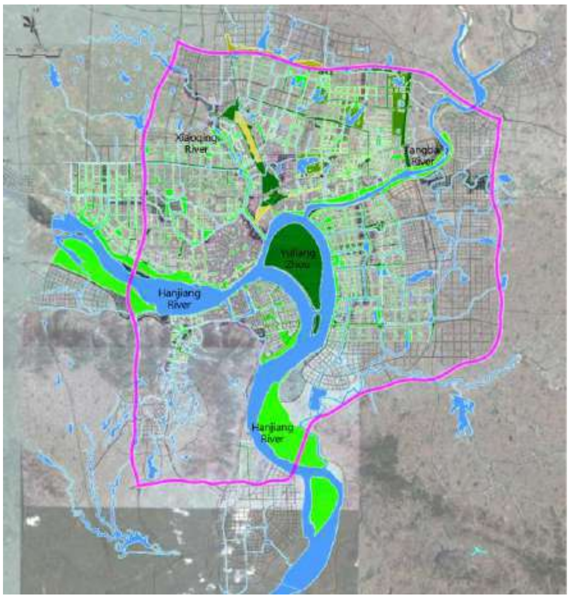

Figure 5: The pattern of water system green net in Xiangyang City

(drawn by the author)

The urban greenway is constructed along with the dredging water body and combined with the waterfront green space, and four wedge-shaped ecological corridor formed by Han River, Tangbai River, Xiaoqing River and main ecological matrix directly are connected with Yuliangzhou ecological green island to form the whole urban wind channel, which can effectively separate the comprehensive group of overall urban planning and extend the landscaping to the central city to improve the central city's environmental quality and the heat island effect. The inside and outside ecological corridor and city wind channel are connected in and around the city with the network of four ecological rivers connected with Nanqu Moat, Dali Moat, Lianshan Moat and Haoran River in four urban areas, and Gunhe River and Chunhe River natural river-way are regarded as the platform outside the city to strengthen the natural ecological environment protection and form an urban micro-environment conservation area of water body. Meanwhile, the water body in the central city and urban streets is connected with the urban comprehensive park and street landscaping to form several secondary ecological landscaping corridors and construct the urban low-carbon ecological green land systematic network (Figure 5).

3.2.3 Multi-protection: Construct the Resilience System of Urban Aquatic Security

(1) Construct the urban security pattern of rainfall flood

Recently, except for Han River, Dali Moat and Xiaoqing River, the flood control standard for others of nine rivers is relatively low, which increases the pressure of urban flood control. Furthermore, the outside flood control system is also uncompleted and the flood drainage standard is about once in 5-10 years, which cannot meet the requirements of urban flood control.

According to the results of "pre-assessment", the recent heavy rainfalls are taken into account comprehensively in the planning. The assessment level has been re-evaluated to plan nine dikes of waterways and construct the resilience flood-control protection with the combination of dam protection, water system connection and ecological corridor. The specific goals of various flood-control protections can be determined in the planning based on the water system's function position. Moreover, the security protection of waterfront space can be strengthened by controlling the dam or greenbelt width, section form, flood-control standard. Aiming at the issue on Nanqu Moat flood-control that the old city is difficult to be widened, the "Han River-Nanqu Moat-City River" water system connection project has been adopted. Based on the existed section of Nanqu Moat, the upstream to Han River flood diversion is connected and the downstream is connected with the city moat channel, which can enhance the regulation and storage capacity of nature to meet the whole regional flood-control standard by utilizing the storage of city moat.

Figure 6: Tangbai River ecological corridor *（drawn by the author）*

Meanwhile, in response to the severe situation of climate change, the green corridor protection area is established on both sides of the river-way with a once-in-a-century standard to reserve the flood-control channel. Connect the ecological corridor with the surrounding water catchment region, construct the natural protection system of water ecological infrastructure by ecological wetland and artificial lakes, adopt the multi-functional storage facilities to regulate the discharge of runoff rainwater, and establish the six-in-one "city sponge" of "seepage, stagnation, storage, purification, usage and drainage" to enhance the resilience of urban rainfall flood (Figure 6).

(2) Build up the "rainfall flood cell" of sponge city

As a kind of management method based on the principle of "natural accumulation, natural infiltration and natural purification", the sponge city is of great significance to relieve the urban flood, cope with the dry climate, and reduce the urban heat island effect, building energy consumption, consumption treatment and water consumption, which is an important measure for cities to cope with climate change.

The planning aims to break up the past pattern that the city rainwater is unified in the pipelines and is discharged after the unified treatment by constructing the "ecological rainfall flood cell" and "community rainfall flood cell". The local absorption is actively adopted to divide the large-scale catchment area into "sponge cells" with small areas and carry out the reasonable rainfall flood planning aiming at the water catchment situations, thus reducing the surface runoff and large-scale rainfall gathering.

Table 2: The indicator control of low-impact development facilities（drawn by the author）

<table>
<tr><th>Category</th><th>Land Usage</th><th>Land Code</th><th>Sunken Green Belt Ratio</th><th>Green Roof Coverage Ratio</th><th>Permeable Pavement Ratio</th></tr>
<tr><td rowspan="6">Building and Residential Quarter</td><td>Residential land</td><td>R</td><td>New-built≥30%
Rebuilt ≥25%</td><td>Low-rise Construction≥20%</td><td>New-built≥50%
Rebuilt≥40%</td></tr>
<tr><td>Commercial Service Land</td><td>B</td><td rowspan="2">≥40%</td><td rowspan="2">≥50%</td><td rowspan="2">≥50%</td></tr>
<tr><td>Public Management and Service Facilities Land</td><td>A</td></tr>
<tr><td>Industrial and Storage Land</td><td>M</td><td>≥40%</td><td>—</td><td>≥30%</td></tr>
<tr><td>Utilities</td><td>U</td><td>≥40%</td><td>≥50%</td><td>≥50%</td></tr>
<tr><td>Transportation Facilities</td><td>S</td><td>≥30%</td><td>—</td><td>≥30%</td></tr>
</table>

The "ecological rainfall flood cell" mainly utilizes and integrates the urban ecological resources to form the "rainwater receivers", which organically combines the forest, wetland, grassland and river channels through point, line and surface to form the dense, scattered and connected arrangements and increase the probability of local absorption. The “community rainfall flood cell” mainly utilizes the strategy of “low-impact development” to encourage the community construction and enhance the absorption or stagnation of rainwater from multiple levels of sites, buildings, roads, squares and green belts. The proportion of community sunken greenbelts, green roof coverage and permeable pavement is controlled in the planning to ensure that the total annual runoff is within a certain range and realize that the rate of final urban annual runoff control is 77%.

3.2.4 Strategy Four: Promote the Transition of Low-carbon Cities with Water as a Medium

(1) Transfer the industrial city to the low-carbon city by water resources

As a historical and cultural city, Xiangyang City has a history of more than 2,800 years with rich water resources. However, its urban development mainly relies on industries such as automobile and textile industry. The scenery resources have not been effectively utilized and the urban water system pollution has become one of the factors that restrict urban economic and social development instead.

By means of the treatment of urban water system to construct the landscape structure of mountains and rivers, the planning further optimizes the green space of riversides to promote the adjustment of industrial structure and the transformation of development model and gradually realize the transition from “industrial city” to “landscape cultural city”. On the basis of different geographical locations of each water system, different locations of cities, different cultural background, the local cultural exploration is taken as the starting point to build up the unique district and promote the industry transformation. Taking Xiangyang City as an example, it aims to build up the distinctive tourism industry with history, culture, folk customs and ecological civilization by connecting with water system connection project, restoring the historical culture, improving the ecological environment, optimizing the surrounding green space and connecting Zhenwu Mountain, Mayuetan Stream, Zhang Clan Temple, Yang and Du Clan Temple, Xi Clan Park, Guanyin Pavilion and many other historical interests

(2) Rational land-use: build up the shared, ecological and low-carbon public space

The urban water resources are susceptible to the external environment that is characterized by fragility and sensitivity. Several rivers in Xiangyang City all pass through the interior of the city and the non-point surface of water system is seriously polluted. The improper development of waterfront sensitive areas is an important factor for city’s disturbance to water bodies. The rational land-use of waterfront sensitive areas is the key way to alleviate the urban aquatic environment, adapt and mitigate the climate change.

The urban waterfront space development and construction standards for different types of rivers have been formulated to divide the waterfront space into ecological protection zones, ecological control zones and ecological coordination zones. Meanwhile, the land along the water system has been controlled to adjust the waterfront construction type and the quantified waterfront space to reduce the disturbance of urban water body. Considering the operability of implementation, the waterfront greening control can be regarded as the foundation and the waterfront construction control can be regarded as the complement in accordance with the principle of "combination of unified control and hierarchical control, forced control and coordinated control". The basic flood control security of rivers can be regarded as the reference to determine the water face control line and formulate the blue line setting standards for each river water body aiming at the rivers management. According to the waterfront space control requirements, the construction requirements of urban development, urban greenway and urban open space are combined to formulate the waterfront green line and jointly build up the layered protection control system of water body.

In addition, the combined use of waterfront land-use and the dynamic, shared, low-carbon waterfront space with the public transportation as the core and the waterfront slow-moving system as the link can be encouraged to alleviate the urban heat island effect and reduce urban carbon emissions. The public service system characterized by space-efficiency, compact development and moderate advancement has been formed to guide the rational layout and diversity allocation of layered public service facilities by the urban design of waterfront areas(Figure 7).. Meanwhile, the dense pedestrian network-small street layout is formed in the waterfront areas to create the walking space characterized by high-accessibility and beautiful environment, which can reduce the dependence on automobile traffic, effectively reduce traffic carbon emissions, alleviate the negative impact of regional environment on the urban construction activities and promote the resilience of city.

Figure 7: Schematic diagram of the riverside slow-moving traffic and ventilation corridor

（drawn by the author）

3.2.5 Strategy Five: "Net-zero" Vision: Promote the Comprehensive Utilization of Urban Water Resources

The US Environmental Protection Agency defines that "net-zero" vision refers to the restriction of regional water consumption in city and the recycle of water extracted from the river basin to the natural watershed with the same water quality and quantity, avoiding the water depletion. 8 The net-zero strategy mainly achieves the protection of water resources by reducing urban water use, water resources recycling and water environment management.

In order to reduce the urban water consumption and promote the recycling of water resources, the municipal facilities are optimized to establish the dual water supply network, and reduce the conventional water use by the optimization of water supply pipelines and sanitary ware. Furthermore, the water resources optimized strategy is proposed to guide the urban construction: ① Establish the regional shared water resources, rationally allocate the wading facilities to realize the large-scale balance of water supply and demand, and alleviate the uneven distribution of water resources; ② Use the local or local-adapted native landscape plants as much as possible to reduce the amount of water for municipal watering;

and ③ Actively adopt the unconventional water resources, develop and utilize the recycled water with multiple channels. The rainfall collection and utilization and the recycling of recycled water have been included in the urban construction management and control indicators. The roof rainwater collection and recycling system has been encouraged in the urban new buildings to improve urban green belts and large public spaces, which can provide the water collection function and can be used as the municipal water, such as spraying, irrigation, fire-fighting, landscape and others.

In response to the water environment management, it needs to not only strengthen the urban infrastructure to improve the sewage treatment capacity, but also enhance the self-purification capacity of water bodies to improve the resilience of urban water environment to cope with climate change. The planning aims to adopt the ecological water body remediation technology, ecological revetment technology and ecological landscape technology to establish the waterfront ecological buffer zone or water ecological wetland by connecting with water system, and build up the ecological restoration and protection system. The restoration of revetment vegetation, river wetlands and river greening can provide the habitats and foraging environments for birds, insects, and small fish at the bottom of rivers and improve the self-purification capacity of water bodies by means of planting aquatic plants.

3.3 Late Planning: Construct the "Post-evaluation" System of Urban Water System Planning

The "post-evaluation" of urban water system planning mainly measures the urban water system planning effect by the evaluation indicator of sponge city and river ecological construction effect, which can be used to measure, adjust and guarantee the healthy operation of urban water system.

(1) The evaluation indicators of sponge city

The planning of "Sponge City Planning Guideline of Xiangyang City" has proposed the control requirements of aquatic ecology, aquatic environment, aquatic resources and aquatic security to guide the urban construction. As for the spongy city, on the one hand, each construction project implementation has been monitored and evaluated according to all indicators (Table 2); and on the other hand, the factors on the urban climate in Xiangyang City, water resources conditions, the difficulty of urban old and new district reconstruction and land-use conditions have determined the total annual runoff target of Xiangyang City and the adjustment value of total runoff control in various types of lands. Whether the land can meet the control requirements of annual total runoff depends on the calculation of annual average integrated rainfall runoff coefficient and the water storage capacity of each land.

(2) The evaluation indicators of river ecological construction effect

According to the requirements of comprehensive aquatic ecosystems, the evaluation indicators can be divided into aquatic ecosystem status indicators and aquatic ecological construction indicators in the planning, which can measure the effect of river ecological construction. The aquatic ecosystem status indicator reflects the capacity of aquatic ecological self-repair and the aquatic ecological construction indicator mainly reflects the coordination level of water and city, which can guide the formation and daily management of constructive planning. (Table3)

With the gradual construction of China's "Multi-standard Integration" platform and the continuous optimization of intelligent monitoring technology, the future "post-evaluation" system should be more perfect: ① Construct the spatial data of planning area with GIS and compare the pre-assessment target for the optimization and adjustment by implementation, monitoring and evaluation; ② Consider the dynamic factors of climate change to realize the dynamic tracking; ③ Evaluate the actual effect of planning for the climate change by carbon emissions and related indicators of aquatic ecology and security; and ④ Optimize and adjust the existed technical defects in the planning by the evaluation results.

Table 3: The evaluation indicators of river ecological construction effect

（drawn by the author）

No.	Indicators Types	Names of Indicators	Unit	2015	2020	2030
1	Aquatic Ecological Status Indicators	Water quality standard rate of water functional area	%	50	60	95
2		Chlorophyll of urban water body	μg/l	>65	30～65	<30
3		Transparency of water body	m	≤0.5～1.5	0.5～1.5	>1.5
4		Water quality standard rate of urban centralized drinking water source	%	96	100	100
5		Submerged plant coverage	%	10	20	30
6		Species diversity indicator （Shannon-Weaver Index）	!	0～2	1～2	1～3
7	Aquatic Ecological Construction Indicators	Urban sewage centralized treatment rate	%	37	80	90
8		Urban domestic sewage pipe network collection rate	%	41.6	83.2	92.4
9		Urban non-point source pollution treatment rate	%	0	20	50
10		Waterfront greening rate	%	30	40	50
11		Harmless disposal rate of domestic garbage	%	50	80	100
12		Soil erosion control rate	%	20	50	100

4. Conclusion

It is an important part of urban construction in the future to strengthen the ability of urban planning to cope with the climate change. Taking the planning of “Nourishing Cities with Nine Rivers” as an example, the comprehensive planning methods and technical strategies of aquatic system for climate change have been discussed respectively in this paper. On the one hand, the climate change factor has been included in the system of “pre-assessment”, “interim technology” and “post-evaluation” according to the methods and characteristics of planning; on the other hand, the strategy on the climate-adapted urban water system comprehensive technology has been discussed and the implementation strategy and path of urban water system for the climate change has been explored by combining with the core content of “alleviating and adapting the climate”. Due to the shortcomings of urban basic data and technology, the related research on the pre-assessment and post-evaluation system is week. With the establishment and optimization of urban intelligent information platform, the index assignment and calculation of aquatic system to cope with the fragile climate change should be included in the following planning, and meanwhile the application and verification of technical simulation in this process and the dynamic real-time evaluation system should be strengthened.

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ENERGIS: Tool For Demand Characterisation In Urban Settings To Support Energy Planning At Different Sscales

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1. Abstract

Current urban growth rates represent a major challenge in the fight against Climate Change and the willingness to implement a more sustainable future, where the environment, health and well-being are not compromised, and a low-carbon and secure energy provision is granted. Several global actions have emerged, such as the Paris Agreement, which highlighted the general problems and set some objectives. These were then followed by the generation of Energy Directives at European level, which shaped and detailed the objectives of the agreement, which should be complied with by Member States. All of these challenges end up having an impact on planning processes, which need to give answers to all of the demands and aim for holistic and integrated approaches.

However, achieving these goals is a daunting task that requires the careful and accurate analysis of both current energy conditions (baseline) and the evaluation of the impact of energy actions to be implemented. This usually implies devoting a high amount of resources and time, which would otherwise decrease and be shortened if adequate tools existed in order to support this decision making processes at urban level. The effort and progress achieved in the building simulation tools has not been observed in the simulation of energy performance at urban level.

Having these aspects into consideration, the goal of the ENERGIS project is the development of a tool that supports stakeholders involved in energy planning in the decision making process in specific areas or urban settings by automatically estimating the energy demand of the residential sector using publicly available data and representing geo-referenced results through a web platform.

All in all, this platform will ease the decision making process when planning urban refurbishments by obtaining a better vision of the as-is-state situation in terms of energy demand of selected areas. This will help making informed decisions when selecting the areas needing improvement and thus better establish new objectives for long-term plans.

2. Introduction

Current urban growth rates have exponentially multiplied in the last century: from only 746 million people (29,6% of global population) living in urban settlements in 1950 to 6.3 billion (66%) [1]. In this context, cities are the key elements to tackle, since even though they occupy only 2% of global land, they account for 70% of GDP, 60% of energy consumption, 70% of greenhouse gas emissions and 70% of solid waste [2]. Bearing this numbers in mind, it can be seen that cities both represent opportunities for growth as well as great challenges to achieving a more integrated, more socially inclusive and connected cities in the framework of sustainable urban development, which is resilient to climate change [2].

One of the main challenges is assuring the development of cities which grant a heathy environment and assure the well-being of inhabitants, while granting their sustainable development. In this line it is important to consider the impact cities have on aspects such as energy consumption, which in the end mirror the CO2 emissions produced and thus, the degree to which not only a healthy environment and the well-being of inhabitants can be compromised, but also the assurance of a secure provision of energy. To this respect, according to the European Parliament and the Council of the European Union [7], almost 50% of the Union's final energy consumption is used for heating and cooling, 80% of which is used in buildings. More in particular, according to Eurostat figures [3], households account for 25.4% of this consumption, similar to the industry sector.

These alarming figures are the origin for initiatives such as the 21st Conference of the Parties of the United Nations Framework Convention on Climate Change (COP21), where the Paris Agreement was signed (2015) [4] that urged for taking specific actions against Climate Change and established guidelines and objectives to stop the current temperature rise below 2ºC. This universal agreement was the seed for the subsequent legislative actions set at European level, such as the "Clean Energy For All Europeans" directive package, aiming at establishing more specific goals and obligations to be followed at Member State level. Then, each Member State had to implement the legislation at national level with even more specific goals, which should be measured, monitored and reported, so as to assure the adequate implementation of the energy actions and check their effectiveness.

To this end it is of the utmost importance to invest in energy planning, and quantify the current status of cities in an unbiased fashion, as well as be able to evaluate what will happen in the future if a determined action is carried out. The more accurate and close to reality this analysis is, the more successful the energy actions carried out will be, since specific problems will be identified and actions will be well-targeted. These issues are closely being followed and analysed by the Global Covenant of Mayors [24], in particular by Edmonton Declaration signatories [25] and by Covenant of Mayors signatories [26], who need to reflect these aspects in Sustainable Energy and Climate Action Plans (SECAPs).

However, these established goals often represent a burden to comply with. Not only because of the efforts and the energy actions that need to be carried out, but also because of the difficulties to adequately evaluate and measure the benefits achieved, which often lead to distrust in the construction sector, among investors, for instance, and in general public. As a consequence, further advancing towards a decarbonised and more efficient building sector is hindered. Irrespective of the reasons why this occurs, providing the adequate mechanisms to evaluate and easily plan energy refurbishments at urban scale will prove highly beneficial in order to achieve the goals established either by European Directives and be able to monitor the improvements. Therefore, in order to alleviate the problems emerging from these lack of data, lack of understanding of the issue and, consequent lack of support; it is necessary to provide effective tools to measure the baseline status of urban settings.

In this line, ENERGIS is proposed as energy demand mapping platform to aid in the decision support making in energy planning processes. This user friendly platform will provide estimated demand values based on calculations performed with validated Energy Performance Certificate tools at national level, which will be displayed in a map with a colour code that will enable to identify which urban areas are most in need of refurbishment.

This paper delves into all the problematics presented above. First, in Section 3, a review of current European Energy Directives will be shown. Here the main energy directives will be explained, as well as a more in depth description provided of the Energy Performance of Buildings Directive [6], which has been recently updated. Then, the energy planning context in Europe will be presented (Section 4), where the link with energy planning strategies will be analysed, as well as the need for the platform clarified. After, the specific goals covered by the ENERGIS platform will be listed in Section 5 and the main differences with similar projects illustrated. Later, a more detailed and technical description of the platform and its main components is introduced in Section 6. Finally, lessons learned during the platform development and conclusions and future work are provided in sections 7 and 8, respectively.

3. Current European Energy Directives and their deployment at Member State level

The "Clean Energy for All Europeans" [5] legislative framework proposed by the European Commission on November 2016 was the first action towards achieving a clean energy transition and contributing to the goals established in the Paris Agreement. This package of measures was based on three main goals: putting energy efficiency first, achieving global leadership in renewable energies and providing a fair deal for consumers. It includes as well eight different legislative proposals that tackle, among other, Energy Efficiency, Energy Performance in Buildings, Renewable Energy and Governance.

The most relevant directives for the purpose of this paper of this legislative framework proposal are the Energy Performance of Buildings Directive (2010/31/EU) [6], the Renewable Energy Directive (2009/28/EC) [8] and the Energy Efficiency Directive (2012/27/EU) [9]. These directives set certain objectives to Member States and should be transposed by each nation in order to comply with them by establishing plans and strategies. After each Member State has carried out his strategies, the results should be reported at European level.

When considering energy planning at urban level, the Energy Performance of Buildings Directive has to be taken into account. Entered into force in 2010, it has set some measures among which the following can be highlighted: all buildings must be nearly zero-energy buildings by 2020, EU countries must establish inspection schemes for heating and air conditioning systems and also cost-optimal energy performance requirements should be established for new buildings. However, the most interesting of the legislative measures contained in this Directive is the obligation in Member States of issuing Energy Performance Certificates for every dwelling, building block, or commercial premise to be leased or sold, as well as for every new construction and public building [10]. In order to assure coherence among the results obtained in each Member State, a methodological framework is described in the annex of the aforementioned Directive. This annex does not exactly set the formulas to be deployed, but instead presents the type of calculations to perform or which aspects to consider (for instance, thermal bridges). To this respect also Mandate 480 [27] has been defined, for the elaboration and adoption of standards for a methodology calculating the integrated energy performance of buildings and promoting the energy efficiency of buildings. Each Member State has the obligation to transpose this framework in their country and develop either a concrete methodology or develop specific tools to serve this purpose, leading sometimes to inhomogeneous approaches within the European Union. Nevertheless, even when representing a major challenge, a great leap forward has been achieved by providing the general public with information on energy performance of buildings and thus, aiming to make them aware of the relevance of these issues.

This Directive of 2010 has recently been updated and entered into force in July 2018. This recast of the EPBD (2018/844/EU) [7] directive aims for a more comparable and measurable energy performance among Member States. To do so, countries, will not only have to establish national energy performance requirements, but also will have to foster the use of smart technologies and should rely on real consumption data to measure energy performance. All in all, it sets the adequate steps towards a more homogeneous view on energy performance within the EU.

In relation to this, the ENERGIS platform aims to support the implementation and compliance of the Energy Performance of Buildings Directive by providing a tool that supports energy planning processes. Additionally, the estimation of the energy demand contemplated within the platform is based on the calculation methods set by the EPBD and transposed in the Spanish legislation, from which four validated Energy Performance Certificate tools were generated: HULC, CERMA, CE3X and CE3. One of these tools, CE3X, has been the base for the calculations performed within the platform, which have been automatized, as it will be later explained. This way, the platform both ensures to be providing adequate data to the user and also contributes to the compliance of the Energy Performance of Buildings Directive.

4. Energy planning context in Europe and platform need

The implementation of European Energy Directives and energy planning are closely related to each other. The achievement of the first in different Member States is performed differently depending on the administrative structure of each country. While in some of them the Directives are transposed and enforced at national level, in other actions are taken at regional level. Thus, these authorities will have to further detail the specifications established at European level and set plans for a determined period of years to comply with European goals. In particular, the general stages within the energy planning process and the roles of these authorities and involved stakeholders are the following:

1. **Stage 1: development of the enforcing norm**. Before transposing the goals established at European level, it is of the utmost importance to have a clear idea of what the current status of the country or the region is in terms of energy needs so as to be able to define realistic goals to be complied with. Having a clear basis will grant the establishment of coherent goals at national or regional level that can be achieved in a reasonable manner.
2. **Stage 2: definition of energy actions**. Once the European directive has been transposed at national or regional level, the corresponding public authorities (regional or local) should define the action plans and specific energy actions should be carried out, such as refurbishment of district or buildings. At this stage, not only authorities, but also energy planners, energy service companies or investors will be willing to know how to target their resources effectively, that is, knowing which urban area counts with the most adequate conditions for an energy action to be implemented: it is the most unfavourable in terms of building construction, energy demand, or it is a socially deprived area, or other criteria that can be measurable and analysed.
3. **Stage 3: evaluation of different scenarios**. Once a determined area has been selected, the design and implementation of a specific energy action needs to be defined, tailored specifically to the area at hand. At this stage it is crucial for energy planners or designers to be able to compare the effect different actions can have in comparison to the current status of the area (the baseline). By performing an intense study and comparing a number of possibilities (different scenarios), the most adequate one can be selected according to the criteria of the designer or energy planner (for instance, being the main goal the reduction of the consumption and not exceeding a certain investment amount).
4. **Stage 4: monitoring the results of the energy actions.** Once the optimal energy action has been implemented, the impact obtained in terms of achieving the established goals should be measured and compared with the initial status. This monitoring process, apart from enabling the reporting of results as the norm demands, it allows for further reflection on the impact each measure has had. This way, it fosters a better decision making in stages 2 and 3, by feeding them with knowledge and experience generated in implementing energy measures, as well as objective indicators that measure the positive impact of each measure.

As it has been explained, for a successful decision making at all of the stages a great deal of analysis and simulation of results is required. This processes, when performed aiming for accuracy, end up being a time-consuming process. Also, because of the amount of data involved it can tend to be an error-prone process when performed by humans, leading to uncertainty and inaccuracies, thus, to inadequate decisions.

For all of these reasons, there is a need for tools that automate all of these processes, which can provide an adequate accuracy for the decision making at urban level to be able to cover all of the abovementioned stages. However, in the energy field, while there are a great amount of tools for dynamic simulation at building level (requiring a high amount of input data), there are not many tools to simulate at urban level energy related aspects. In this sense, some examples of projects tackling these problems will be presented in Section 5, and will be contrasted with what the ENERGIS platform can provide.

In general terms, and bearing in mind the stages described above, the ENERGIS platform, (being an online platform that maps the energy demand in cities and regions at different scales) is oriented to supporting the decision making at Stage 1 and Stage 2.

5. ENERGIS objective and main differences with other approaches in the energy planning field

The ENERGIS platform main objective is to provide an easy to use energy decision support tool to map energy demand at urban and regional level calculated through validated methods. To this end, public data is collected, analysed and processed; the energy demand building by building is automatically calculated using a validated Energy Performance Certificate tool; and all of the information mapped in friendly web maps, making use of the functionalities provided by Geographic Information Systems. Therefore, the three main pillars in the development of the platform are:

1. **To make use of publicly available repositories**: all of the data deployed within the platform are publicly available and approved by official authorities. The main data source is the Spanish Cadaster [20], which provides information on the geometry of buildings and semantic data on them, such as the year of construction or the number of heights.
2. **To implement a calculation method based on validated Energy Performance Certificate tools**: to this end, the four validated tools at national level in Spain were analysed and one of them (CE3X) chosen as the base for the energy demand estimations displayed in the platform. The objective was to automatically create the input files and run the process to obtain the output results.
3. **To exploit Geographic Information Systems possibilities:** a great amount of synergies can come from linking GIS with planning because of the nature of both disciplines. The ENERGIS platform will therefore display a coloured map at three scales where analysis widgets will be added in order to classify the content displayed in the screen.

Some of these objectives are sought in projects sharing a similar approach to that of ENERGIS. Below, two of them are listed, as well as the main differences with the ENERGIS platform explained.

1. **Estimated total annual building energy consumption at the Block and Lot level for NYC [12]:** Developed by the Sustainable Engineering Lab, this project aims at analysing the dynamics of final energy consumption in the city of New York. To this aim, the final heating, cooling, DHW and electricity energy consumption in the built environment are estimated, based on data at district level on the energy use, natural gas, diesel and vapour consumption of 2009 and it was combined with information coming from MapPLUTO, a geographical database of the Urban Planning Department in NYC. The results are then displayed following a colour code through a web map, providing two levels of aggregation: at block and at lot level. The information is complemented with a pop-up that appears when clicking on a block or lot. However, this map only covers the city of New York, where the calculations have been estimated, without offering the capability to replicate this methodology in other cities.

2. **Energie label atlas [14]**: The objective of the Energie Label Atlas is to represent the estimated Energy Labels of buildings in Holland. This project was carried out with the aim of covering almost all residential buildings in the country and of offering citizens the possibility to obtain an accurate EPC of their dwelling. This would require performing additional calculations over the estimated value proposed in the map, but at a lower cost than usual. The estimated values shown have been calculated using

reference buildings and assigning a label to each of them, which implied the study of a number of building typologies that was representative enough of the residential sector in the Netherlands. In addition, real Energy Labels coming from real EPCs were also mapped and the comparison among both results enabled. This results in some cases in high discrepancies between both results. The visualization capabilities are similar to those of the NYC case; however, the whole country was covered providing the estimated results at block level, regardless of the visualization scale. The information is also complemented by a widget, which serves to detail information at dwelling level, if real EPC information is available.

The projects described above represent interesting approaches to the energy planning problem, by providing basic information on the energy status of a city (in the case of NYC) or of a country (in the case of the Netherlands). However, it is worth highlighting the main differences to the ENERGIS platform, which are related to the calculation methodology, automatization of the process and the scale tackled.

The **calculation methodology** is considered highly relevant in order to provide accurate results. Therefore, instead of deploying estimated approaches in order to calculate consumption (as in the NYC case) the ENERGIS project is constrained to the estimation of the energy demand. This is due to the fact that there is no source of public information that can provide data on the energy systems, rendering it inaccurate to assume the existence of a determined energy system. The approach used in NYC to calculate consumption, that is, assigning an energy system according to the typology of the building would be highly beneficial if applied within ENERGIS and would improve the quality of the platform. However, since there is no available database where these systems are described in Spain, no reliability can be assumed from this process. Moreover, the calculation is focused on the **automation of validated tools** to generate EPCs in Spain. This fact ensures a determined level of precision to the results obtained, opposed to the abovementioned approaches.

With respect to the **scale** considered, aggregation possibilities are granted as in the case of the NYC map, but the unit of measure used to estimate the demand is the block, as in both showcased projects. Nevertheless, the scope to which the ENERGIS platform can be applied is the same as in the Netherlands case: at country level, since the main source of data is the Spanish Cadastre [20] which covers the whole country.

6. Components of the ENERGIS platform

The ENERGIS platform, in order to achieve its objectives, deals with three main aspects: (1) information processing and treatment; (2) estimation of the energy demand and (3) the storage, mapping and visualisation of the data (3). The platform scheme can be seen below:

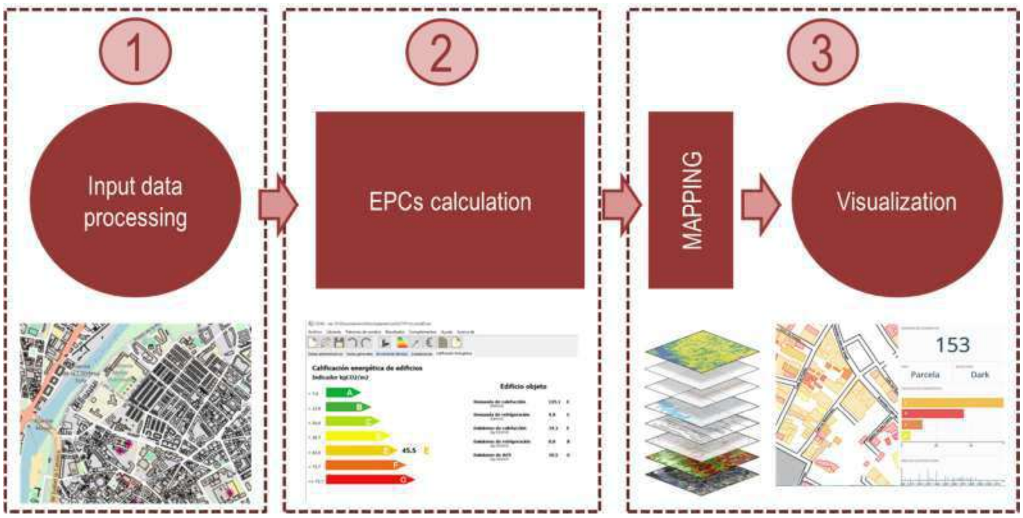

Figure 1: Scheme of the ENERGIS platform

6.1 INFORMATION PROCESSING AND TREATMENT

One of the main requirements of the platform is the use of open public data from official sources to be deployed in the estimation of the energy demand, which should be retrieved in an automated manner. These data are collected from different sources and they must be transformed to meet the input requirements of the estimation engine. Therefore, after being gathered, these data should be processed and transformed.

There are three main types of data required by the platform: (1) geometry data on buildings, (2) climate zones and (3) building thermal properties, which are explained below.

For the **geometry data on buildings** the key data source is the Spanish cadastre. The cadastre, for each building, provides geometrical information (in a GML file) and general semantic information that will be used in order to identify and to characterize the building. More specifically, the information obtained from the cadastre to be used within the platform is the geographical information of the building, i.e. the footprint of the building, and also important information as the number of the building floors above ground, and below ground, the year of the construction, current use of the building and the address of the building. Additionally, apart from these data that can be directly used, there is other data that needs to be inferred according to certain established hypotheses. This is the case of some building envelope elements, such as windows or thermal bridges, whose dimensions were estimated according to each building's dimensions [20].

The geometry information automatically collected from the cadastre in GML files is processed to offer the energy demand estimation engine the information as is required. The main processes are on the one hand the generation of the information for the different envelope elements of the building, with their dimensions and the orientation, and on the other hand the production of shadows patterns with the information of the façades of neighbouring buildings and the implementation of calculation methods to obtain how this façades influence the direct incidence of the sun.

For **climate-related data**, the National Code for Building Construction [21] in Spain was queried, since it establishes reference climate zones according to the province or town (static) and their height above sea level, having different climate data each zone.

In the case of the **building thermal properties**, no information was directly found through public data sources so the National Building Code was consulted. Based on several studies a Catalogue of building elements and materials was generated. This catalogue of building elements is used by the different EPC tools in order to assign default thermal property values to walls (external and internal), roofs, floors, windows, etc. The ENERGIS platform is able to use this catalogue in order to consider different building characteristics, where according to the type of element, the year of construction and the climatic zone, some thermal characteristics and other parameters are assigned in the same way that the EPC tools use this catalogue of building elements.

All this aforementioned information is encapsulated in one only file per building, in *.json* format, that will be used directly in the next process.

6.2 ESTIMATION OF THE ENERGY DEMAND

In this process the energy demand of each building of interest is estimated. As it has been commented the estimation engine is based in one of the EPC calculation tools recognized by the Spanish government for the energy certification of existing buildings. In the case of Spain four validated tools are available to the public free of charge: *Herramienta Unificada Líder-Calener* (HULC), CE3, CE3X and CERMA. The tool selected as basis of the estimation engine should enable the introduction of an adequate amount of data that can be fed by the public data sources identified.

For this aim the study of the abovementioned tools was performed, choosing in the end CE3X because of it being easy to use and because of having data requirements that can be easily covered with information coming from public sources. Moreover, CE3X files are the reference in terms of data model at national level (the data model proposed at national level to represent information related to EPCs follows the same structure as the output of CE3X). Additionally, the accuracy behind the results provided in the calculations of the tools was also tested prior to the selection of the EPC calculation tool.

The basic operation of the engine consists of the automatic creation of the *.cex* format file by processing the *.json* file created in the previous step and, after that, the automatic execution of the CE3X tool and the exportation of the results in *.xml* format, among which are the energy demands of the building: cooling, heating and global energy demand.

The process was validated, first at building block level, then at district scale and, finally, citywide, in order to improve the engine and thus achieve more accurate results, which were more in line with the actual demand values of the buildings.

6.3 MAPPING AND VISUALISATION

The output information of the ENERGIS tool is stored in a geodatabase, which is structured in three tables: one table for buildings, one for blocks (groups of buildings) and one for cadastral zones (neighbourhood). These three scales come inherent in the project, since they are the ones provided by the Spanish Cadastre's online services and data. These three scales are not arbitrarily defined in the cadaster, but are common definitions set in the INSPIRE Directive (which deals with the harmonization of geodata) and which is followed and implemented in the data offered and the services provided by the Spanish Cadastre.

Thus, the ENERGIS data is provided at these three different scales: the building demand information is directly calculated with the estimation engine, while for the demand in the blocks and the cadastral zones aggregation operations have been carried out in order to calculate the demand values. In order to geo-reference and be able to map this information, the geographical information retrieved in the first step will be also used.

These stored data is shown to the public through the ENERGIS online platform. The data will be presented as is reflected in the Figure 2, with the geo-referenced values and with a recognisable colour code that corresponds to the Energy Label scale used in Energy Performance Certificates.

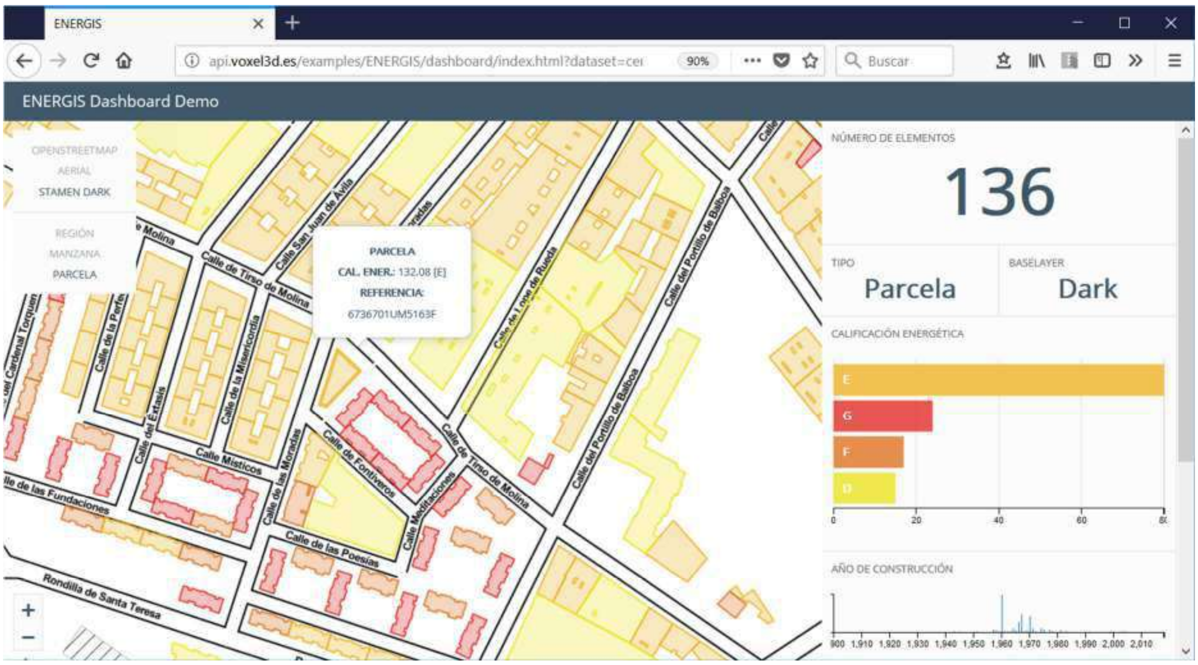

Figure 2: ENERGIS web platform

Moreover, some widgets providing more information on all the data displayed in the screen are shown in the figure in the column on the right. Using these widgets the user will be able to filter the information displayed on the screen by building type, demand label and year of construction, among others. In addition, the user will be able to move among the different scales by scrolling in the map or by using the shortcuts displayed on the top left corner of the screen. Also, there are three different base maps available for the user: openstreetmap, aerial view (ortophotography) and stamen dark (simplified black and white map, as shown in the figure).

In addition, an online web portal with further information of the platform (information about EPCs in the ENERGIS platform, instructions on how to use the tool, etc.) has been implemented in the following link: http://api.voxel3d.es/examples/ENERGIS/portal/.

7. Lessons learned

During the design and the development of the ENERGIS tool, the difficulties faced and the lessons learned were mainly related to two aspects: from the point of view of the platform development and from the point of view of energy planning and the implementation of Energy Directives.

With respect to the difficulties and lessons learned **with respect to the tool development**, the first problem faced was the absence or inaccuracies of the input data. The information provided for the cadastre was not homogeneously defined at regional and local level. Due to this heterogeneity of the information and also to the peculiarity of the different structures of the buildings, more cases than those foreseen a priori had to be taken into account. In addition all the data needed, such as, were not available in the cadastre so some hypothesis (for example dimensions of openings and lengths of thermal bridges) had to be set.

Other important challenge was tackling scalability and moving from the calculation of the energy demand of one building or district (set of buildings) to a city or regional level. The high increment of files and processing time was experienced in this proof of concept, but should be addressed in the future by means of high performance computing, big data technologies or parallel processing.

In a more general context, **from the point of view of energy planning i**t must be stated that in order for holistic and integrated approaches in the field of urban planning to succeed, based on multidisciplinary collaboration (for instance, urban planning per se and energy planning) it has been detected that it is of the utmost importance to share a common language, a common data model, and it is highly beneficial to rely on a standard. This fact has manifested in two steps in the platform development: (1) when analysing the input data coming from cadastre and (2) when analysing the inputs required for the EPC calculation tools. Standards and harmonisation efforts, such as the INSIPIRE Directive [11] (which aims at harmonising geolocation data) can prove highly effective in achieving common definitions which allow for the understanding across different fields and the ability to contrast results and methodologies: if inputs are defined and obtained in the same manner, then calculation methodologies, energy actions or policies can be aligned and contrasted.

Finally, and more focused on the applicability of the platform within energy planning process, the use of the ENERGIS platform can lead to a reduction of time and uncertainties. By automating processes or rules to analyse our real – life conditions, the efforts required in planning can be devoted to finding better solutions to the problems at hand. Therefore, not only saving money and resources, but also being able to implement more adequate measures and design better refurbishment strategies.

8. Conclusions and future work

The ENERGIS platform combines existing public data, validated calculated methodologies and GIS capabilities to offer a complete and powerful product to support energy planning. The process to define, design and develop the platform has followed several stages, which involved the analysis of data coming from public sources, working with EPC tools, the validation of results at all stages and working with GIS in order to explore its full potential. Difficulties in this process involved mainly the work with public sources of data, in particular the Spanish Cadastre. The main problem was the lack of a standardised approach in the definition of geometric data. This fact would be solved with an adequate implementation of the INSPIRE Directive, which would guarantee homogeneous information of the buildings.

The platform provides users energy planning capabilities which will aid in the decision-making process when generating energy plans, by providing with maps showing the energy demand of cities and urban settings. It will reduce uncertainties and provide a knowledge base upon which to ground decisions.

Stages 1 (development of the enforcing norm) and 2 (development of energy actions) [as explained in Section 4] within the energy planning process are covered by the platform. Future work related with this platform includes: (1) enhancing the displayed data (providing consumption estimation), (2) performing calculations at dwelling level, (3) offering new functionalities, such as capacity to introduce improvement measures and (4) offering functionalities to monitor the results obtained with the energy actions and evaluate their adequacy (stage 4). The future work scope can be seen in the figure below:

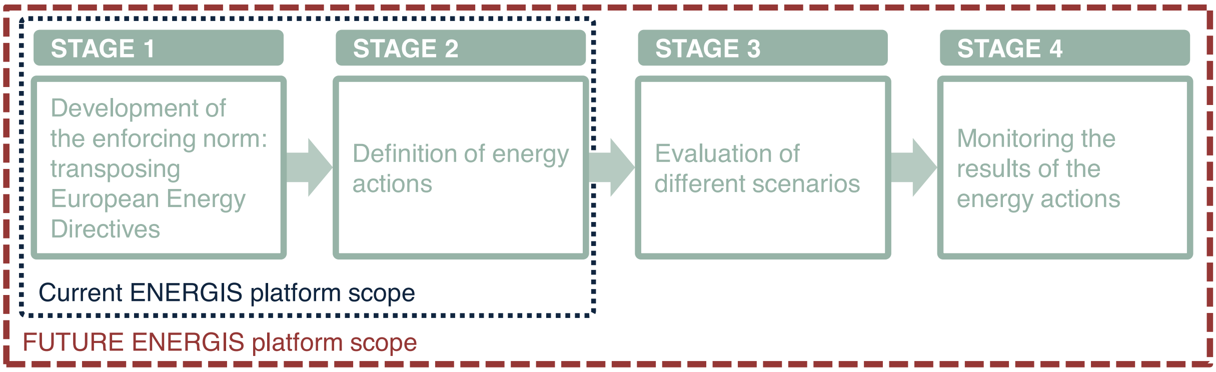

Figure 3: ENERGIS platform: current vs future scope

All in all, by supporting energy planning, the adequate allocation of resources will be fostered to comply with energy directives' objectives and thus, energy retrofitting interventions will be boosted. As a consequence, the energy consumption of buildings will be reduced, resulting in lower emission rates, which will finally contribute in the fight against climate change, advocated by the United Nations with the signature of the Paris agreement.

The achievement of these crucial energy goals should be contemplated within general urban planning processes in order to implement holistic and integrated approaches. Only with these efforts, cities, in their constant expansion and growth, will be regarded not as a major source of problems that impede the maintenance of Earth's natural environmental balance and thus as main contributors for unhealthy environments; but as sustainable opportunities for growth and development.

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Climate Protection and Environmental Impact Assessment: could climate protection be seen as an "overall public interest"?

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1. Introduction

Climate change is a fact. So is the necessity to limit global green house gas emissions. Thus, 195 states[i] have signed the Paris agreement and committed themselves to holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels. All member states of the European Union have signed and ratified the Paris Agreement and are therefore bound to its aim. In order to achieve the long-term temperature goal set out in the agreement parties have to aim to reach global peaking of greenhouse gas emissions as soon as possible and to undertake rapid reductions thereafter in accordance with best available science, so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century. So far the facts, in reality many states still find it difficult to effectively cut their emissions in green house gases. At least in Europe, all states agree in principle to the goal of reducing CO_2 emissions but when it comes to deciding about new infrastructure measures or factories there seem to be very often arguments why these cases are necessary for development and thus more important than climate protection. As a result, many states do not meet their obligation under international law regarding emission reduction. However, there are raising objections to this pattern and civil society, non-governmental organizations, as well as single citizens start opposing this behavior and, among other measures, started various lawsuits trying to force governments and/or administrative bodies to respect the relevant state’s commitment to climate protection under international law.

This paper elaborates whether “climate protection” could be interpreted as an “overall public interest” within the Environmental Impact Assessment. The analysis focuses on a famous case in Austria, the enlargement of the Vienna International Airport and the respective court rulings but also compares this case with the Urgenda lawsuit in the Netherlands.

2. The case: enlargement of Vienna International Airport

Vienna International Airport is the biggest airport in Austria, with about 25 Mio passengers per year and a current growth rate of about 8 percent per year.[ii] Thus, already in 1998 the airport issued its “Masterplan 2015”, which included the decision to build a third runway in order to meet future demands.

2.1 Pre-Proceedings

Knowing that the idea to increase flights to and from the airports would lead to massive resistance from the local population, the airport managers tried to appease the relevant stakeholders by finding common solutions before starting the official administrative proceedings. So, in 2000 a mediation process was started aiming at finding a good compromise with neighbors and municipalities in question. This biggest mediation process in Europe included 50 parties and took 5 years of negotiation. In 2005 a mediation contract was signed, deciding on the exact location of the new runway and limiting night flights (between

23.30 and 5.30) to a maximum of 3.000 or about half of the former number of night flights in order to guarantee night's rest for neighbors. However, this limitation would only come into force fully, if the third runway were built until 2010. As this did not happen, the maximum amount of night flights was limited at 4.700, until a final decision on the third runway will be taken.

2.2 Environmental Impact Assessment

After this rather lengthy mediation process, the formal application to issue a permit for a third runway was started in 2007. Consequently, the developer prepared an environmental impact assessment report, consisting of 32 file folders[iii] and submitted it to the relevant authority, the Provincial State Government of Lower Austria (*Landesregierung Niederösterreich*). The Environmental Impact Assessment was *inter alia* based on the Austrian Aviation Act[iv] and of course on the Austrian Law on Environmental Impact Assessment[v]. The Austrian Aviation Act commits that permits for civil airports (which is the category applicable for Vienna International Airport) have to be issued, if the projects seem suitable from a technical point of view, the developer seems reliable and a secure management of the airport seems guaranteed, the developer has sufficient financial means to secure the payment of public obligations **and there is no contradiction to other public interests** (emphasis added). The latter clause proved to be the most discussed throughout the whole proceedings.

Finally, in 2012 the Provincial State Government issued an affirmative permit, but several parties, mainly neighbors and citizen's initiatives appealed against this decision. So, the second instance body, the Federal Administrative Court (*Bundesverwaltungsgericht*) had to decide on the case and found that the project could not be permitted, due to its effects on the environment.[vi]

2.3 Findings of the Federal Administrative Court[vii]

When deciding on the eligible legal provisions, the Federal Administrative Court ruled, that *inter alia* the Charter of Fundamental Rights of the European Union[viii] was applicable. *In concreto* it referred to Article 37, which states that, "a high level of environmental protection and the improvement of the quality of the environment must be integrated into the policies of the Union and ensured in accordance with the principle of sustainable development". The Federal Administrative Court also cited the Austrian Federal Constitutional Law on comprehensive environmental protection and sustainability[ix], saying "the Republic of Austria (Federal State, Provincial States and Municipalities) support comprehensive environmental protection". Furthermore, the Federal Administrative Court quoted the Constitution of the Province of Lower Austria[x], namely Article 4/2 that rules, "Lower Austria has to provide for the maintenance of environment, nature and landscape. Special importance has to be given to climate protection." Of course, also the Aviation Act and the Law on Environmental Impact Assessment and other legal provisions were found to be applicable.

The focus of the Federal Administrative Court's discussion was the question of the public interest. On one hand it found a public interest, stated in the Aviation Act, in having sufficient flights at Vienna International Airport and promotion of economical growth including the guarantee of existing and creation of future jobs in the region. On the other hand the Federal Administrative Court evaluated the potential rise in greenhouse gas emission, as counteracting the public interest in reducing greenhouse gas emissions and environmental protection. For the latter argument the Federal Administrative Court also referred to Austria's obligation under the Kyoto Protocol to the United Nations Framework Convention on Climate Change[xi] as well as under the Paris Agreement[xii] and of course also to national regulations on climate protection.[xiii] When contrasting these competing public interests the Federal Administrative Court found that climate protection outweighs economic growth, as Austria has obligations under international and European law to effectively cut its greenhouse gas emissions. As the building of the third runway would lead to an increase in greenhouse gas emissions of approximately two percent of Austria's total CO_2 emissions, and as Austria has not managed to significantly reduce its relevant emissions within the last years, another huge project counteracting to these obligations under international law could not be approved.

Furthermore, the Federal Administrative Court stressed the duties under the Austrian Federal Constitutional Law on comprehensive environmental protection, to provide a sustainable environment for future generations, which would also be contradicted by the project.

This judicial verdict, rendered in February 2017, was met with applause by the complainants of the case, but also by many international and Austrian environmental NGOs, citizens and administrative bodies for the protection of the environment.[xiv]

However, the developer decided to challenge this verdict and appealed to the Austrian Constitutional Court (*Verfassungsgerichtshof*), arguing for violation of the right of equality before the law. The Constitutional Court agreed, accusing the Federal Administrative Court of arbitrariness.

2.4 Findings of the Constitutional Court[xv]

In June 2017 the judges of the Constitutional Court concluded that the Federal Administrative Court had applied the Aviation Act in an incomprehensible way, interpreting the law incorrect. *In concreto* it was of the opinion that climate protection was not to be seen as a public interest under the Aviation Act and should therefore not be taken into consideration for the decision whether to grant a permit. As for the Kyoto Protocol and the Paris Agreement the Constitutional Court decided that both could not be applied directly, but only by means of implementation into national legislation. It argued further, that international aviation was excluded from the Kyoto Protocol and not explicitly mentioned in the Paris Agreement and thus was not to be seen under the obligations of national states but the United Nations respectively under its specialized agency, the International Civil Aviation Organization (ICAO).

Consequently, the Federal Administrative Court had to revise its decision on basis of the Constitutional Court's opinion and in March 2018 rendered the permit for the erection of the third runway on Vienna International Airport. [xvi]

3. Discussion of the legal arguments of the two courts

In the following chapter an analyses of the arguments taken by the two courts will be given and their content will be discussed. The case was widely debated in Austria, not only within the scientific and legal community, but also within society as such. For weeks media kept contributing to the topic and still arguments are being exchanged.[xvii] The latest developments being plans by the current government to include the target of "competitive industrial location" in the Austrian constitution, as a counter-part to the aim of "comprehensive environmental protection", as well as a new law supporting the industrial location by excluding certain "projects of overall public importance" from the necessity of an Environmental Impact Assessment. However, most of the discussion did not center on the content of the arguments, but rather on the alleged contradiction between environmental protection and industrial development and on the issue whether it was within a court's domain to decide about fulfillment of greenhouse gas reduction targets or whether this was to be seen as a mostly political decision and should thus be taken by elected bodies.

3.1.Formal arguments

First, it should be documented that the Constitutional Court issued a very sever judgment on the Federal Administrative Court's legal conclusions, defining them as arbitrary and as a violation of the right of equality before the law. Understandably, this caused a lot of discussion within the Austrian legal community as well as within society.

Second, it should be mentioned that within the duration of this special case's legal procedure a major re-organization of Austria's administrative procedure had been taking place, establishing the Federal Administrative Court as responsible second instance body for Environmental Impact Assessments. Thus, many stake-holders criticized the Federal Administrative Court simply for taking the decision of weighing these two different public interests of climate protection and economic development arguing that such decisions should be taken only by political, but not by an administrative body. In fact, the Court was absolutely acting within its domain. [xviii]

3.2.Contents of the arguments

Concerning the Aviation Act:

A central argument of the Constitutional Court focused on the definition of "public interest". It claimed that the interpretation of this term in question must lie within the interests mentioned in the relevant administrative law, in this case the Aviation Act. This act lists some public interests, but also includes a broader clause, talking about "other public interests" which must not be in contradiction to the issuance of a permit for a civil airport. According to the Constitutional Court the Federal Administrative Court was wrong to include climate protection within this clause, as it is no interest under the Aviation Act, especially as the original Aviation Act was enacted in 1957. This argument seems to be out of the ordinary, as it is undeniably a very open clause, which must be interpreted not only within the specific law, but also regarding higher-ranking legal provisions, especially regarding the Austrian Constitution. As there is an explicit constitutional law about comprehensive environmental protection and sustainability (see chapter 2.3), it must be clear that this target provision must be respected when interpreting possible "other public interests". This opinion is confirmed by the fact that the Constitutional Court has come to the same conclusion in comparable cases.[xix]

If you followed the opinion of the Constitutional Court that only public interests as defined in the Aviation Act were to be considered, this would result in the awkward situation that the broad definition within the Aviation Act of "other public interest" would not be interpreted according to the Austrian Constitution but only within a non-constitutional law, thus revising the hierarchy of legal norms.[xx]

Also, the new bill of the federal government to include the target of "competitive industrial location" in the Austrian constitution seems unnecessary, if only the relevant law and not the constitution would serve as the frame for interpretation. Noted should be further, that the province of Lower Austria soon after the judgment of the Constitutional Court altered its Constitution by including the target of "competitive industrial location". Again, this does not seem necessary, if the aim of climate protection, which had already been stated in its Constitution before, should not be used for interpretation.

As for the argument that international climate protection treaties, as Kyoto and Paris, are not directly applicable and thus should not have been taken into consideration by the Federal Administrative Court, it must be stressed, that the Federal Administrative Court did not do that. It simply included these treaties into its reflection on the importance of climate protection as a public interest, which has been done by other high courts in Austria before. [xxi]

Another argument can be found in Article 37 Charter of Fundamental Rights of the European Union, which states that, "a high level of environmental protection must be integrated and ensured with the principle of sustainable development". This Fundamental Rights catalogue is mainly directed towards the bodies of the European Union and member states courts, when interpreting cases with connection to European Union Law. One could argue, that Environmental Impact Assessment is strongly linked to European Law; however, there is an even stronger bond. In 2012 the very same Constitutional Court decided that the Charter of

Fundamental Rights has to be included in the legal norms determining the compatibility of laws with the Austrian Constitution.[xxii] How could this be reasonably be limited just because the law in question does not explicitly state environmental protection or climate change (maybe because it is simply from a time when these issues were not seen as important yet – like in the case in question) and "further public interests" mentioned in the law was not allowed to include further public interest (like even mentioned in the Constitution and the Charter of Fundamental Rights) but only further public interests specially mentioned in the respective law.

As a side note it should be clarified that the Aviation Act does indeed refer to the protection of human health. It does so not within the context of permission of airports, but within the issue of items dropping from planes, still in a broad interpretation this could be seen as a public interest stated by the law and thus as an indicator that the "other public interests" must be interpreted including human health, which certainly is affected by climate change.[xxiii]

Concerning the Law on Environmental Impact Assessments:

Surprisingly, neither the Federal Administrative Court nor the Constitutional Court did examine the case closer under the protected factors within the Austrian Law on Environmental Impact Assessments, although the proceedings for permission of the construction of the third runway were within a legal process under exactly this law. Both Courts lengthy discussed the possible interpretation of "other public interest" under the Aviation Act, but did not refer to the factors protected under the Law on Environmental Impact Assessment, without an interconnection to the Aviation Act.

When taking a closer look at this law, one finds that the aim of Environmental Impact Assessments are defined as determining, describing and assessing the direct and indirect effects of a project on listed factors.[xxiv] The factors most important for the case in questions are: human health, biodiversity and climate, but also other factors mentioned such as water, air and landscape could be affected by climate change. Undeniably, three factors listed in first place will be directly as well as indirectly affected climate change. So, as a first result, protected factors under the Austrian Law on Environmental Impact Assessment are certainly affected by the construction of a third runway at Vienna International Airport, because this construction will lead to an intended increase in flights to and from Vienna and thus to a rise in CO_2 emissions.

Of course, these protected factors are based on the EU Directive on Environmental Impact Assessment,[xxv] which lists in its Article 3, again among other, human health, biodiversity and climate, as the factors on which effects of a project must be assessed.

Under § 17 of the Austrian Law on Environmental Impact Assessment the competent authority needs to make sure that (*inter alia*) "the pressure caused by emissions is to be kept as low as possible on the protected factors. In any case emissions have to be avoided that endanger the life or health of human beings, as far as this is not already foreseen within the relevant administrative laws to be taken into consideration." So, even if one would come to the decision that "other public interests" of the Aviation Act do not have to be interpreted according to the constitutional aim of environmental protection, there would still be this paragraph of the Austrian Law on Environmental Impact Assessment to be examined.

It firstly talks about making sure that emissions posing a danger for protected factors are to be kept as low as possible, and then clarifies that in any case emissions endangering life or health of human beings have to be completely prevented. As a result, applicability of this legal clause can be argued, as climate is listed among the protected factors, which results in the obligation to keep emissions harming the climate as low as possible.

As the predicted emissions, caused by construction of a third runway will amount to 1,8%-2% of Austria's annual total greenhouse gas emissions,[xxvi] these are to be classified as significant factor within Austria's CO_2 end result.

4. The Urgenda climate law suit against The Netherlands[xxvii]

In 2015, campaign group Urgenda (for: urgent agenda) and 886 Dutch citizens sued the Dutch government in the Hague District Court for a stronger 2020 national emission target. It was the first court case in the world in which citizens tried to force their government before a court to increase its efforts against dangerous climate change.

4.1.Formal arguments

The Urgenda foundation, having its base in the Dutch Research Institute for Transition at Erasmus University Rotterdam, challenged the Dutch state to take further action against global warming by reducing the greenhouse gas emissions in the Netherlands.

The Dutch government argued that Urgenda and the citizens claiming were not entitled to sue the government because of lack of legal basis. Indeed, the Court did recognize, that individuals, such as those who Urgenda was representing, as well as Urgenda itself could not directly call on international environmental treaties relevant in the case. However, it admitted that international obligations of the state, European Union treaty provisions and guidelines could indeed play a role in filling open norms of national law. It also stressed the importance of the principle of endangerment and of equity, emphasizing that the needs of future generations must be taken into account.

Also in this case the question arose whether the matter of how much climate protection a state is supposed to provide is suited to be decided by non-elected judges. The Dutch Court argued that Dutch law doesn't know an absolute separation of powers, in this case between the executive branch and the judicial branch. It reasoned that there was rather a division of responsibilities with the goal to achieve a balance between these powers and that judges must, independently of any political agenda, restrict themselves to their domain, the application of the law. Further, it said, that in the case in question, since the severity of the danger increases the legal duty of the government, there were also fewer reasons for such restraint by the court.

4.2.Contents of the arguments

The claimants argued that the Dutch government needed to respect the findings of the Intergovernmental Panel on Climate Change (IPCC), a scientific body established by the United Nations Environmental Program, but also an intergovernmental organization, having 195 countries as member states, including the Netherlands.[xxviii] According to the IPCC, to reach the aim of the Paris agreement to control temperature increases to 2 Degrees Celsius above pre-industrial levels, the concentration of greenhouse gas emissions in the atmosphere will have to be stabilized at a level of 445-490 ppmv (parts per million by volume) CO_2 equivalents. Therefore, Annex I countries (including the Netherlands) must reduce their emissions by 80-95% compared to 1990.[xxix]

Urgenda argued that the Netherlands were a party to the United Nations Framework Convention on Climate Change and thus were obliged to reduce greenhouse gas emissions to prevent the undesired consequences of climate change. It also reasoned that the Netherlands were parties to the Kyoto Protocol as well as to the Paris agreement and therefore had to fulfill concrete reduction limits under these international law treaties.

Urgenda furthermore pointed out that the Dutch constitution reads in its Article 21 “it shall be the concern of the authorities to keep the country habitable and to protect and improve the environment”.

Its actual claim centered that the Netherlands to fulfill their duty under international, European and national climate protection law, needed to reduce its CO_2 emissions by 25% to

40%, compared to 1990, by 2020. As the Netherlands after 2010, however, took on a reduction target of 20%, which is expected to result in a total reduction of 14%-17% in 2020, Urgenda found that the Dutch reduction target was therefore below the standards deemed necessary by climate science and international climate policy. So, in principle there was no different opinion on the basis decision that CO_2 emissions needed to be reduced, but only different point of views on the level and/or timeframe of reduction.

In addition, Urgenda brought also up the international-law “no-harm-principle”, meaning that no state has the right to use its territory, to cause significant damage to other states. It also elaborated on the fact, that the sooner action preventing further greenhouse gas emissions is taken, the cheaper this counter measures are going to be.

The court followed Urgenda’s arguments and ruled that the Dutch government had a duty of care to mitigate as quickly and as much as possible. It agreed that with the current reduction level the Netherlands would not meet their reduction targets under international law and therefore the proposed reduction of 14%-17% had to be qualified as not sufficient, as the state has a duty to protect the living environment. The Court further considered that within the mentioned range of 25%-40% a decrease to the lower boundary is the minimum that is in principle required. Thus, the Netherlands had to meet a reduction target of at least 25% by 2020 compared to 1990.

As for the argument of the Dutch government that the Netherlands were only a small state that did not contribute a lot to the total increase in greenhouse gas emissions worldwide, the Court ruled that the Netherlands as Annex 1 country under the Paris Agreement should be taking a leading role in combating climate change. It focused on the fact, that climate change is a global problem and therefore requires global accountability, concluding that even if the total of the Dutch emissions is small compared to other countries, this does not affect the obligation to take precautionary measures in view of the state’s obligation to exercise care. In addition, it found that also due to the undisputable fact that the Dutch per capita emission are one of the highest in the world the Netherlands were under a more strict obligation to reduce greenhouse gas emissions.

The argument of the Dutch government that the state would risk to loose competitiveness as a business location due to a higher reduction path, was rejected by the court, indication that several neighboring states, like the United Kingdom, Denmark and Sweden, had implemented stricter national climate policies without indications that this created an unleveled playing field for business in those countries.

5. Comparison of the cases

The cases presented have been the most discussed “climate change suits” at administrative level[xxx] in Europe[xxxi], both being pioneers in their field. However, the Austrian case has been revised by the Austrian Constitutional Court, and also the Dutch case has been appealed meanwhile.

5.1.Formal arguments

From a formal point of view there are quite some differences between the cases in question.

The case in the Netherlands is a suit by a civil-society-body against the government. The Austrian case arose within an administrative proceeding that is in the process of a permission procedure. To be precise the procedure was an Environmental Impact Assessment, which is handled as an own administrative procedure in Austria, deciding about all necessary permissions for the relevant project. However, it should be noted that also within the Austrian case discussed, but also for many other Environmental Impact

Assessments in Austria, NGOs and civic associations did play a vital role in appealing against the permission for the construction of the additional the runway.[xxxii]

Both countries are highly affected by the effects of global climate change. The Netherlands because of its low-lying coastal area and Austria because of its position within the Alps, which leads to a higher temperature rise than in countries averagely affected by climate change. Obviously, this is an additional motivation for citizens to become active and challenge decisions by their governments and/or administrative bodies.

3.2.Contents of the arguments

Both cases are in a way similar concerning the argumentation of the opponents.

The dispute between Urgenda and the Dutch government did not concern the need for mitigation, but rather the pace, at which the State needed to start reducing greenhouse gas emissions. Also, in the Austrian case the amount of greenhouse gas emissions resulting from the project can be found within the main arguments of the finding of the Federal Administrative Court. So, in fact, it could be interpreted as motivating the state to set further action in combating climate change by making clear that with the current efforts being clearly not sufficient no further projects leading to significant emissions are licensable.

Both claimants stressed the importance of international climate protection treaties, mainly Kyoto und Paris and the respective states' obligation under these pacts, knowing that they did not provide for subjective rights of individuals. Still, both courts accepted these arguments. Also, in both cases a comparison between the agreed climate protection measures (mostly greenhouse gas emission reductions) and the actual efforts undertaken by the state was made and found that as these did not seem sufficient, more cautious approaches needed to be taken.

Too, the state's responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other states or of areas beyond the limits of national jurisdiction were mentioned in both judgments.

6. Findings

This chapter will draw conclusions, firstly, on the importance of climate protection within international and European Law and, as a second step of interpretation, for Environmental Impact Assessment procedures in Austria.

6.1. Increasing importance of climate protection in International and European Law

International law has for a long time dealt with the issue of environmental protection and climate change.[xxxiii] From the Rio Framework Convention on Climate Change 1994 to the Kyoto Protocol and then the Paris Agreement in 2016 states worldwide have understood the necessity to slow down temperature rise caused by climate change.

The European Union has a strong focus on environmental protection, mentioning this also in its founding treaties. Environmental protection as an aim of the European Union can be found in Article 3 EU Treaty. Also the Treaty on the Functioning of the European Union has a special clause clarifying the objectives of the union policy on the environment. It lists among others: preserving, protection and improving the quality of the environment, protecting human health and promoting measures at international level to deal with regional or worldwide environmental problems and in particular combating climate change. From this follows, that climate protection can be marked as having a very high importance within the EU environmental protection system, which can also be confirmed by the Union's active part in the international climate protection treaties. The European Union not only is a party to the Kyoto and Paris contracts, but also has taken an active and leading part within both instruments.

Also the Charter of Fundamental Rights of the European Union calls upon the principle of sustainability and asks for a high level of environmental protection and the improvement of the quality of the environment to be ensured.

The European Commission has declared energy policy and climate as one of its 10 priorities. As a result, the European Union has decided on an overall climate and energy package, to ensure that the EU meets its climate and energy targets for the year 2020. One of the three key targets is in close connection to the cases in discussion, as it aims at a 20% cut in greenhouse gas emissions from 1990 levels until 2020. Further aims are set as follows: By 2050, the EU should cut greenhouse gas emissions to 80% below 1990 levels. Milestones to achieve this are 40% emissions cuts by 2030 and 60% by 2040.[xxxiv]

Climate protection has generally been given increasing weight in European legislation, as can be seen by the fact, that "climate" has already been defined as protected factor by the first Environmental Impact Assessment Directive by the EU in 1985.[xxxv] This continued also with the latest revision of the Directive in 2014[xxxvi], re-defining protected factors that need to be protected by Environmental Impact Assessments.xxxvii This Directive made it obligatory to take climate change aspects into consideration much more than has been common practice hitherto. This is true in particular with regard to risks of accidents or disasters related to climate change, cli- mate protection aspects such as greenhouse gas emissions and any impacts relevant to adaptation, resulting from the projects in question.[xxxviii]

6.2. Environmental Assessment procedures in Austria: could climate protection be seen as an "overall public interest"?

Also in the international level Austria has bound itself to reduce its emission of CO_2 equivalents. It is member state to the Kyoto Protocol as well as to the Paris Agreement and of the Intergovernmental Panel on Climate Change. Under Kyoto Austria was obliged to cut its greenhouse gas emissions by 8% in comparison to the basis year 1990, but the distribution within the "Bubble" formed by the member states of the European Union bound Austria to reduce 13%.

Under the Paris agreement Austria, like all other EU countries, has committed itself to reduce its greenhouse gas emissions by 40% until 2030, again in relation to 1990 emissions level.[xxxix]

Austria is until now not able to apply to its reduction limits. In contrary, during the last year's national greenhouse gas emissions have begun to rise again. In 2016 total greenhouse gas emissions have increased at 1,3 % from 1990 levels, the sectors mainly responsible for the rise being industry and traffic. A closer look shows, that emissions from sectors not bound by the emissions-trading-system increased, in comparison to 2015 by 2,7% in 2017. Taking this into account it seems obvious that Austria should react as soon as possible to meet its reduction aims as required by European and International law.

What's more, Austria, like the Netherlands, is a country highly affected by climate change. Because of its geographical position in the middle of Europe close to the Alps, a global temperature rise of 2 degrees Celsius would lead to a local temperature increase of 2-3 times as much in Austria,[xl] leading to the effect, that Austrian population, fauna and flora, will be over proportional affective by climate change. That climate change poses sever danger to humans, animals and plants has been proven by various studies and must be considered a fact by now.[xli] As for the argument that climate change can be also tackled by adaption measures, it has to be clarified that also the IPCC reported that mitigation is generally better than adaption.[xlii]

As for the examination whether a project would have significant effects on the climate within the Environmental Impact Assessment it should be clarified that climate was from the beginning of EU legislation within the protected factors, but has gained significantly importance by Directive 2014/52/EU. This directive not only calls upon member states to ensure that environmental protection is improved and that in order to ensure a high level of the protection and human health, environmental impact assessments should take account of the impact of the whole project in question but also stresses that environmental issues like climate change have become more important and should therefore also constitute important elements in assessment and decision-making processes.[xliii] It also states clearly that climate change will continue to cause damage to the environment and compromise economic development. In the regard the Directive sees it as appropriate to assess the impact of projects on climate (for example greenhouse gas emissions) and their vulnerability to climate change.[xliv]

In fact, this is exactly what the Federal Administrative Court in Austria has done. One of its key arguments against the construction of the third runway was, that it would generate a significant amount of CO_2 emissions and was thus not licensable.

By acting like it did the Federal Administrative Court acted also in accordance with principle of sustainability, as proclaimed in the Austrian Federal Constitution, calling for decisions which should take into consideration not only needs of present, but also of future generations.

As debated in chapter 3.2., also the Austrian Constitutional Law on comprehensive environmental protection and sustainability must be taken as a means to interpret open definitions in laws on a lower hierarchical level, like the term “other public interest” in the Aviation Act. Otherwise the whole system of the Austrian legal structure would be absurd. This opinion is also confirmed by the fact that meanwhile the Province of Lower Austria has added a constitutional clause about the importance of being a competitive industrial location to the provincial constitution and the Federal Austrian government has issued a bill aiming at including a similar provision in the Austrian Federal Constitution. If the constitutions (on federal as well as provincial levels) were not to be seen as scale for interpretation of unclear legal formulations, these efforts would not have been undertaken.

As for the arguments that if certain projects were not to be permitted in a specific country, then other countries would welcome the projects and greenhouse gas emissions would still be generated, but only in another state, two things need to be clarified. Firstly, every country is responsible for its own emissions in the first place and it can hardly be seen as evident, that other countries would willingly ignore their reduction targets and take on all rejected projects from their neighboring states. Secondly, according to the general “no-harm-principle” under international law countries must refrain from supporting projects within their territory, which would lead to negative effects in other countries. So also from this point of view, projects including vast amounts of emissions should not be permitted.

Also, the dispute on the issue of competitiveness of the industrial location seems not to be too relevant in Europe. On a formal basis one can also argue with the no-harm-principle. On a more practical approach it can be stressed, that all member states of the European Union have agreed to reduce their emissions according to the EU road map and are thus in comparable situations.

In total, there seem to be many arguments that due to recent developments, climate change has to take a special role in general politics, the more within Environmental Impact Assessments. Also in view of intergenerational fairness it should hence be considered as an “overall public interest” within Environmental Impact Assessment procedures, at least in countries that are highly affected by climate change, according to the “no-harm-principle” by all countries.

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i https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVII-7-d&chapter=27&clang=_en, 09072018, 10072018
iihttps://www.viennaairport.com/unternehmen/investor_relations/news/verkehrsergebnisse?news_beitrag_id=1527139479608, 12072018, 05072018
iii https://www.viennaairport.com/jart/prj3/va/uploads/data-uploads/Konzern/projektinfo_piste3_de.pdf; p. 11, 05072018
iv Luftfahrtgesetz, BGBl. Nr. 253/1957 idF. BGBl. I Nr. 80/2016
v Bundesgesetz über die Prüfung der Umweltverträglichkeit, BGBL. I Nr. 89/2000 idF. BGBl. I Nr. 95/2013
vi As the issue of environmental/climate protection was only started within the jurisdictional proceedings this article does not further develop on the first instance' reasoning.
vii Bundesverwaltungsgericht, GZ W109 2000179-1/291E
viii Charter of Fundamental Rights of the European Union 2000/C 364/01
ix Bundesverfassungsgesetz über die Nachhaltigkeit, den Tierschutz, den umfassenden Umweltschutz, die Sicherstellung der Wasser- und Lebensmittelversorgung und die Forschung, BGBl. I Nr. 111/2013
x Niederösterreichische Landesverfassung 1979, LGBl. 0001-21
xi Kyoto Protocol to the United Nations Framework Convention on Climate Change, 11. December 1997; C.N.XXVII_7_a
xii Paris Agreement, United Nations 12. December 2015, C.N.63.2016.TREATIES-XXVII.7.d
xiii Bundesgesetz zur Einhaltung von Höchstmengen von Treibhausgasemissionen und zur Erarbeitung von wirksamen Maßnahmen zum Klimaschutz, BGBl. I Nr. 106/2011
xiv *Inter alia* Donat, Martin et al. (2017) „Stellungnahme zum Urteil des BVwG zur dritten Piste", Recht der Umwelt, 3/2017
xv Verfassungsgerichtshof, 29.06.2017, E 875/2017-32
xvi Meanwhile the project's opponents have filed another legal remedy against the Constitutional Court's decision, which has to date (July 2018) not been decided.
xvii *Inter alia* Aichinger, Philipp (2017), „Keine Anmaßung des Gerichts", die Presse, 12.02. 2017; Hiltgartner, Karin (2018), „Ein Staatsziel ist kein Verfahrensbeschleuniger", der Standard, 18.06.2018
xviii *Inter alia* Thienel, Rudolf (2017), „Nur Gerichte sichern unsere Freiheit", Die Presse, 24.02.2017
xix Raschauer, Bernhard, (1996) Umfassender Umweltschutz und Verwaltungsrecht, in Kerschner, Staatsziel Umweltschutz,
xx Kirchengast, Gottfried *et alii* (2017), „Flughafen Wien: VfGH behebt Untersagung der dritten Piste durch das BVwG wegen Willkür", Recht der Umwelt, No. 6/2017
xxi Kirchengast, Gottfried *et alii* (2017), „Flughafen Wien: VfGH behebt Untersagung der dritten Piste durch das BVwG wegen Willkür", Recht der Umwelt, No. 6/2017
xxii Verfassungsgerichtshof, 14.02.2012, U 466/11 18
xxiii Kerschner, Ferdinand (2017), Recht der Umwelt, No. 5/2017
xxiv § 1, Bundesgesetz über die Prüfung der Umweltverträglichkeit, BGBL. I Nr. 89/2000 idF. BGBl. I Nr. 95/2013
xxv Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment oft he effects of certain public and private projects on the environment, as amended by Directive 2014/52/EU
xxvi Bundesverwaltungsgericht, GZ W109 2000179-1/291E, p 77
xxvii C/09/456689/HA ZA 13-1396, 24.06.2015
xxviii https://www.ipcc.ch/pdf/ipcc-faq/ipcc_members.pdf, 05072018
xxix IPCC (2013), Fourth Assessment Report, AR5/2013
xxx There have also been civil law suits against companies because of their contribution to greenhouse gas emissions and thus climate change. The most famous probably being the Case Huaraz against RWE. Huaraz is a city in Peru, represented by Mr. Saul Lliuya a farmer from Huaraz (assisted by the NGO Germanwatch). RWE is a German Energy company, claimed to be Europe's biggest energy company, responsible for about 0,47% of global greenhouse gas emissions. The claims are based on damages because of melting glaciers resulting in a thread of flooding to Mr. Huarez land. The first instance court decided that the claim was not within its filed of jurisdiction, but the second instance court (Oberlandesgericht Hamm: Az. 5 U 15/17 OLG Hamm) accepted the claim, which is still pending, in November 2017.
xxxi For a global overview on climate cases refer to, United Nations Environment Programme, 2017, The Status of Climate Change Litigation

xxxii In fact, there is still a claim against the project running, as some claimants did appeal tot he Highest Administrative Court (Verwaltungsgerichtshof).
xxxiii For more detailed information refer to Gupta, Joyeeta (2010), "A history of international climate change policy", Institute for Environmental Studies, VU University, Amsterdam
xxxiv COM (2013) 216 final, COM (2014) 15 final, https://ec.europa.eu/clima/policies/strategies/2020_en, 07072018
xxxv Council Directive 85/337/EEC of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment
xxxvi Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment
xxxvii New: population and human health, biodiversity; old: human beings, fauna and flora
xxxviii For more detailed information refer to Schönthaler, Konstanze *et alii* (2018), Climate Change 04/2018, https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/2018-02-12_climate-change_04-2018_politikempfehlungen-anhang-4.pdf; 10072018
xxxix For more detailed information refer to Hiltgartner, Karin (2017), „Von Kyoto nach Paris: völkerrechtliche Verpflichtungen nach dem Pariser Klimaschutzübereinkommen", IEWT, 2017, https://eeg.tuwien.ac.at/eeg.tuwien.ac.at_pages/events/iewt/iewt2017/html/files/fullpapers/73_Hiltgartner_fullpaper_2017-02-06_22-41.pdf, 10072018
xl Austrian Panel on Climate Change (2014), Austrian Assessment Report 2014,
xli Influence climate change on health: Wegener Center für Klima und Globalen Wandel, Die Auswirkungen des Klimawandels in Österreich: eine ökonomische Bewertung für alle Bereiche und deren Interaktion, http://coin.ccca.ac.at/sites/coin.ccca.at/files/factsheets/Coin_Ueberblick_v20_20012015.pdf; 10072018
xlii IPCC (2007), Mitigation of Climate Change
xliii Directive 2014/52/EU (6), (22), (7)
xliv Directive 2014/52/EU (13)

Actor-network analysis of transition towards urban hi-tech horticulture. A comparative study of development and adoption of urban high-tech horticultural practices in Shanghai and Amsterdam

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ABSTRACT:

Urbanization, urban poverty, food insecurity, rising food prices, growing dependency on food imports and challenges posed by climate change have placed food high on the urban agenda. Advanced technology and alternative food production methods such as vertical farming and hydroponic cultivation methods support the transition of conventional food production methods to more decentralized and local production systems. The development of urban high-tech horticulture is one of the strategies for more sustainable and resilient urban food systems, being explored by cities worldwide to feed their increasing population. Although urban agriculture has been widely studied, the process and consequences of technology driven transitions on urban planning and development are hardly understood. This paper uses the theory of Multi-Level Perspective (MLP) on sustainability transitions and Actor-Network Theory (ANT) to explore this technology driven transition and its adoption in urban planning and development. MLP describes transition as a process of change of the socio-technical regime, resulting from a combination of external pressure (the landscape) and internal pressure by innovation (niches). ANT describes the relations between human and non-human entities (actants) in the process of (de)stabilizing of the regime. The circumstances of configuration and reconfiguration of actants, including horticultural technologies, policy documents, land use plans, spatial development plans and decision makers, were studied Amsterdam and Shanghai were used as case studies. A comparative approach was used to analyse the role and relations of the various actants that were involved in the development and adoption of urban high-tech horticulture technologies in both cities. Studying the implementation of similar technologies in the different socio-political context of both cities allowed to identify the losses and gains in the process of transition and identify recommendations for policymakers, industry and other actors interested in bringing about change. The data were collected though observational research, document analysis and interviews. The results show that in Shanghai, the China Academy of Agricultural Science was a focal actant that used a top-down policy implementation approach to punctualize the urban high-tech horticulture practices into the socio-technical regime. In Amsterdam, the Top Consortium for Knowledge and Innovation (TKI) was the focal actant and obligatory passage point. However, TKI focused on private public partnership and promoting bottom-up policy implementation approaches to negotiate and define the identity of government, business, knowledge institutes, innovations and spatial development plans

Construction of Green Infrastructure Based on Water Ecological Security Pattern, A case study of Songtao River Catchment in Guizhou Province, China

(Construction of Green Infrastructure Based on Water Ecological Security Pattern,

A case study of Songtao River Catchment in Guizhou Province, China)

Song LIU, Song Yao HUAI*, Hong Ting Pan, Tongji University, China

Abstract: China's rapid urbanization and climate change have led to increasingly severe water ecological security problems. The evaluation and construction of water ecological security pattern is an effective way to deal with water resources management, water environment protection and water disaster prevention. Green infrastructure strategy is considered as a sustainable land use planning emphasis on rainwater management. The method of water ecological security pattern shows good applicability to the construction and optimization of green infrastructure. The study area is Songtao river catchment located in southwest of China, which is faced with the problems including water resources shortage, water quality deterioration and frequent occurrence of floods. Based on GIS overlay method and Pressure-State-Response framework, the paper conducts comprehensive water ecological security pattern assessment from three current problems of water resources security, water environment security and water disaster risks. Then, green infrastructure hubs were further identified and prioritized through landscape connectivity index and river corridors were classified and optimized on the basis of the composite water ecological security pattern. Finally, the study draws several conclusions. (1) The water ecological security evaluation index system established by PSR framework provides a basis for the construction of regional green infrastructure. (2) Green infrastructure network of interconnected hubs and corridors can achieve the aims of water resource conservation and utilization, runoff pollution process control and floods resilience regulation.

Keywords: Green Infrastructure Construction; Water Ecological Security Pattern; Songtao River Catchment

1. Introduction

Rapid urbanization and climate change in China have exerted a profound impact on water ecological security. Water problems such as water resources shortage, water quality deterioration and frequent occurrence of floods indicate that it is an urgent challenge to ensure water security(Vörösmarty et al., 2010).

The evaluation and construction of water ecological security pattern provide an effective way to address the regional water security problems. Water ecological security pattern is the land use spatial pattern based on the goal of regional water security(Lin et al., 2016). The construction of water security pattern refers to the optimization of land use and spatial configuration of landscape elements that play a critical role in maintain and protect regional water security(Yu, 1996, Peng et al., 2016). Reasonable evaluation of regional water security can guarantee adequate water supply, reduce water pollution and minimize floods risks, which enhances the resilience and sustainability of regional water ecosystems(Gong, 2009).

Many studies illustrate the green infrastructure is closely related to sustainable water management(Ellis, 2013, Everett et al., 2015, Saygin and Ulusoy, 2011). Solving storm water problems and improving water cycle has become a primary goal of green infrastructure planning. Research show that green areas have reduced storm water runoff up to 100% during normal precipitation years and 77-88% during high precipitation years(Baker and Doneux, 2012). The linkage between green infrastructure and water ecological security are established due to the same aim of maintain water ecological security. But fewer literature focus on construction of green infrastructure based on ecological security pattern.

This paper aims to evaluate the water-oriented ecological security patterns to guide green infrastructure planning in Songtao River Catchment by GIS spatial analysis methods. Specifically, the main objectives of this study are to: 1) establish water ecological security index system based on PSR framework from three aspects of water resources security, water environment security and water disaster risk to construct a comprehensive water security pattern. 2) further identify, prioritize and optimize the hubs and corridors based on the composite water ecological security pattern through landscape connectivity index to build the interconnected green infrastructure network.

2. Study Area and Data Sources

2.1 Study Area

The Songtao River Catchment, with an area of 1563 square kilometers, is located in Songtao Miao Autonomous County of Tongren City in the northeast of Guizhou Province (Figure 1). It has a higher elevation on the sides of the east, the west and the north, but a lower terrain in the middle. The average elevation of the whole area is about 650 meters. The Songtao River Catchment is a typical subtropical monsoon climate where summer is hot and rainy while winter is cold and dry. The average annual temperature is 16.2 °C and average annual precipitation is 1186-1683mm, which mostly occurs from June to September. The imbalance distribution of precipitation often results in the frequent occurrence of drought and floods. People living there are mainly engaged in manganese mining, manganese product processing and agricultural planting. At present, Songtao river catchment is faced with the problems including water resources shortage such as degradation of river network structures and difficulty of water utilization, water quality deterioration due to point source pollution of manganese mines and non-point source pollution of agricultural chemical fertilizers, and water disaster risks such as frequent occurrence of floods.

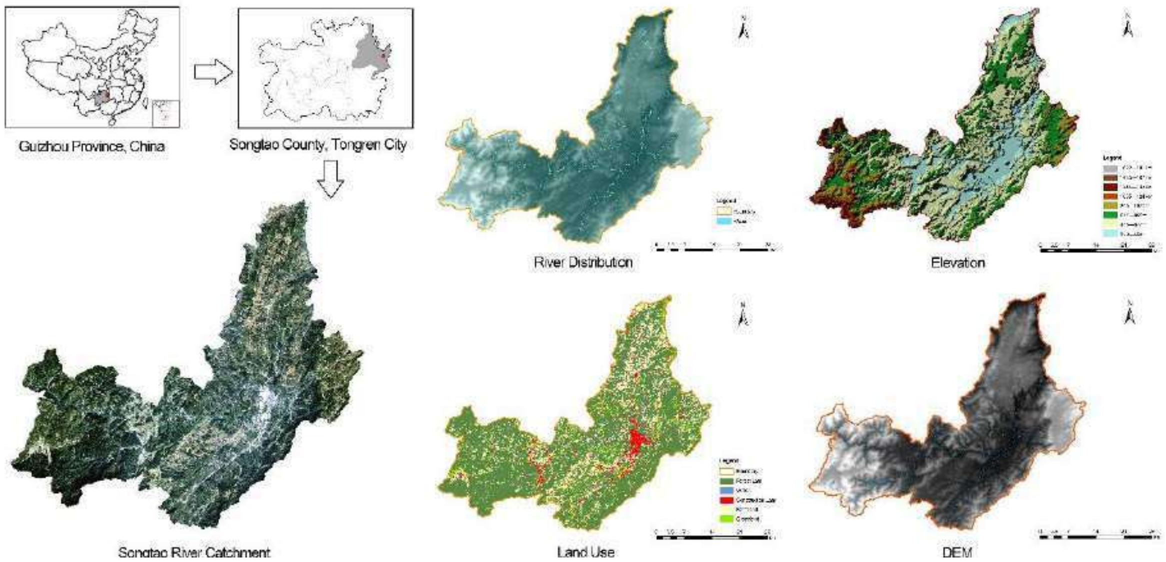

Figure 1: Location and Current Situation of Study Area

2.2 Data Sources

The data used in this study are:

(1) Elevation data was extracted from GDEM Product with a spatial resolution of 30 m from the Geospatial Data Cloud (http://www.gscloud.cn/).

(2) Land use data was interpreted through Landsat 8 images from October 8, 2013. The images were classified into five types of land use including forest land, grassland, farmland, water body and construction land.

(3) Meteorological data is obtained from the local weather station installed near the study area.

3. Methodology

3.1 General Framework

Based on GIS, the paper conducts regional water security pattern evaluation from three aspects of water resources security, water environment security and water disaster risks and puts forward the water-oriented green infrastructure construction strategies. The detailed construction steps are as follow (Figure 2)

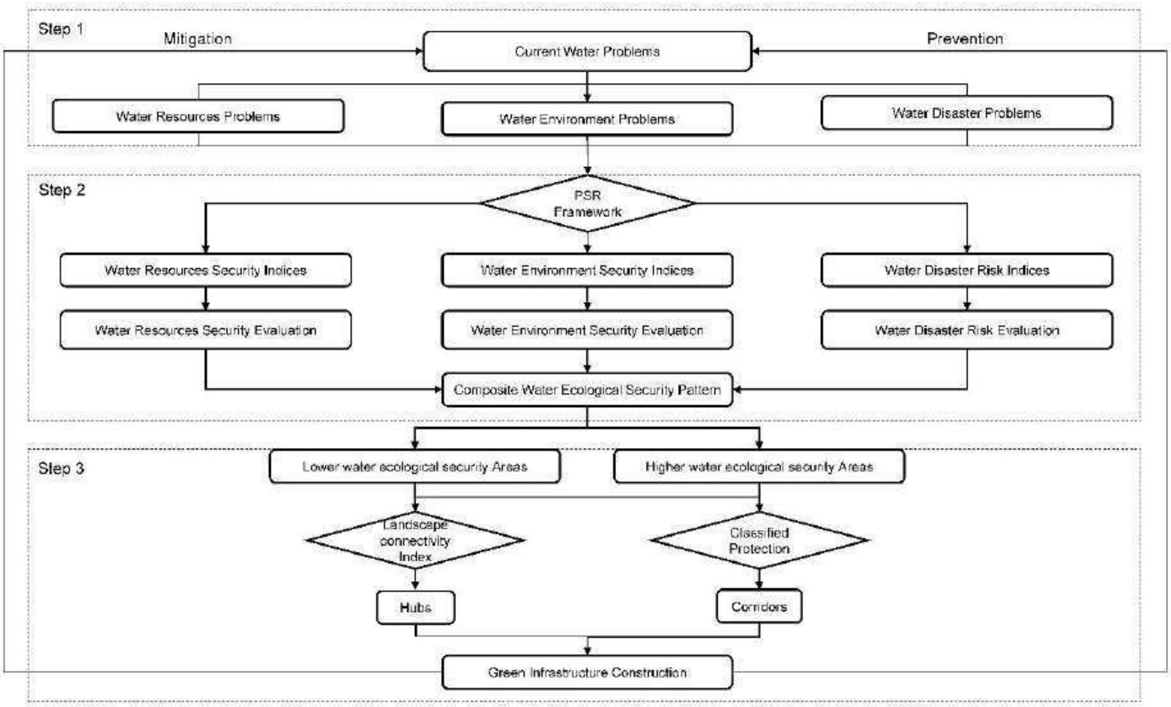

Figure 2: General Framework

3.2 Water Ecological Security Evaluation

Water ecological security evaluation is a process of mapping the water ecological problems to identify and prioritize the ecologically sensitive areas or ecologically significant areas. Areas with higher sensitivity tend to be higher significance but lower security, which are peculiarly prone to environmental problems when they are affected by intensive human activities. Through water ecological security evaluation, different levels of sensitive areas can be identified and water ecological security patterns can be constructed to provide a scientific basis for prevention and treatment of regional water security problems.

3.2.1 Water Ecological Security Indices Selection

Factors related to water ecological security are comprehensive and complex, involving natural ecosystem and socio-economic system. A systematic and logical framework is needed in water ecological security evaluation. Pressure-State-Response (PSR) framework is a conceptual framework to analyze the cause–effect relationships between society and the environment and to support decisions in response to environmental issues. It considers factors of pressures (P), states (S) and response (R), integrating the elements about natural resources and socio-economic development, which has been widely adopted in landscape assessment and environmental management(Zhang et al., 2012, Hughey et al., 2004, Wolfslehner and Vacik, 2008).

Based on the PSR framework, the paper evaluates the water ecological security in Songtao river catchment by analyzing three aspects, water resources security, water environment security and water disaster risk. According to this framework, the natural resources conditions are chosen as the state factors and the local socio-economic conditions can be regarded as pressure factors influencing the development of the catchment.

(1) Water Resources Security Indices

Water resources security refers to the state of ensuring a healthy water ecological cycle of ecosystem and maintaining sustainable living, industrial and agricultural water supply for human society. It mainly includes water source conservation, soil and water holding and water system support and allocation capability. Factors influencing these capabilities are included in the evaluation indices (Table 1).

Table 1 Water Resources Security Indices

Indices	Parameters	Extremely sensitive	Highly sensitive	Moderately sensitive	Lowly sensitive
State Indices	Distance from Rivers	0-30m	30-100m	100-200m	Above 200m
	Elevation	306-550m	550-750m	750-950m	950-1612m
	Soil Thickness	120-150cm	90-120cm	30-90cm	2-30cm
Pressure Indices	Water Facilities	6-8	4-6	2-4	0-2
	Land Use	Water Bodies	Forest Land, Grassland	Farmland	Construction Land
Value		7	5	3	1

(2) Water Environment Security Indices

Water environment security refers to the reduction of point source pollution and non-point source pollution in the river basin to ensure water quality safety. In Songtao River Catchment, the sensitivity of the area affected by point source pollution is mainly measured by the manganese mines density. However, there is no specific source of non-point source pollution, which is mainly discharged through the surface runoff into the nearby rivers randomly. Surface runoff provides quick transport mechanism for potential pollutants between the landscape and surface water bodies(Walter et al., 2000). Therefore, identifying areas that are more susceptible to producing surface runoff, that is hydrologically sensitive areas (HSA's), helps to minimize contamination into rivers and mitigate water quality risk by effective measures. Topographic index, widely applied in hydrological studies(Rousseau et al., 2004, Page et al., 2005), is chosen to identify hydrologically sensitive areas and to estimate runoff distribution to control the transport of pollutants. It is given by the following expression:

$$\lambda = \ln\left(\frac{\alpha}{\tan(\beta)K_s D}\right)$$

where α are the catchment areas, $\tan(\beta)$ is the gradient, K_sD is average soil permeability rate(Woods et al., 1997).

Other factors influencing water environment security, such as precipitation, distance from rivers, land use, are also included in the evaluation indices (Table 2).

Table 2 Water Environment Security Indices

Indices	Parameters	Extremely sensitive	Highly sensitive	Moderately sensitive	Lowly sensitive
State Indices	Topographic Index	10-47	-6-10	-9-6	-17--9
	Precipitation	1550-1650mm	1450-1550mm	1350-1450mm	1250-1350mm
	Distance from Rivers	0-30m	30-100m	100-200m	Above 200m
Pressure Indices	Mine Density	70-130	35-70	15-35	0-15
	Land Use	Farmland	Construction Land	Forest Land, Grassland	Water Bodies
Value		7	5	3	1

(3) Water Disaster Risk Indices

Water disaster risk refers to the possibility of floods occurrence. It is generally understood as an interaction of hazard, exposure and vulnerability(Kaźmierczak and Cavan, 2011). The hazard can be defined as frequency and severity of damage and threats to people, property, and systems, which usually depends on geographical and meteorological factors. Areas with intense rainfall, lower terrain, dense river networks, and poor soil permeability are more susceptible to floods. The exposure is closely related to all social, economic and natural ecosystems that may be threatened by disasters. Vulnerability comprehensively reflects the extent of damage to all property present in a given area due to potential risk. The factors influencing the hazard, exposure and vulnerability are listed as follow (Table 3).

Table 3 Water Disaster Risk Indices

Indices	Parameters	Extremely sensitive	Highly sensitive	Moderately sensitive	Lowly sensitive
State Indices	Precipitation	1550-16509mm	1450-1550mm	1350-1450mm	1250-1350mm
	Flow Accumulation	7146656-15444045	3512763-7146656	1150732-3512763	0-1150732
	Topographic Index	10-47	-6-10	-9-6	-17--9
	Elevation	306-550m	550-750m	750-950m	950-1612m
	Vegetation Rate	0-0.25	0.25-0.5	0.5-0.75	0.75-1
Pressure Indices	Population Density	399-560	326-399	225-326	159-225
	Agricultural Production Value	1.15-1.65	0.95-1.15	0.57-0.95	0.55-0.57
	Water Facilities	1	2-4	4-6	6-8
Value		7	5	3	1

3.2.2 Water Ecological Security Indices Weight determination

Based on the three water ecological security indices mentioned above, the global weights of group indices and local weights of individual parameters were further determined using the Analytic Hierarchy Process (AHP) and the expert scoring method. Water ecological security index system was established as follows. (Table 4). Multiple evaluation indices can be combined through GIS overlay method to map different water ecological security levels.

Table 4 Water Ecological Security Index System

Object	Group Indices	Global Weight	Pressure-State Indices	Parameters	Global Weight
Water ecological security	Water Resources Security	0.2	State Indices	Distance from Rivers	0.0623
				Elevation	0.0240
				Soil Thickness	0.0137
			Pressure Indices	Water Facilities	0.0670
				Land Use	0.0330
	Water Environment Security	0.2	State Indices	Topographic Index	0.0556
				Precipitation	0.0122
				Distance from Rivers	0.0322
			Pressure Indices	Mine Density	0.0500
				Land Use	0.0500
	Water Disaster Prevention	0.6	State Indices	Topographic Index	0.2055
				Flow Accumulation	0.1245
				Precipitation	0.0854
				Elevation	0.0399
				Vegetation Rate	0.0249
			Pressure Indices	Population Density	0.0381
				Agricultural Production Value	0.0450
				Water Facilities	0.0367

3.3 Green Infrastructure Identification and Prioritization Based on Landscape Connectivity

Green infrastructure is a comprehensive network of interconnected hubs and corridors. The hubs are defined as ecologically significant natural areas that provide an origin or destination for ecological processes moving to or through it. Corridors are the connections that tie the system together and enable green infrastructure networks to work(Benedict and Mcmahon, 2002). Connectivity between them is a critical feature to maintain vital ecological processes and services. In addition to water ecological security evaluation, further identification and prioritization of green infrastructure space should be based on landscape connectivity.

3.3.1 Identification and Prioritization of Hubs

Probability of connectivity Index (PC) was applied in areas with lower water ecological security levels to identify and prioritize the hubs. It is defined as the probability of dispersal from one patch to another patch, which reflects the potentiality and significance of landscape connectivity. It is given by the following expression:

$$\mathrm{PC} = \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} a_i a_j p_{ij}}{A_L^2}$$

where $a_i$and a_j are the areas of the patches i and j, and A_L^2 is the total landscape area. p_{ij} is defined as the maximum product probability of all possible paths between patches i and j(Saura and Pascual-Hortal, 2007). The higher PC value indicates the better landscape connectivity and more dominant role in hubs. Probability of connectivity Index (PC) was calculated and classified through Conefor Sensinode 2.2 among the areas with lower water ecological security levels.

4. Results

4.1 Water Ecological Security Pattern

4.1.1 Individual Water Ecological Security Pattern

(1) Water Resources Security Pattern

Fig. 3 shows the security levels and evaluation values for the water resources security of the Songtao catchment, ranging from higher security to lower security (0.2-1.32). The higher value indicates the higher sensitivity and the lower security of water resources. Areas with lowest water resources security are mainly located close to reservoirs, the river sources and dense river network in the north and in the middle of Songtao River Catchment, which covers 2.40% of total area with 37.47km^2 . In the future planning, it is necessary to enhance the protection of water source and build suitable buffer zone to ensure the safety of water resources. In addition, water facilities such as reservoirs should be improved or enlarged to satisfy the needs of rainwater sustainable utilization.

(2) Water Environment Security Pattern

Fig. 3 shows the security levels and evaluation values for the water environment security of the Songtao catchment, ranging from higher security to lower security (0.2-1.35). Regions of high mines density tend to suffer from point source pollution while farmland and construction land are of highly risk to non-point source pollution. Hydrologically sensitive areas with lower terrain are prone to generating and transporting runoff pollution to water bodies. These areas are in lowest water environment security levels, which are mainly distributed in the southeast of Songtao River, accounting for 5.78% of total area with 903.41km^2 . High security level and medium security level lie in forest land and grassland, which occupy the most area of the catchment. In the future planning, it is essential to control the impact of human activities on the water source and maximize the role of green space in contaminants interception and reduction.

(3) Water Disaster Risk Pattern

Fig. 3 shows the security levels and evaluation values for the water disaster risk of the Songtao catchment, ranging from higher security to lower security (0.68-3.86). Areas with higher construction intensity, lower terrain and lower vegetation coverage in the basin have higher flood risk, most of which are concentrated in the river valleys. It covers 3.45% of total catchment area with 53.92km^2 . Most of sensitive and low-sensitive areas are mainly located in forest land and grassland.

4.1.2 Composite Water Ecological Security Pattern

Through GIS overlay of three patterns by individual weight, composite water ecological security pattern can be constructed (Figure 3). Areas with lower water ecological security level are mainly distributed close to the main stream of Songtao River, which are the top priority areas for protection.

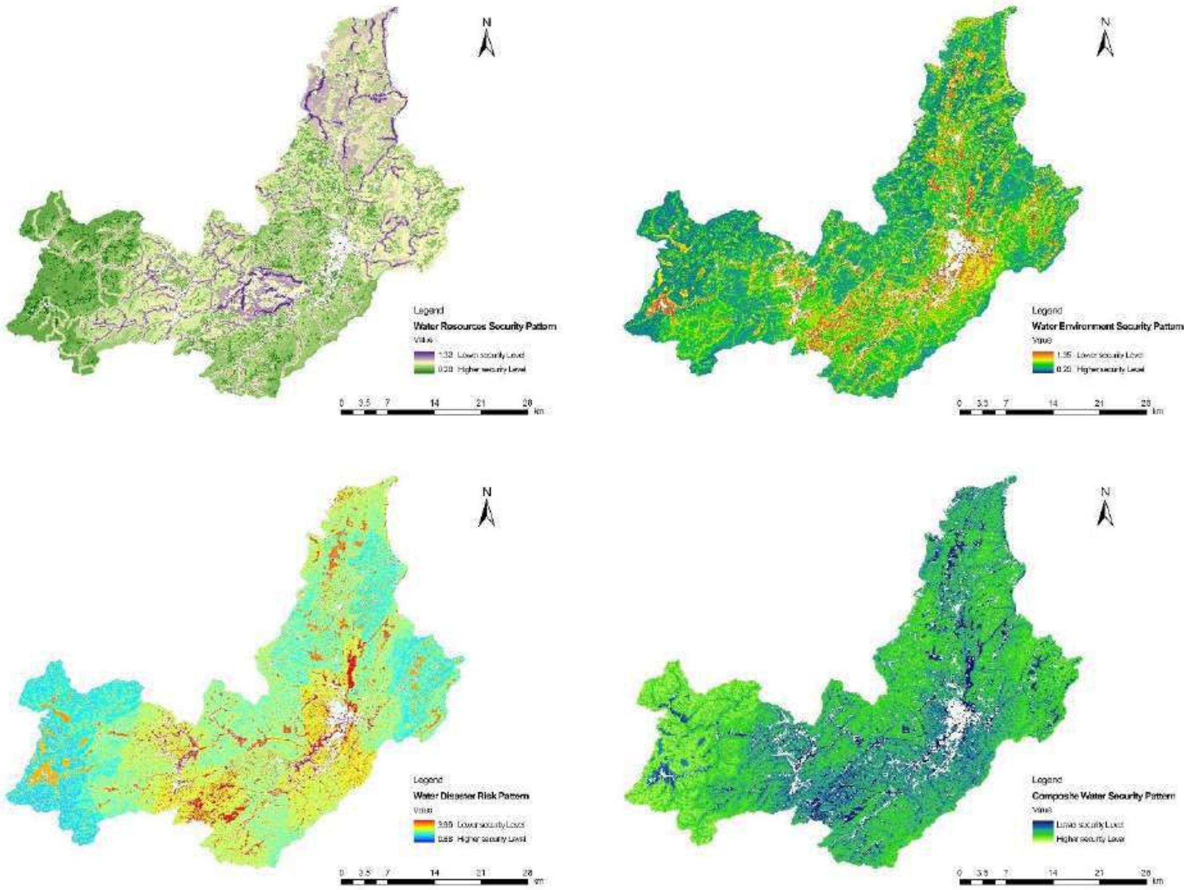

Figure 3: Individual and Composite Water Ecological Security Pattern Results

4.2 *Green Infrastructure Construction*

4.2.1 Hubs

Probability of connectivity Index (PC) was calculated and classified through Conefor Sensinode 2.2 into three categories: PC<0.04、 0.04≤PC≤0.4、PC>0.4, which represent the extremely important hubs with best connectivity, important hubs with good connectivity and slightly important hubs with moderate connectivity. All three categories were included in the green infrastructure hubs (Figure 4).

4.2.2 River Corridors

Based on the composite water ecological security pattern, the river corridors are classified into three levels of protection and optimization (Figure 4). The first level of rivers refers to the main stream of Songtao river system with the purpose of decreasing the floods risk. It is necessary to add additional wetlands, reservoirs and detention ponds to link with main stream to build blue and green flood passages. The second level of rivers are the branches of main stream in the whole catchment, whose function is to prevent contaminants from discharging into the rivers. Some buffer zones of different width can be delimited according to local ecological situation. The third level of rivers are the potential runoffs determined by topographic and soil data, which can collect the storm water and connect with the branches to facilitate the storage and usage of water resources.

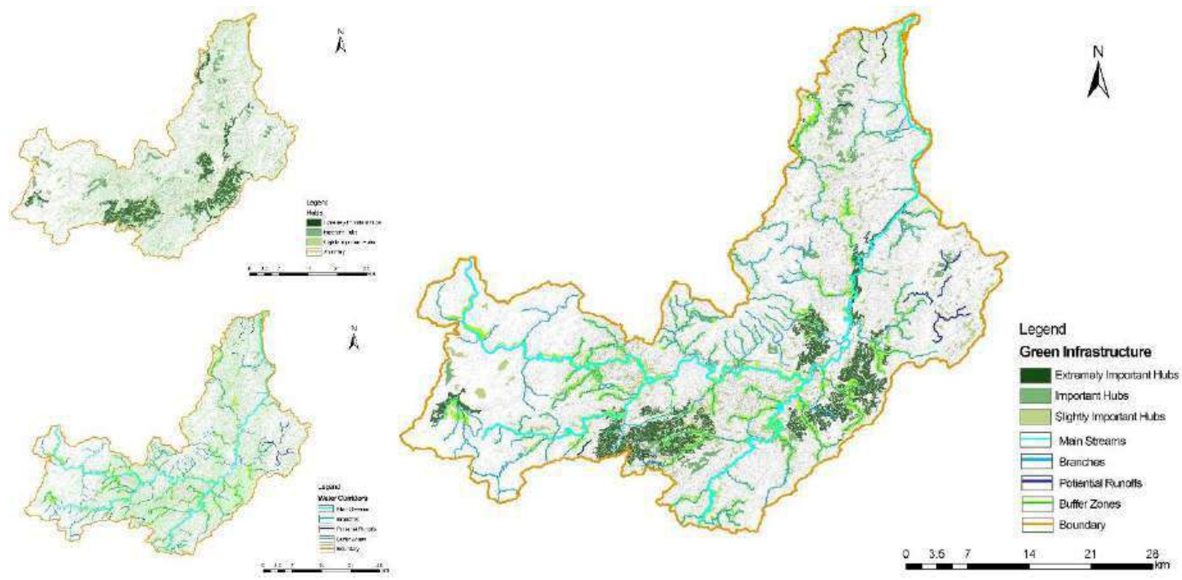

Figure 4: Green Infrastructure Construction Results

5. Discussion

5.1 Methodological Advantages

Based on the understanding of current water security problems, the research expanded the traditional concept of water security pattern by analyzing the cause–effect relationships between human society and environment and including the socio-economic dimension into PSR indices system. In addition, considering the process of water ecological cycle and the typical attributes of green infrastructure, the research made further identification and prioritization of hubs according to the probability of connectivity index to produce a more precise outcome.

5.2 Limitations and future research direction

In the process of indices weight determination, although expert scoring method is feasible, it couldn't fully reflect the influence degree of each index on water security problems. The evaluation results need to be continuously improved in accuracy. As green infrastructure is a multifunctional land use planning method, future studies may involve multi-objective orientated evaluation process.

6. Conclusion

Taking Songtao River Catchment as a study area, this study identified the water ecological security patterns based on the PSR framework from three aspects of water resources security, water environment security and water disaster risk. Then, on the basis of the composite pattern, we applied the further prioritization of green infrastructure space through landscape connectivity index. The hubs were graded into three categories of extremely important, important and slightly important. The river corridors were also classified into three categories of main streams, branches and potential runoffs. The interconnected green infrastructure was constructed combining the hubs and corridors. The construction of green infrastructure is conducive to healthy water cycle and can facilitate adequate water resources supply, water pollution reduction and floods risks resilient regulation.

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Cool Planner: place-based adaptation solutions for South African settlements

Moderators: IVKOVIC, Milena (Vice President ISOCARP and Director Blok74 Rotterdam); NIEL, Lena (Urban and landscape designer, Deltares, Delft)

ABSTRACT:

Cities are facing new types of challenges, because of the effects of climate change and densification in cities. The Sendai Framework, Sustainable development goals and The New Urban Agenda are trying to address these challenges for cities. Cities have to become inclusive, climateproof and economic hubs. Hence, the city is approached as an urban ecosystem instead of a blue print that exists of different layers and flows. Only a truly resilient and inclusive city could be achieved if one understands the functioning of this system. This shift of planning and design also asks a new type of urban planner and designer. But what is exactly this new role of urban planning and design to achieve these climate-proof cities in line with these frameworks?
The aim of this session is to explore furthermore what is the role of urban planning and design within global resilience frameworks. As a preparation of this session, ISOCARP Dutch National Delegation will hold an experts workshop in July 2018. The focus of the session will be on the importance water as the resilience factor. During the workshop, the special water envoy of the Netherlands will discuss the role of planners and designers within these resilience frameworks together with the Dutch ISOCARP members and other Dutch planning societies. Design offices, municipalities, knowledge institutes and consultants will participate in this discussion.

Consequently, this session proposal is divided in two parts. In the first part, the results from discussions amongst the Dutch part of ISOCARP will be presented by a Dutch delegate. In the second part, an international panel of experts on urban resilience will reflect and discuss the role of urban planning and design for the design of resilient cities according to global frameworks. The aim is to come up with several statements that both the panel and the public can reflect on. To conclude, this session is a platform within the ISOCARP conference where both experts and planning professionals can discuss the role of urban planning and design within global resilience frameworks. To keep this discussion on-going is necessary to ensure the design of truly resilient cities in the future.

“Heat!” – testing design approaches to mitigate excessive heat exposure for vulnerable populations in Toronto apartment buildings

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Synopsis

As climate changes, excessive summer heat will impact Torontonians, especially residents in older, high-rise buildings. Toronto Public Health proposes outdoor cooling centres as a strategy for heat mitigation. To assist municipal policy development, researchers documented issues on film, students designed cooling centre prototypes, and community members provided feedback on design proposals.

From Toronto Public Health, 2012 …
“Toronto can expect an almost five-fold increase in three-day heat waves and an increased risk of more severe or prolonged heat events by 2050, as a result of climate change. It is estimated that current heat conditions contribute to an average of 120 premature deaths per year in Toronto. Average annual heat-related deaths could double by 2050 and triple by 2080.”
(Toronto Environment Office, 2012.)

From CBC Radio, August 2016 …
Interviewer: “You did mention the fact that the federal government is developing a national housing strategy to look at affordable housing. How specifically would you like to see tenants' cooling needs addressed in that strategy?
Tracy Heffernan: “Well, I think as soon as you talk about the right to adequate housing, you're talking about the right to live in housing that is habitable. If people are dying, or their health is being compromised, this is not habitable housing.
(Robyn Bresnahan, ‘Air Conditioning as a human right?’ *The Current,* CBC Radio One. 22 August 2016.)

1. Introduction: Toronto’s high-rise landscape in the face of climate change

Toronto’s post-war landscape changed dramatically with the construction of modern high-rise residential apartment towers across the city in the period from the early 1950s into the 1970s. As a consequence, Toronto contains the second highest number of high-rises in North America (defined as a building of 12 stories and higher). (Stewart 2016) Many of these towers are found in Toronto’s inner suburbs. Home to diverse communities, these towers are located in neighbourhoods that show trends towards increased poverty, isolation, lack of economic opportunity, social need and health risks. (United Way Toronto 2018) Most of these towers lack centralized cooling plants and during periods of extreme heat in the summer, residents experience inordinate discomfort. Outdoor cooling centres offer the possibility of providing residents respite during periods of extreme heat. A research project undertaken by Ryerson University in association with Toronto Public Health explored the potential of outdoor cooling to address this issue. This paper presents findings and opportunities arising from this research.

2. Context and Background

2.1 Climate change, extreme heat and public health

The World Health Organisation estimates that the warming and precipitation trends due to anthropogenic climate change of the past 30 years have already claimed over 150,000 lives annually. (Patz et al. 2005) In the USA, since 1998, heat waves have resulted in more weather-related fatalities annually than any other natural disasters, estimated at 400 deaths per year. (United States Department of Commerce, n.d.) Heat wave effects may increase in the near future as the result of global climate change. (Cubasch et al. 2001) There has been an extensive review of the potential health effects of climate change. (Haines et al., 2004; Patz et al. 2005; Patz et al. 2006; McMichael et al. 2006; Haines et al. 2006, Ebi et al. 2006) The effects of heat, include benign disorders (fainting, sweating or hyperventilation), more acute responses (nausea, vomiting or weakness) and, most serious, heat-stroke, which can lead to renal failure and profound physiologic derangements, with a high fatality rate. (Frumkin et al. 2008) Risk factors for developing heat stroke or dying during a heat wave, including being elderly, having certain diseases, and living on upper floors. (Kilbourne et al. 1982) Poverty and minority race or ethnicity are also risk markers. (Semenza et al. 1996)

While heat-related mortality has historically been important, it remains an underestimated public health problem. (Bernard and McGeehin, 2004, p. 1520) Public health practitioners advocate the necessity of a public health approach to climate change. They argue that proactive measures need to be taken to address the impact of climate change on health.(Frumkin et al. 2008) Principal concerns include illness and fatalities related to severe weather events and heat waves, and require both primary and secondary prevention measures. Mitigation and adaptation are key to this approach. Public health practitioners are mobilizing community partnerships and actions to address this issue, developing policies and plans to support their efforts and engaging with other disciplines to research and develop innovative solutions to health problems related to climate change. (Frumkin et al. 2008) Health professionals are turning to planners, urban designers, architects and landscape architects, who can play a leading role in this matter.

Greater collaboration between architect, planners and health promoters would support the overall improvement of the health of the public in the face of climate change. This paper addresses the question of mitigating the impacts of excessive heat through architectural and site planning measures, aided by policies that are embedded in both coordinated planning and public health initiatives in order to adapt our environments to anticipate heat stress resulting from excessive heat and long-duration heat waves. Specifically, activities in Toronto point to ways in which collaboration between public health practitioners and design and planning professionals can climate-proof urban environments.

2.2 The vulnerability of urban landscapes with climate change / the urban heat island

On warm days, urban areas can be 3 – 4 ºC warmer than surrounding areas. Dark surfaces such as pavement and rooftops that absorb heat from sunlight and reradiate it, and the absence of significant areas of vegetation, especially trees and green spaces, are causes for the urban heat island. As cities expand, the heat island increases in both scale and intensity. Continued urbanization further aggravates the heat island effect. (Frumkin 2002) The sprawling regional metropolis becomes vulnerable, where the urban heat island effect could intensify extreme climatic events. (Patz et al. 2005)

2.3 Toronto's Changing Climate

The Greater Toronto Area (GTA), a region encompassing the City of Toronto and four regional municipalities that surround it (Durham, Halton, Peel and York), is Canada's most populous metropolitan area. With a population of 6.4 million, it is home to 20% of the Canadian population. (Statistics Canada 2018) As a result of climate change, the region is experiencing an increase in extreme weather conditions. In 2013, Toronto suffered two severe weather events – a winter ice storm and a summer flood – that gave residents a taste of what climate change will bring. The cost was over $CAD1.3 billion, the equivalent to a one-time 51% residential property tax increase. (Toronto Environmental Alliance n.d.) In 2012, Toronto recorded its earliest ever official heatwave from June 19 – 21. This summer, as of writing in July 2018, the City has issued three extended heat warmings (temperatures greater than 31 ºC). (Toronto Public Health 2018)

Climate change prompted Toronto to undertake a review of the implications of severe weather, beginning in the early 2000s. In February 2013, Toronto City Council received the outcomes of the study, *Toronto's Future Climate*, and directed the Board of Health (BoH) to review and consider the social and health impacts as a result of increased health and extreme weather conditions. The background report indicated that between the date of the report (2013) and into the next 30 years (2040-2049), average temperatures in Toronto will increase by 4.2 ºC. Average summer temperature are predicted to increase by 2.0 ºC, and the extreme daily maximum will increase by 9.2 ºC. The report indicated that the maximum daily temperature will rise from 33 ºC to 44 ºC. The number of days greater than 33 ºC will triple from 20 to 66, and the number of heat waves (three or more consecutive days with temperatures greater than 32 ºC) will increase five-fold (from .57 to 2.53). The report addressed the impact on the City and articulated adaptation responsibilities. With regard to extreme heat, the increased summer temperatures would impact energy consumption six-fold. (Toronto Public Health, 2012)

2.4 Addressing climate change health risks for Toronto Residents

Toronto's changing climate poses health risks to Toronto residents. Particular concern is directed toward the city's older high-rise apartment buildings, constructed during the first post-war residential boom of the 1960s and 1970s.

Beginning in the early 2000s, architectural and heritage researchers drew attention to this unique architectural heritage of Toronto. Under appreciated and misunderstood, Toronto's concrete architecture represents an exciting era of cultural investment, city building, and design innovation. (McClelland & Stewart 2007) The stock of over 2000 buildings, containing 30,000 apartment units, house a significant portion of the city's population at densities as high as 350 units per hectare. (Tower Renewal Partnership 2007, *Fact Sheet*) In 2008, the reinvigoration of these buildings and their sites became an initiative of Toronto's Mayor and brought attention to the social, economic and architectural renewal of apartment neighbourhoods. (Tower Renewal Partnership 2007, *The Tower Renewal Opportunities Book*). Out of this, a collaboration of designers, planners, stakeholders, building owners, academics and interested citizens came together to form the Tower Renewal Partnership (TRP) with the objective of revalorizing Toronto's high-rise heritage. A key focus of this renewal is the development of amenities, community services and facilities, lacking in many of the apartment neighbourhoods. (McClelland et al. 2011)

In 2011, Toronto Public Health (TPH) launched *Healthy Toronto by Design,* an initiative that sought to address the major impacts of urbanization and city design on health in order to highlight and strengthen the role local governments may take in creating healthy, liveable and prosperous cities. (Toronto Public Health 2011b). As part of these explorations between health and design, TPH reported on the health of Toronto's apartment neighbourhoods. In their study, *Toward Healthier Apartment Neighbourhoods,* TPH considered how Toronto's several hundred clusters of post-war high-rise apartment buildings – labelled as apartment neighbourhoods – could better support the health of their residents and people living in the surrounding communities. Improvements to building settings – including natural environments and places for people to gather – as well as improvements to lighting and security, and programs and facilities for physical fitness were investigated. (Toronto Public Health and Centre for Urban Growth and Renewal, 2012) This initiative has led to several positive outcomes.

First, Toronto established new zoning regulations for apartment neighbourhoods. The recently-adopted Residential Apartment Commercial Zone (RAC) (City of Toronto By-law

No. 572-2014) breaks down traditional single-use zoning that historically characterized these communities. Toronto's new zoning allows for a mix of uses to complement the apartment towers, allowing for broadening uses, mixing scales of development, and permitting the development of new amenities and services. It is anticipated that these new regulations will allow for these neighbourhoods to evolve as economically diverse and lively places. (Hug et al. 2013; Stewart 2018) The impact of this bylaw has yet to be fully realized. However, it holds promise for effecting needed change in apartment neighbourhoods.

Second, detailed attention was paid to the energy consumption of these inner suburb apartment buildings. Opportunities for sustainability through retrofit, including building envelope performance, air conditioning, passive conditioning through envelope renewals, and proposals for best practices are being explored. (Tower Renewal Partnership 2007.*Thermal Comfort and Cooling in Apartment Towers*)

Third, close attention was paid to the linkages between extreme heat and attendant health risks to residents in these apartment neighbourhoods in units that do not have air conditioning. A process to explore detailed options began. (Toronto Public Health 2015b). While the City of Toronto sets minimum heat requirements in rental housing during winter months, there are currently no provisions for maximum temperatures in summer months. The City considered establishing standards for maximum heat in apartment buildings. The report, *Protecting Vulnerable People from Health Impacts of Extreme Heat,* revealed that the idea of creating regulations that would legislate a maximum heat standard presented complex challenges, including reticence on the part of apartment building owners, who believed that a majority of apartment dwellers chose not to have air conditioning and also chose not to use existing indoor cooling rooms. Further, they expressed concern that such standards would have profound negative environmental consequences in terms of exacerbating the heat island effect, as well as severely straining existing electrical systems within buildings and the local electrical grid. (Toronto Public Health 2011a) (Correspondence, GTAA to BoH, 27 November 2015)

Consequently, the City pursued alternate strategies that permit property owners to meet a maximum heat standard through the provision, at minimum, of a cool location where building occupants can go during hot weather. At the direction of the Toronto BoH, TPH worked with City departments to explore strategies to mitigate extreme heat such as onsite indoor and outside cooling spaces in and near apartment buildings. A 2015 workshop, *Extreme Heat in Multi-unit Residential Buildings,* considered potential strategies to reduce the risk from extreme heat. The creation of on-site indoor and outdoor cooling centres became one strategy that was pursued. The benefits of such centres were identified, including their potential to create positive relationships among tenants, the potential of access by multiple users at various times of the day, and the ways such spaces, if situated out-of-doors, could relate to underutilized or undeveloped green spaces adjacent to existing apartment buildings. It was contended that these cooling centres would have multiple, long-term benefits, including reduction in heat island effect and improvement of community cohesiveness and interaction. Many apartment buildings already have locations on their properties which would be ideally suited for outdoor cooling use, and residents and owners were ready to act. (Toronto Public Health 2015a, Toronto Public Health 2015b)

The creation of these on-site cooling centres also would address concerns previously identified by TPH. A 2011 survey explored the relationship of Toronto residents to extreme heat. It found that many people without air conditioning often chose to stay home, even though there was a cool place nearby, citing lack of transportation (10%) or being "too far" (14%)or the perception that such places were inaccessible at night (11%), worries about personal safety (4%) or inaccessibility for disabled persons (5%). (Toronto Public Health 2011a)

A strategy of access to cooling on site was pursued by TPH. In order to explore the design of outdoor cooling centres, in 2016 TPH partnered with Ryerson University's Department of Architectural Science to undertake a pilot study to design prototypes for outdoor cooling centres, and receive community input on design proposals.

3. Ryerson University's Pilot Study to Investigate Outdoor Cooling Centre Design

In late 2010, the TRP undertook a community design charrette on one property to explore practical design strategies in and around the public space of the two apartment buildings on the site that would support long-term planning of the apartment neighbourhood. (Tower Renewal Partnership 2007, *Kipling Towers Community Design Charrette)* The project engaged residents to identify opportunities for property renewal. Attention focused on public spaces, services, security and wayfinding, but the specific question of heat mitigation were not addressed. The outcomes of this charrette formed the starting point for Ryerson University's engagement.

The project's goal was to undertake design research on behalf of TPH. This research would aid in their work with apartment building owners and community residents to address issues of energy planning and costs through creating alternate strategies for cooling in periods of extreme heat. The pilot project was viewed as part of the larger question of infrastructure renewal aimed at high-rise housing. Mitigating impacts of extreme heat through thoughtful and considered design became a key component of the pilot project. Here is how the project unfolded.

4. Heat! Cooling spaces for high-rise places

The pilot project took place from 2016 – 2018. It focused on sites identified by TPH as case studies where prototype design interventions were to be proposed. Interventions were developed by undergraduate students in Ryerson University's Department of Architectural Science (DAS) program in their annual Collaborative Exercise in 2017 (CEx17). Design interventions were presented to focus groups comprising building residents to elicit responses on proposed design interventions. It was anticipated that the study's outcome would form the basis of a larger investigation leading to the development of design standards and approaches for heat mitigation in Toronto's high-rise apartment towers. A component of the study included a documentary film on the impact of excessive heat on the quality of life of occupants in high-rise buildings. The film was conceived to provide student designers and focus group participants with an overview of the issue and featured interviews with key stakeholders and typical residents.

4.1 Ethics Approvals, Owners' Consent, Project Funding and Research Support

Prior to the commencement of research involving human subjects (filmed interviews and community focus groups) the project underwent research ethics review. Ryerson University's Research Ethics Board (REB) approved the film (Ryerson REB 2016-225, approved 24 June 2016) and focus groups (Ryerson REB 2016-351, approved 28 October 2016). TPH REB approved the focus group (TPH REB 2016-10, approved 17 February 2017). The owners of the apartment buildings on whose sites where prototypes were developed and where focus groups were to be held gave their consent to the use of their properties and facilities. Prior to project commencement, the author, the project's Principal Investigator (PI) secured funding for portions of the project from the Ryerson University Centre for Urban Research and Land Development (CURLD). TPH supported the project, but was unable to provide any financial support. Funding provided support for a Research Assistant (RA) and a documentary filmmaker, a graduate student in the Ryerson University School of Image Arts (SIA), where a faculty member also assisted to advise on the film.

4.2 Site Selection

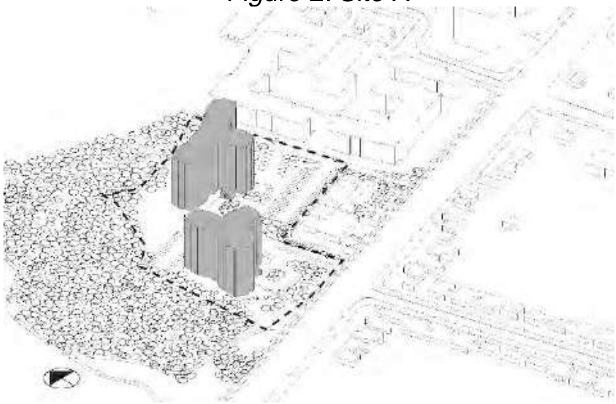
In the spring of 2016, the PI consulted with staff of the Healthy Public Policy Directorate of TPH who identified seven sites within the City as potential candidates for the development of prototypes for outdoor cooling centres. Prior to the commencement of the project, the owners and managers of buildings of these sites had expressed interest in addressing issues of extreme heat and had been actively involved with TPH. Community residents had also been active in working with the owners and building managers on this issue. TPH advised the PI that these groups would assist, as appropriate, in the implementation of the project. The sites were typical of apartment neighbourhoods located across the city. The PI researched proposed sites and obtained detailed architectural, landscape and site design information. The PI selected three sites as locations for the study based on specific criteria, including the configuration and orientation of buildings on the sites, and the availability of locations on each site for outdoor cooling centres. The property owners confirmed agreement to utilize these sites for this study. For reasons of privacy and out of respect for the residents of these sites, the addresses of these sites are not identified. (Figure 1)

Figure 1: A view of the apartment towers on one of the candidate sites (Site A)

This apartment neighbourhood located in an inner suburb of east Toronto is typical of the high-rise neighbourhoods that were part of the pilot project.
Credit: Christopher Marleau

Site A comprises two Y-shaped high-rise 14-storey apartment towers containing 168 units in a mix of types with both on-site and below-grade parking for residents. All units are rented at market rates. Site A is located on the north side of a major arterial road. The site is bordered by a ravine on the west and north, and a local community “hub” and low-rise commercial district on the south and east. Given the configuration of the towers, apartments face all four directions and, consequently, residents experience a range of sun exposure during the summer months. A small convenience store is located on the ground level of one of the apartment towers. The site borders Toronto’s ravine system to the north, an area protected by the Toronto Region Conservation Authority. (Figure 2)

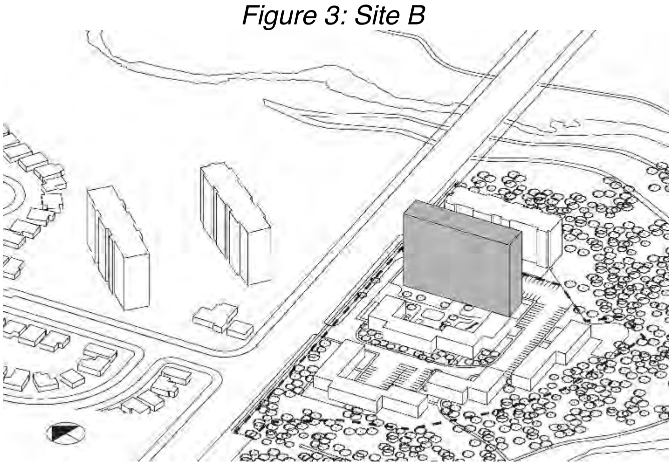
Figure 2: Site A



Site A comprises two Y-shaped high-rise 14-storey apartment towers containing 168 units in a mix of types with both on-site and below-grade parking for residents.
Credit: Drawing by Joe Ball.

Site B consists of one 19-storey slab-type apartment tower containing 192 units in a mix of types. All units are rented, some at market rates and other subsidized through housing assistance. The tower is oriented north-south and located on the south side of a major east-west arterial road. A series of three-storey townhouses sit adjacent to the east and south. A lower, high-rise apartment tower is located on the west. The site contains on-grade parking and amenity areas for outdoor recreation. The site borders Toronto's ravine system to the south, an area protected by the Toronto Region Conservation Authority. (Figure 3)

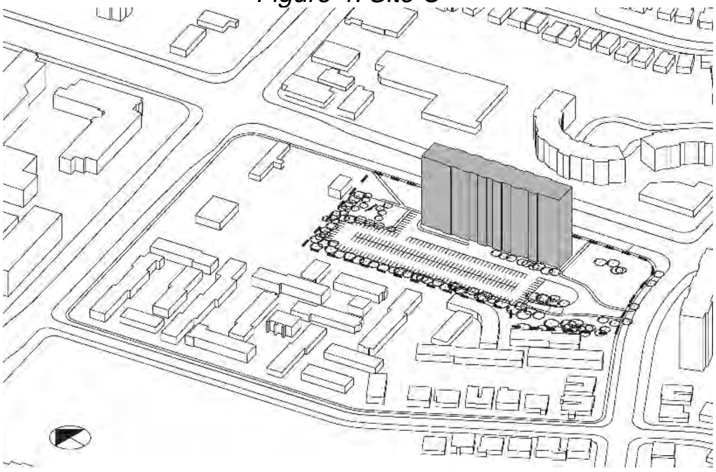
Figure 3: Site B



Site B consists of a 19-storey slab-type apartment tower, oriented north-south and surrounded by low-rise townhouses on the east and a lower apartment building on the west.
Credit: Drawing by Joe Ball.

Site C consists of a 20-storey slab-type apartment tower, oriented north-south. All units are rented at market rates. The site is located on a major north-south arterial road, close to a major east-west road and neighbourhood commercial area. The site is flanked on the west by a parking lot and a low-rise residential single-family neighbourhood beyond. A major commercial area is across the street, on the east, and there is a high-rise tower currently under construction in this location. The site is a five-minute walk from a community centre. A community day-care is operated on the ground floor of the apartment tower, the entrance of which is located on the tower's north face. The building main entrance is situated on the building's east side, although access is provided to the parking lot on the western side of the building through a lobby that bisects the ground floor from east to west. (Figure 4)

Figure 4: Site C



Site C consists of a 20-storey slab-type apartment tower, oriented north-south, with parking along the western side of the property.
Credit: Drawing by Joe Ball.

All sites are served by public transport. The sites were documented in film, still image and digital mapping.

4.3 Film, "Heat! cooling spaces for highrise places"

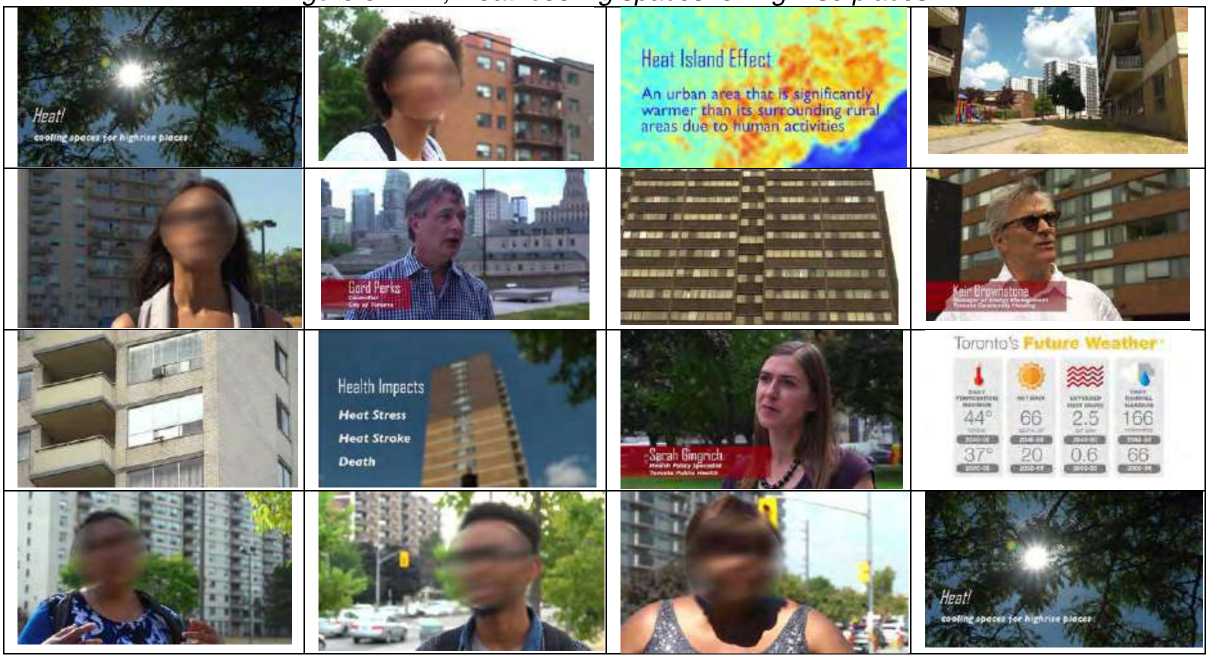
During the summer of 2016, which was reported as Toronto's hottest to date, the filmmaker and RA conducted and filmed interviews in the vicinity of the three sites. They recorded interviews with approximately 15 residents in these communities. Positioning themselves on public property, the RA presented the project to potential interviewees and requested an interview, describing the project and its objectives. Subjects were selected randomly. Each subject confirmed that they lived in a high-rise building in the neighborhood, were in residence there during the summer (i.e. they did not have access to another summer location, such as another residence or a summer home), and did not have air conditioning in their unit. All interviewees provided consent as per REB requirements.

The RA followed a standard set of questions querying the interviewee's response to Toronto's summer heat, how they kept cool during the summer heat, and what measures they took, either in their unit or away from it, to keep cool. Filming took approximately 20 minutes per interview. Water was made available to interviewees and, as much as possible, all interviews were conducted in the shade.

The PI identified a number of experts on heat, heat island, climate change, building management, architecture and public health. The REB approved specific questions for each expert. Each expert agreed to an on-camera interview and signed a release form permitting their name and affiliation to be included in the film. The researcher interviewed six interviews and their observations were filmed.

The documentary filmmaker and researcher completed the collection of film interviews in the late summer of 2016. The filmmaker and PI reviewed film footage and prepared a film treatment. Editing of filmed interviews and review of the rough-cut of the film took place in the fall of 2016. The PI secured a composer to compose music to accompany the film. In late fall 2016 the PI and the SIA faculty advisor reviewed the final rough cut of the film and the final version was completed in January 2017. (Figure 5)

Figure 5: Film, Heat! cooling spaces for highrise places



Still images from the film, Heat! cooling spaces for highrise places. Faces of residents interviewed have been blurred to protect their identity.
Credit: Peter Conrad, filmmaker.

The PI screened the sixteen-minute film, "*Heat! cooling spaces for highrise places"*, during the CEx17, where the filmmaker and SIA faculty advisor discussed the role of film-making in architectural research and documentation. Following the completion of the film, the PI oversaw the production of a film transcript containing still images of the film; images of residents are blurred to protect their identities. A copy of the film transcript is available on request from the PI. The film was made available for screening at each of the focus groups. An abbreviated version of the film of approximately 9 minutes duration is available for screening during academic presentations of this research.

4.4 Prototype Design – The 2017 DAS Collaborative Exercise

The Ryerson DAS runs the Collaborative Exercise (CEx) annually at the start of the winter term. All DAS undergraduate students participate for a pass-fail credit. DAS graduate students provide support to the CEx and DAS faculty members participate as advisors to the undergraduate student design teams. The PI was the Instructor for the DAS Collaborative Exercise in January 2017. The focus of CEx17, entitled Design approaches for outdoor Cooling Centres, was to address ways to mitigate excessive heat exposure for vulnerable populations in Toronto high-rise apartment buildings through on-site cooling centres.

CEx17 asked students to address the following questions:

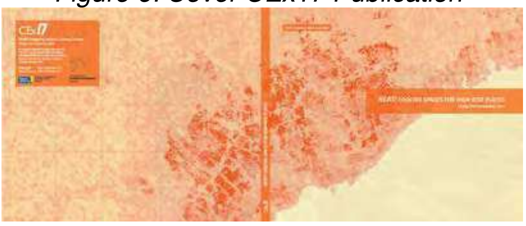
> "What effective passive design interventions can be created to provide outdoor Cooling Centres on sites adjacent to older inner-suburban high-rise buildings in Toronto?" and "How can architects contribute to the design of these outdoor Cooling Centres to provide places that provide comfort and relief in periods of extreme heat, and are well designed, safe, inviting to a wide variety of users, and have a low-energy impact?"

Approximately 425 DAS students participated in CEx17, under the guidance of 12 graduate students and an equal number of DAS faculty members. During the five days of CEx17, students followed a rigorous agenda and developed designs for outdoor cooling centres. Students completed final designs and produced posters of their designs that were displayed for a two-week period in January 2017 at the CEx17 conclusion in the Ryerson University

Paul H. Cocker Gallery located in the Architecture Building. The DAS CEx is seen as a way to start the winter term with a bang and energize students for the term ahead. For CEx17, each day was given a different name, to reflect the build-up of the week's work: Monday: "Heat Alert", Tuesday: "Heat Exchange", Wednesday: "Heat Wave", Thursday: "Making Cooling Outcomes" and Friday: "Show your stuff". Experts who were interviewed in the film spoke at a panel during Tuesday's "Heat Exchange". The filmmaker discussed his work on the same day. Six invited jurors drawn from health, design and the community, reviewed submissions and identified a number of noteworthy designs. The week ended with a celebration and all-school party on Friday evening.

The Instructor and PI oversaw a publication, *Heat!, Cooling spaces for highrise places* that documented CEx17 activities and design project outcomes. The publication was completed in 2018 and is available through the Ryerson University and Archives digital portal, https://library.ryerson.ca/. (Figure 6)

Figure 6: Cover CEx17 Publication



Cover, Heat! cooling spaces for highrise places, CEx17 Publication. George Thomas Kapelos, Editor. Credit: Sarah Lipsit

5. The Collaborative Exercise 2017 – Creating Cooling Centre Prototypes

Continuing in the tradition of past Collaborative Exercises, which addressed a number of important topics related to architectural issues and the public interest, including 'Civility' (2013), 'Identity' (2014), and 'Water' (2016), CEx17 addressed the topic of 'Heat'. The focus was the creation of prototypes for outdoor cooling centres. The PI, a professor in the Ryerson University DAS, was the Instructor for the CEx17, responsible for course conception, development and delivery. He developed the parameters for CEx17, which follow.

5.1 The sites

The design of outdoor cooling centres in CEx17 focused on three high-rise residential sites located in Toronto's inner suburbs (Sites A, B and C). The exact addresses and locations of these sites were not relevant to CEx17, as the three sites were chosen as typical of the approximately 2,000 high-rise sites where outdoor cooling centres may be located.

Table 1: Typical locations and location requirements and / or restrictions

	Name / location type	***Requirements / restrictions***
Typical location 1	**PARKING** Within an existing paved parking area	Must address the question of heat buildup on pavement and may require a raised platform. No excavation allowed into the pavement for plantings or water features. Must be accommodated within the existing flow of vehicular traffic and not block emergency routes. Plant and / or water features must be constructed on the platform and / or at grade. Must provide for a raised, well-drained area in the event of inclement weather.

Typical location 2	**GRASSY** On a grassy area which may have the potential to be enhanced with tree plantings	Some excavation of the site is allowed. Trees and other vegetation can be planted in the ground. Must provide for a raised, well-drained area in the event of inclement weather.
Typical location 3	**STREET** Adjacent to a major public thoroughfare and visible from the street	Some excavation of the site is allowed. Trees and other vegetation can be planted in the ground. Some form of enclosure is to be provided separating the cooling centre from the adjacent street / public walkway and providing privacy from the street. No obstruction of public pathways / emergency routes is allowed. Must provide for a raised, well-drained area in the event of inclement weather.
Typical location 4	**REAR** At the rear of the property, away from a major public street.	Some excavation of the site is allowed if this area is on grass or earth. Trees and other vegetation can be planted in the ground if the area is on grass or earth. Clear lines of sight into the cooling centre, ensuring surveillance of the facility from outside the cooling centre must be provided. Must provide for a raised, well-drained area in the event of inclement weather.

The sites display characteristics typical of older high-rise buildings located in the inner suburbs. The high-rise buildings contain from 200 – 300 residential units in a mix of bachelor, one-, two- and three-bedroom units. Typically these are rental buildings. The instructor secured the permission of the owners of these properties to utilize these sites for CEx17. However, as there were issues of privacy and respect for the residents, the instructor did not disclose the exact locations of these sites. Adequate information on each site was provided on D2L, the Ryerson University digital learning portal. Each of the high-rise building sites presented four typical locations where an outdoor cooling centre could be placed. Students were to assume that all locations at each site had access to power and water. The typical locations with requirements and / or restrictions are described in Table 1.

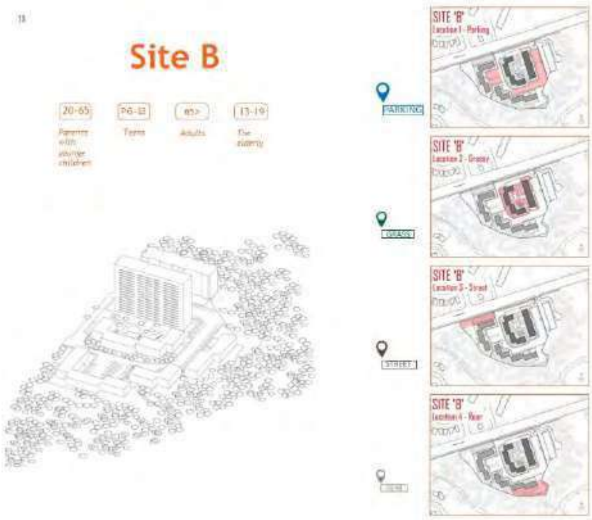
Figure 7: Site A

Site A, showing typical locations for outdoor cooling centres.
Credit: Saman Soleimani-Deilamani

Student teams were assigned one of the three sites (Site A, Site B or Site C). Within each site, teams were assigned one of the four location types (Type 1, Type 2, Type 3 or Type 4).

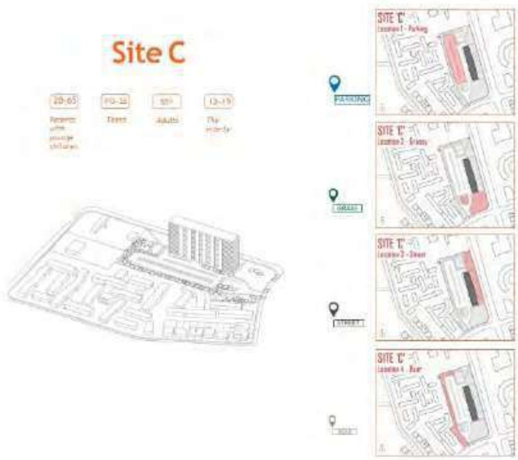
No changes were permitted. Typical locations for the cooling centre designs were identified on site materials posted on the D2L site. The sites and locations are indicated in Figures 7, 8 and 9.

Figure 8: Site B



Site B, showing typical locations for outdoor cooling centres.
Credit: Saman Soleimani-Deilamani

Figure 9: Site C



Site C, showing typical locations for outdoor cooling centres.
Credit: Saman Soleimani-Deilamani

5.2 Project Description – Heat: Creating Outdoor Cooling Centres

CEx17 took its cues from the growing concern about climate change and the ways in which episodes of extreme heat will impact Torontonians.

CEx17 invited students to design an outdoor cooling centre on a specific type of location on one of the three typical high-rise sites found in Toronto's inner suburbs. The cooling centres were to be designed in such a way to provide a range of residents of high-rise buildings the opportunity to seek respite during periods of extreme heat in the summertime in Toronto.

The cooling centre was to provide basic amenities to users that would provide them comfort during a heat alert. It was recommended that the cooling centre be open 24 hours / day, 7 days / week, and be accessible to building residents on a priority basis. Other residents in the surrounding community might also access the cooling centre. Student design teams therefore were also to address questions of security, round-the-clock use and the implications of mixing user types in the centre's design.

The cooling centres were to cater to a wide range of individuals representing the spectrum of high-rise apartment dwellers in Toronto. Therefore and to focus the design, four specific user groups were identified. Each team was assigned one prime user group, but would have to consider at least two other user groups as secondary users. Students were asked to address the question of sensitivity between different types of users and potential conflicts that might arise when the site is programmed for a mix of users. In all cases, there might be a mix of ethnic groups and a range of abilities within these groups. Students were to be mindful of these issues as they developed their designs. Table 2 identifies the proposed user groups.

Table 2: Proposed user groups:

User Group 1	Parents with young children (i.e. children under 12 years of age)
User Group 2	Teenagers
User Group 3	Adults
User Group 4	The elderly

5.3 Project Drivers

A major thrust of this project was to seek ways in which to explore ideas of passive cooling and the use of water, plant materials and shade (either natural or constructed) as elements in the design of the cooling centres. Each cooling centre would have access to water and electricity but was not to be energy dependent for cooling. These were not to be designed as "air conditioned" rooms but rather as places that provided comfort and respite during periods of extreme heat through natural means.

Therefore, as a means for participants in CEx17 to explore the potential for passive cooling in these outdoor cooling centres, each team was asked to consider encapsulating passive cooling, which would provide thermal comfort to cooling centre users with low or nil energy consumption.

5.4 Design Considerations

Students were advised that these were to be unique facilities that would bring together a variety of people who might have common needs but not necessarily share similar values, beliefs, backgrounds or interests. Students therefore were to be mindful of providing privacy and a range of spaces within the cooling centre to address the diversity of the populations and their individual requirements.

The cooling centre might accommodate a cross-section of users, from individuals to small groups to large gatherings, of all ages and demographics. Therefore, the cooling centre might have within it a variety of zones from the intimate to the public. Therefore, the design was to be considered at three scales: the cooling centre, its immediate context (e.g. an area within 20 meters of its focus), and its larger context (e.g. extended vistas, views from within the site and from the larger urban context).

5.5 Design Objectives and Parameters

Each team was tasked to design an outdoor cooling centre that would provide comfort to a range of residents during periods of extreme heat. Different groups might have different needs and these needs were to be accommodated. For each cooling centre, students were to consider nine design issues. These are described in Table 3.

Table 3: Design issues

Access and welcome	For the cooling centres to be used by residents, the designs must demonstrate that they are accessible and welcoming places.
Comfort	Thermal comfort is important in these centres. As they are not to be "air conditioned" and are to use passive means of cooling, using low to no energy, students must demonstrate that comfort is achieved in their proposed design.
Security	Create a space where users may feel secure and welcome. If the decision is taken that the cooling centre may be in operation 24 hours per day, students must address the question of security of users around-the-clock.
Recreation	Create a space where users may engage in recreational activities, either individually or collectively. This may be in the form of quiet reading or group activities, including engaging with water recreationally, or other activities requiring more exertion. Different age groups may have different recreational needs and students should be mindful of this.
Culture and Ethnicity	Be capable of accommodating the needs of diverse cultural and ethnic groups and communities.
Function	Provide basic functional needs such as seating, resting/relaxing and toileting. Other activities may be incorporated, such as information functions, capacity to access internet, public telephone or charge individual portable computer devices or telephones. The facility may include a shower for individual bathing as appropriate.
Privacy	Provide the opportunity for individuals to find comfort and privacy, albeit in a public or quasi-public setting.
Sociability	Provide the opportunity for people to undertake sociable activities in small groups.
Information	Provide information to users on possible heat-related or public-service related issues.

5.6 Project Scope and Considerations

Table 4 identifies dimensional and area considerations each cooling centre design. Table 5 lists program considerations.

Table 4: Cooling centre dimensional and area considerations

- A space of approximately 100 m2 which will form the core of the cooling centre, capable of accommodating 15 – 20 people.
- If 24 hour use is proposed, present ways the space may be secured at night to permit possible overnight sleeping by residents during periods of extreme heat.
- It must be shaded and provide coverage in inclement weather.
- If students believe that this area is too small or too large, they may contract or expand the area and provide a rationale for their decision.
- If the area is enlarged, it must not exceed the area of 200 m^2 as discussed below.
- A larger space of approximately 200 m^2 which may extend the area of influence of the cooling centre into the larger location.
- The cooling centre may be a one- or two-storey structure. Be mindful of accessibility requirements. The maximum height of the built area is to be no more than 8 metres.

Table 5: Cooling centre program considerations

- The underlying premise of CEx17 is to create safe, comfortable, accessible and secure cooling centres that provide comfort to residents during periods of extreme heat.
- Each cooling centre will have common program elements.
- Specific program elements will be required for specific user groups and students may propose additional elements and incorporate these into their designs.
- Passive cooling is to be the main means of cooling. Energy consumption for cooling is to be low or nil.
- The tectonics of the cooling centre should be explored and clearly developed. The form and materiality of the cooling centre may seek to reinforce the idea of cooling. The tectonic, therefore, should consider both construction and how the choice of materials, assemblage and construction raises the architecture of the cooling centre to a higher meaning beyond the functional, allowing the design and object to have a significant presence.
- The cooling centre must have weather-protected / shaded and open / outdoor components.

- The cooling centre is to function from late spring through early fall. Its use, function and operation may change with time (daily or seasonally). - The cooling centre may be a permanent or temporary facility. If permanent, provision must be made for its enclosure / security in the season when it is not in use. If temporary, the design must demonstrate how it may be demounted and stored for reassembly and use in future summer seasons. - The cooling centre should accommodate a multiplicity of purposes and activities that may change over time.

5.7 Program elements and design requirements

Each cooling centre was to include common elements for any type of user and specific user-related elements. Table 6 lists common program elements and design requirements. Table 7 lists program elements and requirements for specific user groups.

Table 6: Common Program Elements and Common Design Requirements

Common Program Elements
− Water and electricity are provided
− Water: pools either need 24 hour surveillance (e.g. a lifeguard) or need to be drained when there is no surveillance
    - Must be wading pool or splash pad (wading pools are 0.75m or less in depth)
    - Misting station
    - Drinking water fountains
    - Two unisex bathrooms equipped with toilet / sink and a changing station; one may include a shower
− Shading: natural and constructed
− Area: $100m^2$ secured area, $200m^2$ maximum footprint
− An area for a person who will operate / supervise the cooling centre (including locked storage)
− Lighting: dependant on the program (sleeping, activities, etc.)
− Cooking space, including a barbeque, sink area
− Garbage disposal
− Assume even grading for the site
− Vending machine for cool drinks
− Ice machine
− Refrigerator for storage of cool/cold items
− Night activity permitted
    - Said activity to be determined by the group (active or passive)
− Students must address what happens to the site during the other seasons

Common Design Requirements − Barrier free design − Charging stations − Information panel − First aid station − Location for a Public Health worker or community volunteer to attend the Centre on an occasional basis − Digital component (audio, visual, etc.) − Storage space − A public address system − Possibility of public event area / public gathering area − Area for quiet relaxation, reading, listening to music (on earphones), lounging, resting − Picnic area − Universal activity tables

Table 7: Program Elements and Requirements for Specific User Groups

Parents with young children (i.e. children under 12 years of age)	− Easy visibility of children − Spaces must allow for adults to interact with their children − Park / play structure − + other uses as determined by student team
Teenagers	− Gathering space

	− Study space+ other uses as determined by student team
Adults	− No special uses other than those presented above − + other uses as determined by student team
The Elderly	− No special uses other than those presented above − + other uses as determined by student team

6. Design Prototypes

In CEx17, ten designs were prepared for each of the three sites, comprising a total of thirty different designs. Each design was the product of a team of students in the four-year Ryerson University DAS undergraduate B. Arch. Sci. program. Students in each group worked as a team in a four-day charrette.

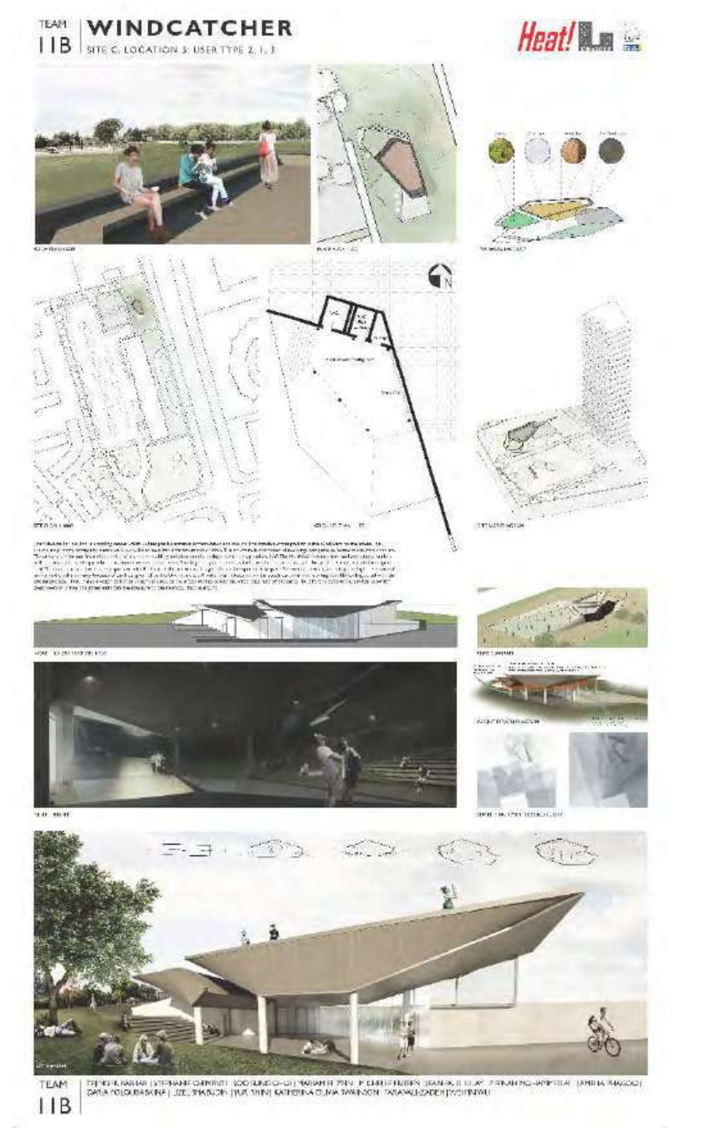
For the focus groups, four projects were selected for discussion and feed-back by focus group participants at Sites A and C. The projects were chosen to represent a range of design approaches for the four locational conditions and age-group focus of specific users. Table 8 lists design parameters for each prototype reviewed.

Table 8: Prototype names, on-site location and primary/secondary user

	Team number and Project Name	Location on site	Primary User	Secondary Users
Site C	11B Windcatcher	street	teenagers	adults parents with children under supervision
Site C	12B Heat: It's lit	rear	senior citizens	adults parents with children under supervision
Site C	13B Cool	parking	teenagers	adults parents with children under supervision
Site C	14B Cross Shade	grass	senior citizens	adults parents with children under supervision
Site A	6A Cool-Haus	grass	parents with children under supervision	adults teenagers
Site A	7A Sombra	street	adults	seniors parents with children under supervision
Site A	8B River and Chill	rear	teenagers	adults seniors
Site A	9A Chill Out	parking	adults	teenagers seniors

Each student team chose a name for their design and provided a brief description. The complete range of work is available through the Ryerson University Library and Archives digital portal, https://library.ryerson.ca/. The design prototypes present consistent themes of passive cooling, relaxation and sensitivity to the surrounding natural and built environment. Figures 10 – 17 present student designs and brief descriptions prepared as part of the student submission. These descriptions have been revised and edited for consistency and are provided as captions to each of the figures.

Figure 10: Site C – Team 11B, "Windcatcher"



The Windcatcher pavilion is a cooling centre which utilizes passive systems for ventilation and cooling. The structure is composed of two large compressive masses and its form is derived from the intersection of the street, building and playground, creating a place to stop and cool off.

The north-west wind direction flows along a sunken path to create a versatile space for relaxation, events or activities. The larger suspended space is to be used as a patio space and the small, as a climbable green roof.

The manipulation of wind is incorporated into the pavilion form, as air is drawn into the open activity space. A water wall is featured on the south-east entrance, creating sensible cooling for pavilion users. The different levels of the pavilion allow for great views to adjacent playground.

Credit: T Babbar, S Chimenti, S Choi, M El Zein, M Friesen, JP Guay, Z M Ali, T Phagoo, D Poloubabkina, L Shabudin, Y Shin, K Swainson, T Vali-Azdeh, W Y Wu.

Figure 11: Site C – Team 12B, "Heat: It's Lit"

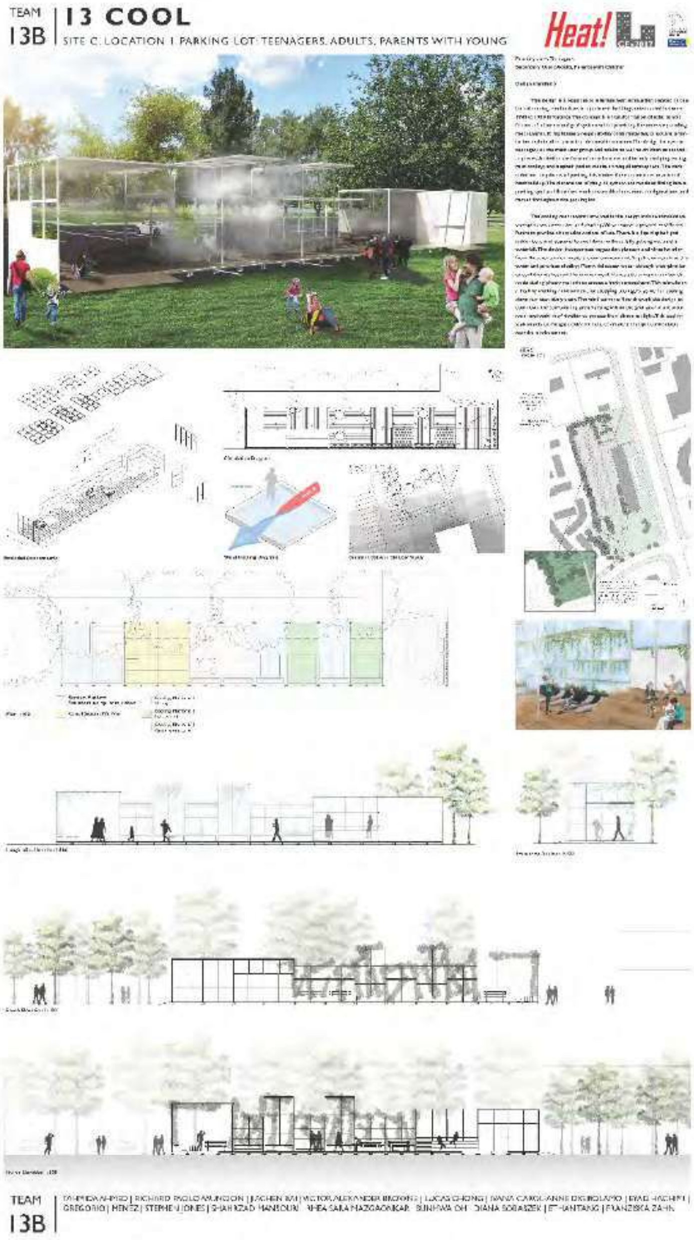
The aspirations of this project culminated in a minimal impact cooling pavilion, providing various cooling effects to the immediate community, with specific focus on the elderly.

The pavilion is divided into three distinct zones: an air zone, a water zone and a comfort zone. By incorporating passive air movement and providing a live wall that will catch the wind, the pavilion can provide more-than-adequate cooling on even the hottest of summer days. The inclusion of an interactive misting station provides opportunities for children to play. A small kiosk provides additional benefits to users, offering cold beverages when needed. A seating area in the comfort zone is geared towards the elderly, allowing places for rest and socializing.

The inspiration behind the form and tectonics is drawn from the adjacent apartment slab tower, as well as the less-is-more minimalist approach of Mies van der Rohe. Ideally, the pavilion acts to engage fully with the community and solve the issue of extreme heat during the summer by means of passive cooling strategies involving air and water.

Credit: A-J Christie, A R Singh, D L Gawel, D Luong, E Somo, K Tsoukas, M Teyouri, N Budhwa, S Niekerk, S Shahzad, R He, R Menh-Huang, T Lecky, T Tin-Nok-Yu, Y Ying, R Ng.

Figure 12: Site C – Team 13B, "Cool"



The design concept is the transformation of solid-to-void to fit into a three-dimensional grid while at the same time providing mechanisms for cooling. Materials, structure and orientation are brought together to provide a pleasurable summer experience for users. Teenagers are the prime user group with activities focused on relaxation, eating and studying. Mist cooling and a splash pad create a tranquil atmosphere. The lines demarcating parking spaces create the scheme's modules, which can be assembled in various configurations and moved in a number of locations on the parking lot.

Cooling is brought about through conduction, transpiration, convection and shading. Water in various forms – vapor, mist or liquid – provide options for cooling. There is a splash pad for wading, misting stations for cooling, and a waterfall for visual pleasure. Hanging vines and planters emphasize the coolness of this place and provide shading and cooling through transpiration and carbon transfer. The presence of water and vegetation stimulates a healthy working environment for teenagers who wish to study. Winds moving through the pavilion cool the surrounding area. Shading devices protect users from harmful UV. The cooling station acts to mitigate extreme heat through the creation of a tranquil and comfortable exterior environment.

Credit: F Ahmed, R P Asuncion, J Bai, V A Browne, L Chong, I C-A Digirolamo, E Hachemi, G Jimenez, S Jones, S Mansouri, R S Mazgaonkar, S Oh, D Sobaszek, E Tang, F Zahn.

Figure 13: Site C – Team 14B, “Cross / Shade”

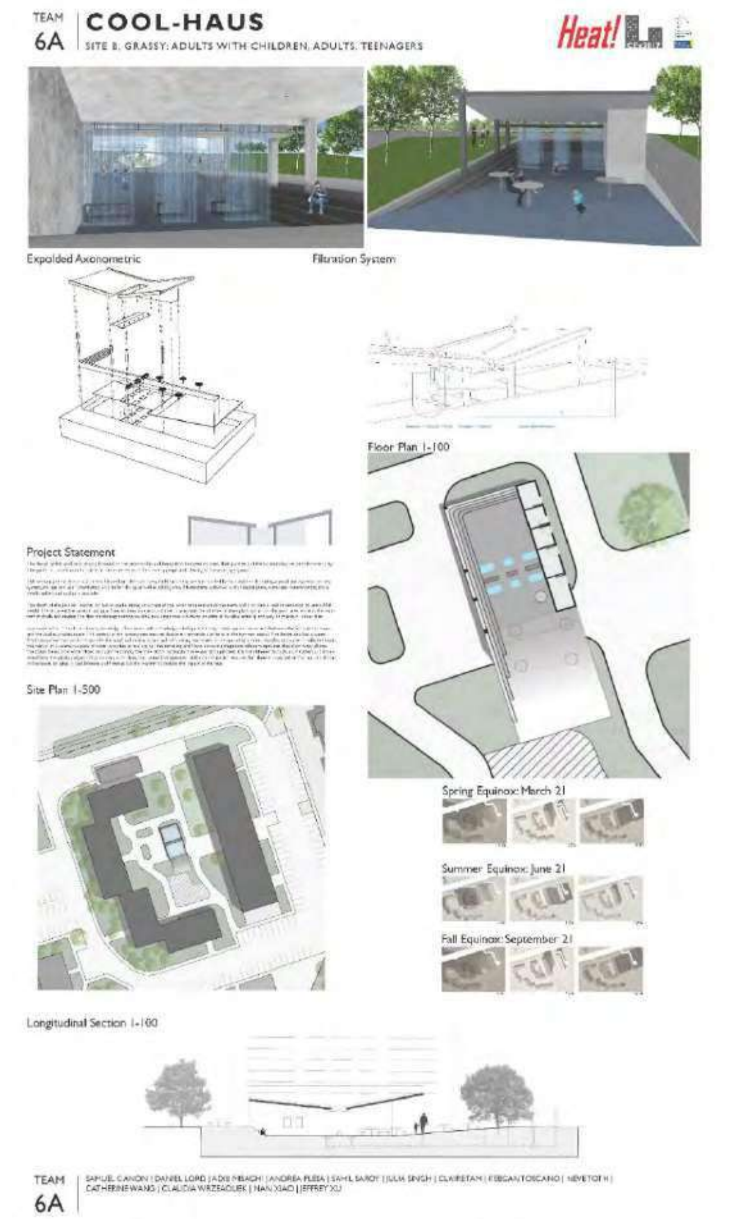
The goal of this project is to create a communal cooling system for elderly residents. The centre provides a refuge in heat wave and a lively recreation space. The design features four spaces, each with a specific purpose, all unified by an overhead lattice structure housing a misting station and branching from the central area to connect with other spaces.

A decked seating area is located in the centre of the site, furnished with patio tables and chairs and sitting over a narrow extension of the adjacent wading pool. Three existing trees shade the area and a small structure houses a small kitchen, washrooms and storage is located adjacent to the seating area. The wading pool (that can become a winter skating pond) is part of a larger water system across the site and provides a space for children to play.

Another seating area is designed, closer to the apartment building, intended for elderly users. Set off from the other areas, this is a quiet space, separated from the more active areas for users to enjoy board games, conversation or reading. The lattice structure extends to cover all areas of the site, unifying the composition.

Credit: S Adnan, D Ahmad, Y Arboleda, A Brenna, M Breteon-Honeyman, J Cavliere, G Chalabi, L Crichton, V Chow, E Doucette, B Esuan, S Elangko, J Hache, I Jeong, V Paningbatan-Cerez.

Figure 14: Site A – Team 6A, "Cool-Haus"



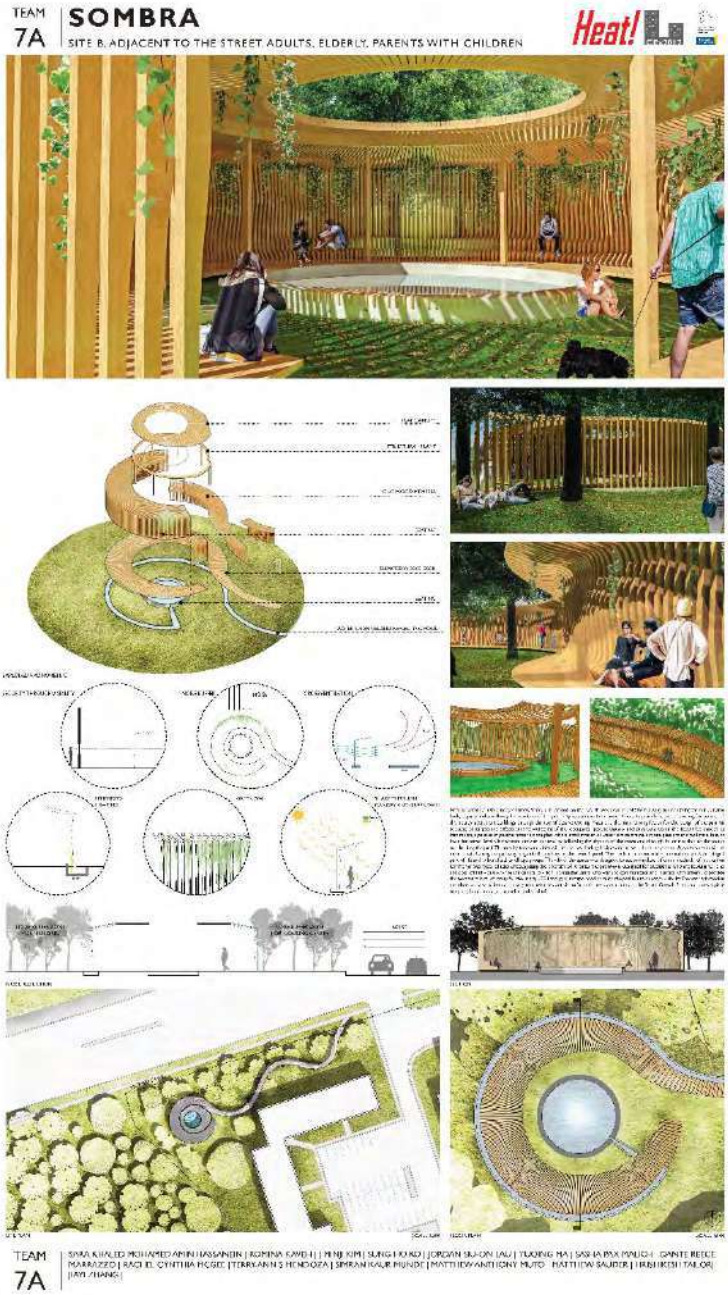
The design of the pavilion is focused on the interaction between children, their parents and their neighbourhood. The goal is to unite fun and comfort in the experience of the space. The versatile and fully accessible pavilion offers an open multipurpose space, seating, waterfall cooling, amenities, a BBQ cooking area, with a nearby splash pad and small park. The pavilion floor sits 1 m below grade, creating a cool environment. This grade differential allows for parent supervision beyond the enclosed area.

A shaded roofed space offers users a place for easy transition between hot exposes outdoor spaces and cooler, shaded spaces. A water filtration system and rainwater collection mechanism provides water to the pool and a constant flow of water, supplemented with municipal water, flows down the slope falling into the ponds below. A UV system filters water for use in the splash pad, all while cooling the overall area.

The openness of the structure ensures there is a constant airflow and through ventilation. Cool breezes reduce the impact of summer heat.

Credit: S Canon, D Lord, A Misaghi, A Plesa, S Saroy, J Singh, C Tam, K Toscano, N Toth, C Wang, C Wrzeouek, N Xiao, J Xu.

Figure 15: Site A – Team 7A, "Sombra"



Nestled within a lush canopy of trees, an undulating form denotes a space and a walkway for residents to call as their own. The design aims to provide respite to residents through passive cooling. Nature is the main driving factor of the pavilion because of its positive effects on the wellbeing of occupants, psychologically and physically.

Using the local tree canopy as inspiration, a palette of natural materials together with a small stream of water aim to create a pleasant microclimate that helps lower a user's stress. The design that overlooks the park respects the site context, following the rhythm of the trees. Nearby, vegetation provide shade and noise reduction.

The pavilion accommodates meditation, as it is an integral part of the natural world and provides benefits to users of all ages. The pathway provides space for people who seek relaxation and cooling relief, while the central pavilion is larger for users to interact and engage with each other. To provide necessary levels of safety for users, LED lighting is incorporated in the design to enhance visibility. The vertical wooden members are oriented to allow constant views to the south.

Overall, Sombra creates a place to take a break in nature, to relax and cool off.

Credit: S K M A Hassanein, R Kaveh, M Kim, S H Ko, J S O Lau, Y Ma, S P Malich, D R Marrazzo, R C Mcgee, T A S Menoza, S K Munde, M A Muto, M Sauder, H Tailor, J Zhang.

Figure 16: Site A – Team 8B, "River and Chill"

The earth's climate is changing. Recent warming trends are significant as they are the result of human activity. Toronto will experience the impact of climate change.

Cooling stations may help prepare us for future heat waves. Ideally these cooling stations should utilize passive cooling that takes advantage of local climate and site conditions to maintain a comfortable environment, minimizing the impact on the environment. A building built for passive cooling may be no building at all but rather an intervention that is integrated within nature and uses no energy.

Our proposal therefore guides users to a river adjacent to the site. This waterway has the potential to be fantastic cooling amenity for residents from the adjacent building. Modules designed for specific activities frame the path that brings users through the forest to the river. These spaces will allow users to relax on their own, gather in groups and enjoy activities together, such as an outdoor meal. The modules are passively shaded by the surrounding dense foliage, ensuring that users remain cool at all times.

Credit: A Falls, R Fernades, D Klissarova, C Li, T Marshall, N Mishariti, A Naeshkumar, J Okoh, M Crino, P Panus, K Rashid, R Riabinski, B Shi, s Twarog, G Zhou.

Figure 17: Site A – Team 9A, "Chill Out"

Chill Out is a proposal for a cost-effective modular cooling station. Designed to occupy the vast outdoor parking spaces surrounding apartment towers, the modular unit is derived from the size of a typical parking spot. Using a combination of semi-enclosed and open units, a variety of configurations are made possible, allowing for future expansion and use in other places.

Passive cooling is achieved by creating a module that is devoid of any solid walls, allowing for a constant breeze to pass through the space. In addition, shading is provided by the solid roof element and through vegetation and vines that grow around the cables and planers. Active cooling is achieved through a misting bar found at the entrance of every module that generates a mist when someone walks through the entrance. Electricity is generated through photovoltaic panels found on the roof or the modules. Additionally, the roof is designed to collect rainwater that provides a constant supply for misting.

To accommodate the activities of users, a variety of leisure, work and gathering spaces are provided. Each module is subdivided into three zones: intimate relaxation, circulation, and a multi-use active space.

The construction of the modules is made cost-efficient by using dimensioned lumber and steel cables as the main structural elements for the cooling stations.

Credit: A Al-Rashid, B Al-Waadeh, A Azia, J Bridglal, N Caccavella, A A Carere, N Chen, C S Chin, J S Cruxton, S Gurevich, E L Hamanova, R Ivanytskyy, S M Serrano, N Sokolov, J Tian, L Yang.

7. Community Focus Groups

The project anticipated three focus groups, one on each site. The protocol called for a random selection of up to 12 residents from each site to discuss the outdoor cooling centre prototype designs. The protocol anticipated focus groups would take no more than two hours.

In planning the focus groups, the PI recognized that it would be unlikely that focus group participants would have an in-depth knowledge of architecture. The PI also determined that presenting all the designs for each site could overwhelm participants and extend discussion beyond the focus-group's two-hour limit. Therefore, the PI in consultation with the focus group facilitator identified four designs per site to take to each focus group and posters were prepared. These are presented in Figures 9 – 16, above. The graphics contained architectural plans, descriptive texts and colour renderings of the spaces of the proposed cooling centres. An architecture student presented these design ideas at the start of each focus group, so participants could better comment on the architectural drawings presented to them.

In recruitment and organizing the focus groups, three issues arose.

First, due to delays in receiving REB approval for the focus groups (received in mid-February 2017), implementation of the focus groups was delayed to late winter / early spring of 2017.

Second, late in the process, a community group involved with one of the sites advised the PI that this group would not support Ryerson's engagement with that community, believing that the community had been "studied enough". This news came as a surprise to both the PI and TPH who had received permission from the property owners and community representatives for the focus groups. Consequently, the PI organized focus groups on the two remaining sites, B and C. Depending upon recruitment, the PI planned to hold up to three focus groups on the remaining two sites.

Third, agreed recruitment protocols – postering in the buildings and distributing flyers to building residents – yielded no participants, even after several attempts. Given constraints of budget, timing and availability of all personnel, the PI decided to approach recruitment with a more concerted effort and in a targeted manner. On the day that each focus group was scheduled, the RA and focus group assistants arrived early at each building. By going door to door and also waiting in the buildings' lobbies, they were able to recruit six participants at each site who met the participation criteria. In consultation with the PI, the facilitator proceeded to undertake the focus group utilizing each group as a convenience sample of users.

The first focus group was held on Saturday 22 April 2017 in a meeting room dedicated for community discussions, located in one of the low-rise buildings at Site B, the first of the two remaining sites. This focus group had three male and three female participants of various ages. One participant is active on the tenant council. All participants could communicate in English, as required, and also appeared able to follow the design presentations made. However, one participant seemed less comfortable participating than the others, and another participant made multiple efforts to divert the conversation to his personal interests about the housing complex. In general, the participants had great familiarity with their own site. When asked about personal cooling strategies, they all talked about going somewhere else: air-conditioned mall, park, or city beach. With respect to their own apartment building site, they gave detailed responses to their preferences about the best location on the property for an outdoor cooling centre. They were also very sensitive to issues of safety, security and vandalism of property, as well as the role of a property manager to support tenants' needs. Participants were not discerning about the specifics of design details other than the relationship of material choices and construction to property management and maintenance issues. The group was extremely interested in a design that would enable a wide range of residents to assemble and use a cooling centre, whether all at once or at varying times of the day.

The second focus group was held on Sunday 23 April 2017 in a meeting room in the high-rise building on Site C, the second of the two remaining sites. This focus group consisted of three male and three female participants. All participants could communicate in English, as required, and also appeared able to follow the design presentations made by one of the student focus group assistants. At this site, the participants all identified strategies of personal cooling in hot weather rather than going off-site. These included finding shade, wearing light-weight and light-coloured clothing, and staying hydrated. When assessing the student designs, these residents demonstrated a good knowledge of their own site. They indicated that the large open green space to the south is used from time to time for building-wide events but also that this area is both the hottest part of the site and the least convenient for assembling residents. Participants focused on the specific location of an outdoor cooling centre. They were mindful of the potential costs of constructing a centre. Participants expressed interest in modular designs that could be erected quickly, re-arranged and / or replicated to meet a variety of needs and conditions. When asked about property management issues, vandalism and security, the participants in the focus group described their building as well-managed and therefore had few concerns about these issues. The participants in the second focus group expressed interest in the social aspects of a cooling centre and offered support to those designs that would continue to facilitate wide use and social interaction of residents beyond periods of extreme heat.

8. Project Findings and Observations

This research project required the unfolding of a series of events and activities, with specific deliverables over a limited timeframe, in order to present to TPH and potential cooling centre users prototype designs for consideration and evaluation. The requirements of the multiple players added to the complexity of the project and led to delays in implementation of aspects of the project and a delay in project completion from early 2017 to late 2018. Nonetheless, the multiplicity of stakeholders reflects both the complexity of this issue and the necessity of a multi-valent approach to the question of addressing heat mitigation through outdoor cooling in apartment neighbourhoods. The following are presented as project findings and personal observations by the PI.

8.1 The development of design prototypes for outdoor cooling centres and the value of student engagement

This research project centred on architecture and the utilization of design-as-research as a means to explore an issue in the domains of public health, urban design and city planning. The use of actual sites, with real site constraints, obliged student designers to engage in creative and collaborative problem-solving. Specific locations within the given sites, further required consideration of both typical and unique conditions that would shape design decisions and outcomes for given sites and locations. The development of design objectives and parameters, the identification of potential user types and the articulation of design issues, and their application to the design problem, challenged students to meet all aspects of these real-world constraints, conditions and obligations in their design proposals.

The short time-frame for decision making and project execution in within a team of a dozen student called for all participants to negotiate decisions in a constructive and positive way, in order to achieve the objective of a coherent and considered design prototype. Foregrounding user comfort in extreme heat, sustainable design practices and passive cooling brought students into the contemporary exigencies of design praxis.

Engaging students with practitioners in multiple disciplines, exposed them to the complexities of design in the world beyond the academy. Presenting designs in focus group settings brought students into the reality of client engagement and feedback, necessary for effecting successful, engaging and useable design outcomes. Notwithstanding these multiple factors, constraints, issues and obligations, students produced a range of prototype designs that provide a spectrum of possibilities potential for the creation of outdoor cooling centres.

The outcomes of this pilot project demonstrates the potential of design to reveal possibilities and imagine different and otherwise unimagined futures

8.2 Utilization of focus groups for design feedback and community "buy-in"

Focus groups can be an effective way to elicit user feedback on a design proposal. In these particular focus groups, engaging architecture students in the development of designs, the presentation of design outcomes in focus group settings and hearing the community members' response to discuss proposals, provide student assistants a one of a kind opportunity to experience user feedback to design work.

For reasons of time and cost, the material presented to the residents in the focus groups at the apartment sites was in the form of reduced scale reproductions of the students' presentation panels, produced at the end of CEx17. These panels contained a lot of information and were presented in a variety of formats. The lack of uniformity and the relative lack of capacity among focus group participants to engage with architectural drawings and renderings may have made it more difficult for lay users to understand design concepts. A different process, such as providing more time or making designs available prior to focus groups, or more simplified and consistent presentation, may have made it easier for residents to quickly understand and then assess each proposal.

Focus groups depend upon participation. The absence of a significant financial incentive for participation (as a result of ethics considerations) and the timing and location of focus groups (and possibly the underlying issue of community residents believing that they had been "surveyed enough" without any long-term perceived benefits or outcomes) appears to have inhibited large-number participation in the focus groups. The low number of participants in the focus groups was disappointing. Although promised, community support for the project did not materialize that resulted in low turnout. Broadening recruitment to residents outside those on the subject sites may have yielded greater numbers. Nonetheless, the convenience sample of users at the two sites provides useful feedback on design proposals.

The positive response to cooling centres in both focus groups indicated a support for outdoor cooling as a potential to address one aspect of excessive heat for apartment dwellers in Toronto's summer. Based on comments received, designing for such facilities must anticipate a wide range of users, extensive use over all times of day, and support for use of these facilities outside of periods of extreme heat.

Securing the buy-in of stakeholder groups is essential. Early in the process, the project anticipated engaging with building owners and managers, but this was not pursued, due to time constraints, changes in project personnel and limitations of resources. Sensitivity to community needs and closer work with community groups may facilitate broader participation and deepen project findings.

8.3 A complex issue takes time

As the research content and background information to this paper indicates, the issue of the impact of climate change on human health, in this case in relation to extreme heat for vulnerable populations living in highrise buildings without air-conditioning, has been developing over a long time. Evidence-based and conclusive research has provided considerable data for practitioners in health and planning.

The paucity of design-based research points to opportunities for architects, urban designers and physical planners to develop expand the field of knowledge and add their voices to those of the scientist, health promoter or policy maker. Continued investment in design-based research is called for in expanding this field of knowledge.

8.4 The power of film media to convey ideas and present issues in context

The production of a film on the impact of excessive summer heat, shown to architecture students in mid-winter, contributed positively to the CEx17. Capturing the voices and thoughts of residents in times of extreme heat (participants were filmed in the summer of 2016, Toronto's hottest summer to that time) provided viewers with insights into the issue, that otherwise would have been difficult to convey. The Image Arts graduate student filmmaker is to be commended for his insightful development of this film and his work together with the RA to capture the essence of being in an overheated city in summertime.

The successful use of this medium to communicate a set of architectural issues is evident and worth continued pursuit. The showing of this film to a wider audience – perhaps through public libraries or community recreation centres or other community facilities – may prompt a broader discussion of this issue. The impact of film – and its current capacity to be easily accessible and user-friendly – may prompt architects, urban designers and city planners to engage in this aspect of research and documentation to support the advancement of their respective disciplines and professions.

8.5 The creation of permanent record of the project and project dissemination

The publication of the CEx17 outcomes allows for a wider distribution of this material and provides opportunities for further focus group or other user feedback. The opportunity to present findings at academic conferences and public events further supports discussion of the seminal ideas of the project, feedback and knowledge transfer.

8.6 The complexity of inter-disciplinary and inter-sectoral research and the potential of positive synergies between multiple stakeholders

In the design and planning disciplines, engagement with multiple stakeholders, listening, responding and acting, are keys to successful practice.

This project originated with conversations between the PI and staff at TPH, who were interested in advancing ideas about outdoor cooling centres that were coming out of their research and stakeholder engagement on the issue of climate change. As the project developed and was implemented, others were drawn into the process, including a filmmaker, building science researchers, academics in many disciplines, health promoters, building owners and managers, landscape architects, tenant representatives and their associations, climate change experts, housing providers, municipal politicians, community leaders as well as collaborators in the Tower Renewal Partnership and others. In all this, the exigencies of time, the responsibilities and obligations of participants to their individual organizations created unforeseen challenges as well as unanticipated revelations. Nonetheless, common goals and shared aspirations for successful outcomes continued to propel the work of this project.

Addressing solutions to climate change is both time-consuming and challenging. As we all know, good things take time to develop and be realized. Inter-disciplinary and inter-sectoral work has the potential to yield fruitful outcomes for multiple benefits.

8.7 Further work

Funding from Ryerson's CURLD provided for three focus groups, of which only two took place. Additional focus groups may provide further and more extensive feedback on the issue of cooling centre designs.

Seeking a broader audience for this issue, through showing the film then effecting a focus group, may prompt greater participation and elicit a broader range of opinion.

Since the conclusion of the project, staff at TPH has changed and priorities shifted. In light of a newly appointed Medical Officer of Health and new staff appointments, a full presentation of prototype proposals, a discussion of their designs and implications for future work to support concept of heat mitigation through outdoor cooling centres is warranted.

9. Conclusions

Vulnerable populations will face greater challenges to test their resilience in the face of climate change. Concerns about climate change, urbanization, heat island effects and concomitant impacts on the quality of life and the health and well-being of residents have been on the minds of planners, health promoters, designers and municipal leaders for decades. These concerns are not new. They echo the voices of early planners and putlic health practitioners that sought to ensure the health and well-being of all citizens through investment in urban infrastructures and attention to the design for health of urban places.

The push to re-valorize Toronto's aging inner-suburb apartment neighbourhoods is a process of continual evolution. The new DAS zoning promises to promote the introduction of new uses, and the recreation of these monolithic neighbourhoods into vibrant and multi-faceted new places. The work of the Tower Renewal Partnership demonstrates leadership and vision. It is hoped the activities and findings of this pilot project may support their ongoing work.

Cooling centres and environmental awareness of design interventions promote a holistic view toward the design and renewal of buildings and their settings for the benefit of all residents, regardless of means, stage in life, backgrounds or abilities. The City of Toronto, through its agencies, boards, commissions and divisions is in a position to work collaboratively to address holistic issues of climate change, public health and resilience in order to mitigate effects of climate change, adapt to changing conditions and equitably seek solutions to address the diverse needs of Toronto residents.

Toronto's comprehensive approach to “cool planning" (the theme of the 54th ISOCARP Congress 2018), reflects a responsible and considered approach to climate-proofing vulnerable citizens in Canada's largest metropolitan region.

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For further information
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A framework to identify risk level of areas for the formation of evacuation zones during cyclones

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Abstract

India has 7516km long coastline, close to 5700km is prone to cyclones and tsunamis. Approximately 250 million people lived within 50km from the coast in the year 2010. Major cities like Mumbai, Chennai, Surat, Vadodara, Vishakhapatnam, Pondicherry etc. lie along these coasts. The rapidly growing urban population in these coastal zones and the increase in severe weather events have magnified risk in these areas. On an average, nine cyclonic and severe cyclonic storms are formed over north Indian ocean per year. Evacuation during cyclones is one of the most effective strategies to reduce human loss. The purpose of this work is to propose criterions for defining the risk level of different zones that will help in the management of phased evacuation. In this study, an approach is proposed to identify the risk level of zones in hazard impact area based on parameters related to hazard, vulnerability and exposure. The hazard frequency is considered for measuring the proneness of a block to the cyclone. The level of vulnerability is determined using social and economic parameters. The exposure component is a combination of physical susceptibility and response infrastructure of an area. The spatial pattern of these three components is mapped on the GIS platform to understand the distribution of risk. The proposed approach will help emergency managers understand about the disaster impacts and the response needed to counter them. This will also help in the efficient utilization of resources during an evacuation process and will improve the total evacuation time.

Keywords: Disasters, Evacuation zoning, Risk assessment

1. Introduction

Human developments from their nature of location, activities and other factors are susceptible to natural and man-made disasters. The impacts are generally in the form of capital and human losses. According to the Centre for Research on the Epidemiology of Disasters (CRED) global database, the hydrological, meteorological and geophysical hazards have respectively contributed to the maximum number of disasters across continents in the past decade. The increasing number of Hydro-meteorological (climatological, hydrological and meteorological) disasters are linked to climate change and its related impact. Studies have shown that developed countries generally face high capital losses while the number of victims is more in the case of developing nations. Although the capital losses in the case of developing countries appear to be small in absolute terms as compared to developed countries, they correspond to a significant percentage of their GDP.

An estimate from the global database of CRED between the year 1900 to 2009 shows that the maximum number of disaster events and deaths in India have resulted from Hydro-meteorological hazards. These hazards together contributed to 78.4% of the events and 47.94% of the deaths over the period of 1900-2009 (Government of India, 2011). India is second among the countries with a large share of the population living in low elevation coastal zones (LECZ) and among the top ten countries according to the land area under LECZ exposed to coastal hazards (McGranahan, Balk and Anderson, 2007). Based on scenarios predicted by Neumann et al. (2015), Indian coasts are likely to show rapid population growth in the future, putting it among the countries with the highest population exposed to storm surge following China. The socio-economic condition in developing country like India adds to the vulnerability of the exposed population and amplifies the disaster. This configuration of population equates to the concentration of risk and disaster affecting these areas have compounding impact with a par to the population and infrastructure density of the place. Since urbanization and economic development are unavoidable, disaster mitigation

clearly has an important role in managing the disaster. Identifying and measuring risk and vulnerabilities are essential tasks in mitigating the effect of a disaster. In pre-disaster conditions, these assessments help in communicating and managing disaster operations and after disaster these help in the reconstruction process (Joern Birkmann, 2007).
Studies related to risk mapping of threat from cyclones in India generate risk profiles of area based on hazard characteristics and physical characteristics of place. Currently, zoning for evacuation during cyclones is based on personal judgment to some degree. The risk maps are used for ordering evacuation without defining manageable zones corresponding to the risk-levels, thus leading to inefficient utilization of resources. Such ad hoc planning of evacuation hinders estimation of priorities during an evacuation and results in unsuccessful evacuation from high-risk areas.
The purpose of this study is to develop block level indicators to prioritize evacuation based on exposure, vulnerability and coping capacity of communities. Local level analysis of vulnerability has not been attempted in this study. The study looks into factors which lead to the spatial variability of the risk of communities in coastal areas. The damaging agents of the cyclonic storm are considered for identifying the type of threats they impose on settlements in the coastal region. It also focuses on the socio-economic condition which adds to the vulnerability of the exposed population and amplifies the disaster in developing countries like India, Philippines. The study is based on block level analysis of a district highly vulnerable to cyclones in the east coast of India. It attempts to identify the risk levels of different blocks in a hazard (cyclone) prone area by considering factors related to hazard, vulnerability and exposure of population in an area to map risk. The hazard component is studied using the historical data on cyclones. The difference in exposure and socio-economic vulnerability gives the variability in block level impacts. The spatial variability of risk at the block level is demonstrated on the GIS platform.
In the first section, the existing body of work on the components of risk and its dimensions like hazard, exposure, vulnerability etc. have been reviewed. It is followed by a brief explanation of concepts of these dimensions from the previous studies. The list of indicators is finalized from the existing literature. The next section of the paper gives a broad framework for the valuation of these indicators into a risk index. Furthermore, the framework is implemented in the study area and the results are discussed in the next section. The implications of the study are discussed in the final section.

2. Literature review

The familiarity of systems, that interact to produce a disaster, is necessary for any disaster-related study. The system characteristic influences the level of impact, suitable responses and recovery period in a disaster. Some study considers disaster to be the result of interaction between the following three systems: the hazard system, the geophysical system and the social system (Chakraborty, Tobin, & Montz, 2005). The hazard system looks at the characteristics of a hazard over space and time. The Geophysical and social systems are occasionally combined together to give place-based vulnerability as described in the hazard of place model (Susan L Cutter, 1996). The exposure, susceptibility and coping capacity of communities vary over space and time depending on the characteristics of their geophysical and social systems. The social system differs from location to location and is modified by changes brought over time in subsystems, like economic, political and institutional. The weaknesses in any of these systems can lead to enormous loss of human life and damage to property.

2.1 Theoretical concepts: Risk, Hazard, Exposure and Vulnerability

Risk as a theoretical concept that does not have an established universal definition. Risk of an area depends on its exposure to hazard and vulnerability of the elements exposed. It has always been estimated based on functions built on components like the probability of a hazard, vulnerability, exposure, coping capacity, resilience etc. The risk is conceptualized in many ways mainly as a function of hazard and vulnerability (ISDR,2004) with its other dimensions like elements at risk (Alexander, 2000), Deficiencies in Preparedness (Villagran,2001), exposure (Dilley et al; 2005), exposure and coping capacity (Hahn, 2003). Risk of a place increases with simultaneous increase in the severity of the hazard and increased vulnerability. Combination of these hazard and vulnerability characteristic gives distinct risk profile of a region over different points in time and spatial distribution of risk across regions. The importance of risk mapping lies in the function that it serves while estimating the level of risk and evacuee population from a zone. The higher the risk level of a zone, the more population is likely to evacuate from that zone.

For the purpose of this study the definition of risk given by UNISDR (2015) is adopted which considers the risk to be "a function of hazard, exposure and vulnerability. It is normally expressed as a probability of loss of life, injury or destroyed or damaged assets which could occur to a system, society or a community in a specific period of time".

Hazard

Hazard is a phenomenon that has the potential to cause severe adverse effects and can either result in emergency, disaster or catastrophe. Hazards involve more complex patterns of onset (instantaneous or slow), frequency (frequent and infrequent) and impact (small-scale and large scale), and can last for months, years or intermittently even for centuries.

The hazard potential is either moderated or enhanced by the place-based vulnerability i.e. interaction of biophysical and social configuration of a place (Susan L Cutter, Boruff, & Shirley, 2003). In order to quantify hazard, each magnitude is tied to a specific return period or its inverse, frequency. The magnitude-frequency relationship of a particular hazard is locality or region-specific (Thywissen, 2006).

Exposure

Exposure is one of the preconditions for a disaster other than vulnerability and hazard. Exposure is a measure of the number of physical units (Number of households, number of health and education facilities, livestock, length of road, the extent of irrigated agricultural areas, the number and capacity of electricity, water supply and sanitation systems, etc) that can get affected by a hazard. Exposure of an inhabited place is also dynamic and is based on the demographics of that place over time. Exposure is considered as a component in defining vulnerability as given by Jörn Birkmann & Wisner (2006). Exposure is defined as elements (People, property, systems, or functions) at risk of loss that are exposed to a hazard (UNISDR, 2004). While exposure is also used to include the characteristic of the hazardous process ('biophysical vulnerability) (S. Cutter, Mitchell, & Scott, 2000). Exposure has been used as an indicator of the spatiotemporal distribution of an 'element at risk', rather than 'just' an account of what is potentially harmed by natural hazards (Hollenstein, 2005). This comprehension of exposure does not imply an influence on vulnerability as such but represents an additional component of risk. The elements, which do not fall, in the region of hazard impact area, have zero exposure for that particular hazard. Measures of exposure can include the number of people or types of assets in an area. These can be combined with the specific vulnerability of the exposed elements to any particular hazard to estimate the quantitative risks associated with that hazard in the area of interest.

Vulnerability

The vulnerability is a function of exposure (who or what is at risk) and sensitivity of a system (the degree to which people and places can be harmed) (Adger, 2006; Susan L Cutter, 1996) along with the coping capacity of the affected entities (Joern Birkmann, 2007).

The complexity of vulnerability is not only given by its multiple dimensions but also by the fact that it is site-specific and that its parameters change with geographic scale. The parameters that determine vulnerability are different on the household, community, and country level. Vulnerability is a dynamic process, but for measurement, purposes are often viewed as static phenomena (Susan L. Cutter et al., 2008). While Kelman (2007) suggests that for a more comprehensive understanding and analysis of vulnerability one should also consider that vulnerability is qualitative, subjective, proportional and contextual. Although the theory is important in defining and understanding the concepts clearly, the data-driven approach is

mostly used in making policy decisions. The need for identifying and assessing vulnerability has been emphasized in international declarations (The Hyogo framework for action; Jörn Birkmann & Wisner, 2006). It can be operationally defined by providing a method for mapping theoretical concepts to operational concepts. The process of providing operational definition to vulnerability concept is generally called as a methodology for vulnerability assessment (Hinkel, 2011).
The UNISDR (2009) terminology for vulnerability i.e. "the characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard" are followed in this study.

Researchers have considered various criteria's for establishing evacuation zones. A notable work which attempted to establish criteria and procedure for determining the delineated hurricane evacuation zone was done by C. Wilmot & Meduri (2005). Few works following this have been carried out for delineating evacuation zones by considering only the hazard characteristics and zone formation criteria, but they did not cover the social and economic dimensions which generate varying evacuation demand during disasters (Hsu and Peeta,2014; Lim et al.2016). Studies defining a method based on social vulnerability to identify the population that would need evacuation during a disaster are fewer in number. Chakraborty et al. (2005) provide one such method for calculating evacuation assistance need index by combining the geophysical risk and social vulnerability indices. This study attempts to assess the differential risk faced by blocks during the tropical cyclone and thereby defining the appropriate evacuation zones.

2.2 Indicators for measuring spatial variability of risk for evacuation need assistance

Disaster vulnerability is socially constructed i.e. it arises out of the social and economic circumstances of everyday living. Morrow (1999) identifies that certain categories of people such as the poor, the elderly, women-headed households and recent residents, are at greater risk throughout the disaster response process. Identifying the concentration of these vulnerable communities can be useful for effective response during disasters(Morrow, 1999).
A list of indicators for the estimation of geophysical, social vulnerability and economic vulnerability have been identified from the literature review and are discussed under following components
The initial list of parameters identified for measuring vulnerability is categorized into five components: social, economic, housing, physical and response capacity. Studies have shown that the young children and the old people have higher risk of death than the rest of the population (equal among genders). People other than children and old, it is observed that the female population is at higher risk of mortality than men. One of the key risk factors found for high mortality of women was their inability to swim. The proximity to the sea is also found to be a very significant factor for contribution to the risk of mortality People living with mental or physical disabilities are less able to respond effectively to disasters and require additional assistance in preparing for and recovering from disasters (McGuire et al. 2007). Emergency managers need to target areas with high concentrations of disabled people, particularly in group-living quarters, for early evacuation and other preparatory measures (Morrow 2008)
Social inequities and limited availability and unequal distribution of resources make people vulnerable to disasters. Some social aspects of vulnerability are beyond quantification (Jörn Birkmann & Wisner, 2006).

The residential units with semi-permanent or temporary construction type are highly vulnerable. Temporary houses in coastal areas lying outside the evacuation zones are also vulnerable to events like overturning in strong wind, windblown objects and falling trees can penetrate their exteriors (Baker, 1991). The response infrastructure includes parameters like proximity to medical services, proximity to transport infrastructure, the density of road network, coastal defense structures (natural and artificial) and availability of cyclone shelter, unavailability of these response systems can lead to loss of life (Cutter, Boruff, & Shirley, 2003).

	Parameters / factors	Indicators	Description	Source
Social / Demographic	**Population Density**	Persons per sq.km	Population density is measured in a number of persons living in per square kilometre of a zone. Higher the population density of a zone, more traffic will be generated from that zone.	Turner et al 2003a; Chandra Sekhar Bahinipati 2014;S Maiti,2015;M mahapatra 2017
	Female population	Percentage of Female Population	Women are considered more vulnerable than men at the time of disasters and during the recovery period	Cutter, Boruff, & Shirley, 2003
	Children	Percentage of children(<6 years)	Extremes of the age spectrum affect the movement out of harm's way, Need more care during the evacuation process	Cutter, Boruff, & Shirley, 2003; Mazumdar & Paul, 2016
	Old People	Percentage of Old People(>60years)		
	Special Needs Population (Institutional HH+ Houseless)	Percentage of Special Needs Population	Special needs populations will require mobility assistance for evacuation.	Chakraborty et al., 2005 , Mazumdar & Paul, 2016
	Demographic Pressure	Population Growth Rate (decadal growth rate)	Rapid population growth would create demand for more shelters, social services network and often results in unpredictable demand of relief supplies during disasters	Cardona, IDEA (2005), Bollin and Hidajat, 2006
	Disabled	Percentage of disabled Population	They need special care as they face constraints in terms of information gathering and mobility during the evacuation	Cutter, Boruff, & Shirley, 2003;Mazumdar & Paul, 2016
	Literacy rate	Percentage of illiterate Population	Literacy level influences the ability to understand warning and information related to evacuation measures.	Cutter, Boruff, & Shirley, 2003;Mazumdar & Paul, 2016
	Poverty Level	Percentage of people below the poverty level	Households below the poverty line are more vulnerable	Bollin and Hidajat, 2006
Economic / Access to resources	**Vehicle Ownership**	Percentage of Households having a vehicle	Vehicles help in mobilization during evacuation and recovery. In absence of any vehicle, families may have to travel by foot or public transport to reach the nearest shelter	Mazumdar & Paul, 2016, Devendra K. Yadav and Akhilesh Barve (2017)
	Information devices	Percentage of houses with television, radio, mobile phone	These devices act as a source of information on hazard conditions, warnings, evacuation notice and guidance.	Joerin et al. 2012;Mazumdar & Paul, 2016
Location / Physical	**Elevation**	Percentage of low lying area	Low lying areas are susceptible to inundation	R. Prerna et.al 2014, Arun Kumar 2012, S das 2012, Jana 2016, Parthasarathy and natesan 2015
	Land use/Land cover	Percentage of built-up area in a zone	Type of activity in a zone will give the size of the population present in a zone at a particular time.	V Poompavai , 2013,R. Prerna et.al 2014
	Proximity to cyclone track	Distance from cyclone track	The distance from the path of the cyclone is an indicator of the level of risk. More the distance from the centre of the cyclone the safer is a zone.	V Poompavai, 2013
	Proximity to landfall	Distance from landfall (Surge)	The distance from landfall decides the impact of the surge in an area. If the zones are away from the landfall point they will receive relatively less damage	V Poompavai, 2013
	Proximity to sea/coast	Distance from coast	The effect of damaging agents on houses and assets decreases with increasing distances from the coast	V Poompavai, 2013

	Proximity to the major river	Distance from a major river	Major rivers have large carrying capacity, carry away surge water and help in reducing the surge velocity to flooding. Nearness to the major river should reduce death	S das, 2012
	Proximity to the minor river	Distance from a minor river	Minor rivers get inflated and bring in more water to interior areas during the storm surge and can cause more death in nearby areas	S das, 2012
	Hazardous facilities (factories, power plants)	Distance from a hazardous facility	Households living near hazardous facility are vulnerable to the damage from the breakdown of these facilities	
	Distribution (Built Density)	Number of Households per sq.km of a zone	Evacuation demand depends on the number of HH in an area.	Chakraborty et al. 2005
	Critical road connections	No of bridges and culverts	The failure of these elements can lead to a loss in evacuation route for the people in risk zones and will increase the pressure of re-routing and management on managers	
Housing Condition	**Construction Material or type of Dwelling**	Percentage of Semi Pucca Houses	Pucca house can resist high-speed winds during cyclones while thatched/mud houses are less resilient to cyclones	Devendra K. Yadav and Akhilesh Barve (2017)
		Percentage of Kutcha Houses		Cutter, Boruff, & Shirley, 2003; Mazumdar & Paul, 2016
	The condition of the dwelling unit	Percentage of dilapidated units	The condition of a structure decides its resilience to disaster. Weak structure are prone to damage from cyclones	Cutter, Boruff, & Shirley, 2003
Response capacity	**Medical Services**	Number of Healthcare Centres	The lack of proximity to medical services effects immediate relief and longer-term recovery from disasters. Delay in medical attention may lead to an increase in fatalities	Cutter, Boruff, & Shirley, 2003, Devendra K. Yadav and Akhilesh Barve (2017)
	Transport Infrastructure	Distance to a paved road	Inadequate transportation infrastructure leads to difficulties in access to evacuation route and relief supply resources	Cutter, Boruff, & Shirley, 2003, D K. Yadav and A Barve (2017)
	Road Network	Road density per sq.km	The road density shows the level of accessibility to the population of that area. Higher road density provides more alternatives to people during the evacuation.	Upasna Sharma and Anand Patwardhan(2008)
	Coastal defense structures (natural and artificial)	Length or density of coastal defense structures (Mangrove(sq.km), Sand Dunes(km), length of rocky coast(km))	Coastal defense structure reduces the impact of the cyclone by acting as barriers against strong winds, flood water and decreasing the energy of storm surge when they pass through the defenses.	Cutter 2008,M Mahapatra et.al 2017
	Cyclone shelters	Number of cyclone shelters	Availability of shelters in the local area will reduce the travel distance and distributed demand	Devendra K. Yadav and Akhilesh Barve (2017)

3. Study Area

India has 7,516 km long coastline, close to 5,700 km is prone to cyclones and tsunamis. Approximately 250 million people lived along the coastline in India in the year 2010. The Indian coast is subject to severe weather events, such as cyclones and super-cyclones at an average of nine cyclones per year (ICZMP 2010).

3.1 *Tropical cyclones over the Indian Ocean*

Cyclones form over seven basins worldwide out of which the North Indian Ocean(NIO) basin provides favourable conditions for cyclone landfall over India. The NIO basin is divided into two areas: The Bay of Bengal and The Arabian sea and they receive cyclones averagely in the ratio of 4:1. The breeding season for the storm over NIO are generally pre and post-monsoon period i.e. periods from April to May and October to December are the months during which most of the cyclonic storms occur in the Bay of Bengal(BoB) and Arabian Sea(AS) as shown in Figure 1.

The probability of Genesis and intensification is less in the Arabian sea as compared to the Bay of Bengal due to the relative difference in their Sea surface temperature(SST). The sea surface temperature of AS is about 1-2ºC lower than that of BoB.

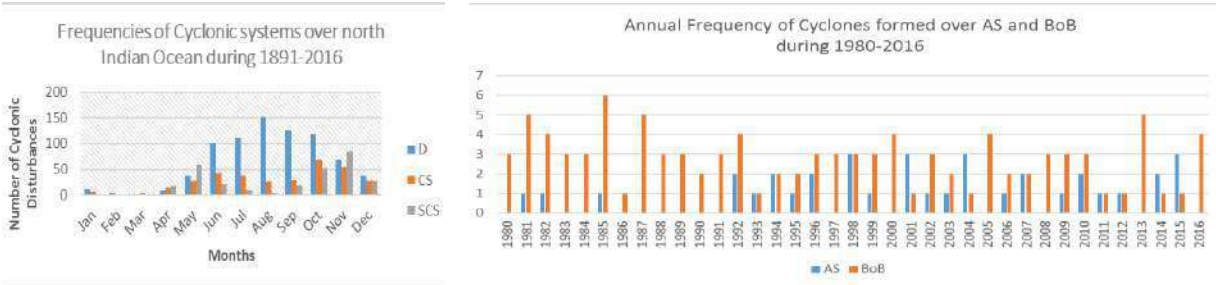

Figure 1: *Frequency of cyclones formed over NIO during 1980-2016*

The effect of cyclone is amplified in the north Indian Ocean (NIO) due to shallow depth of the Bay of Bengal and low flat coastal terrain which produces larger storm surges and takes heavy toll of life (India Meteorological Department, 2013) and the concavity of the bay and its estuaries produce further amplification (Dube et al., 1982).

The study area selected i.e East Medinipur district, it came into existence after bifurcation of erstwhile Midnapur on and from 1.1.2002. The district is located in the southern part of West Bengal adjoining Bay of Bengal. According to the 2011 census, East Medinipur district has a population of 5,094,238 and ranks 20th out of 640 districts in India. The decadal growth rate of the population of the district is 15.36% which is higher when compared to the decadal growth rate of the population of the state i.e.13.9 %.

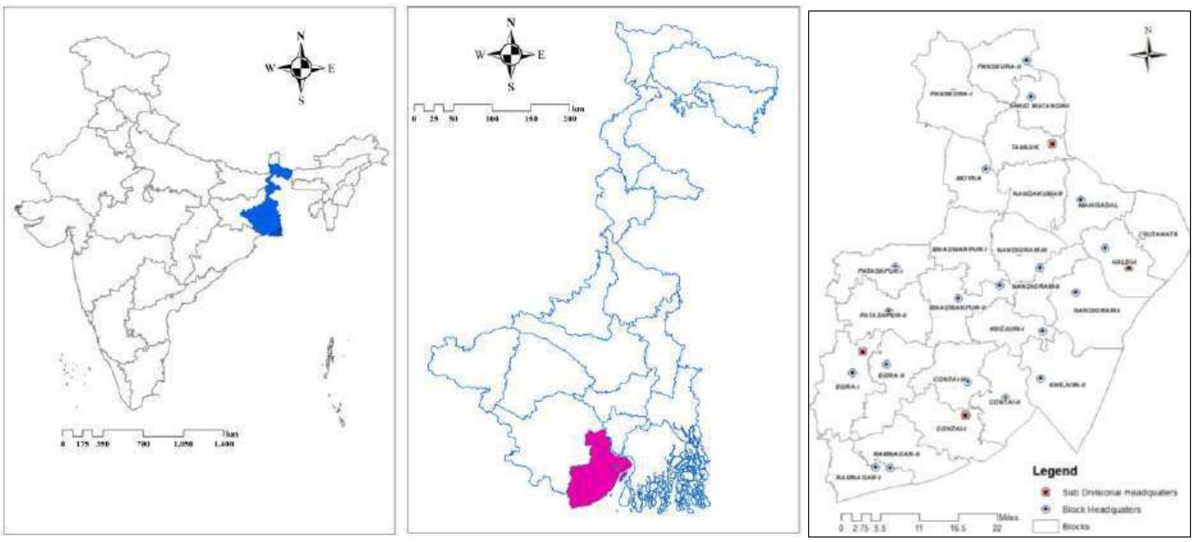

Figure 2: *Study Area*

East-Midnapur district is highly susceptible to floods and cyclones and it falls under 'Very High Damage Risk Zone' according to the vulnerability atlas of India. The major portion of the study area falls under low elevation coastal zone (LECZ). The probable maximum storm surge height in the study area is 12m according to the vulnerability atlas prepared by the Building Materials and Technology Promotion Council (BMPTC), India. The elevation map (see figure 3) prepared using digital elevation model (DEM) image obtained from USGS shows that the Major part of the district falls in low elevation coastal zone (LECZ). In the past, this region has experienced a number of storms which were very destructive and have created tremendous damage. In Last 100 years, 34 Cyclones have occurred over this coast and three of them (1942, 1974 &1976) is in Severe Cyclones list.

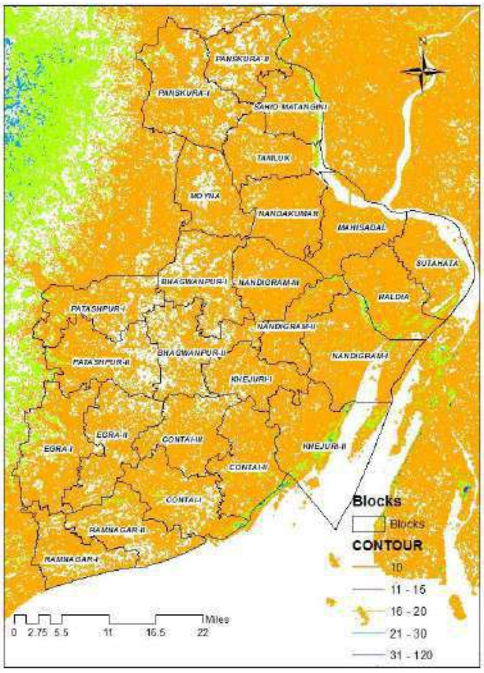

Figure 3: Elevation profile of East Midnapur

3.2 *Data collection*

The data is collected from secondary sources, mainly the source of data is the census of India, 2011, district census handbook district disaster management reports and flood reports. The data used to describe the current vulnerability of Community Development blocks of East Medinipur district include: *Hazard data*: frequency of cyclones; *Demographic data*: Female Population, Children below 6years, decadal growth rate; *Economic data*: Households owning mobile phones, motorized vehicles; *Housing data*: Number of Temporary and Semi-permanent households; *Physical Location Data:* Proximity to coastline, Flood Prone Area; *Response capacity data*: Population served by medical facilities, transport and communication and pucca roads.

3.3 *Methodology*

Disaster management in India had undergone a first paradigm shift from 'response and relief'' approach to 'prevention, mitigation and preparedness' centric approach. Efforts through 'hazard-vulnerability and environment' centric approach focused on disaster risk reduction strategies in various sectors is seen as a second paradigm shift for a holistic understanding of the vulnerability of communities to hazards.

In India, studies on vulnerability assessment of coastal area have mostly focused on hazard and physical characteristics of the area with some recent analyses accounting for socio-economic characteristics (Das, 2012; Bahinipati, 2014; Maiti et al., 2015; Mazumdar & Paul, 2016; Yadav & Barve, 2017). Although most of these studies compared vulnerability at the district level, few measured it at the block (Yadav & Barve, 2017) and the village level (Das, 2012). The method employed in this study integrates hazard characteristics with the vulnerability characteristics and geophysical(exposure) characteristics to form risk indices at the block level.

Indicators are formed based on a function which maps the theoretical concepts to an operational or observable variable. Based on the number of variables needed to make concepts operational, there can be scalar, composite and vector-valued indicators. However, there are challenges in making theoretical concepts operational like the vague definition of theoretical concepts and how they are combined. The broad steps in the development of vulnerability indicators are to define what is to be indicated, selection of indicating variables and aggregation of the indicating variables(Hinkel, 2011).

Index based study to relate the mortality has been done in the past using vulnerability indicators in climate change and Disaster risk reduction domains (Brooks, Adger, & Kelly, 2005; Chakraborty, Tobin, & Montz, 2005). The index method has been used in several studies in Indian context to assess vulnerability in case of tropical cyclones (Dube, Mazumder, & Das, 2006; Bahinipati, 2014; Yadav & Barve, 2017). Use of Indicators for measuring vulnerability at the local scales has been found appropriate for identifying vulnerable people, communities and regions (Hinkel, 2011).

The hazard component in determining risk considers frequency and probability of hazard in its measure. A set of indicators of exposure, vulnerability and response capacity to adapt to a disaster is derived from the literature using a deductive approach. Indicators used to assess vulnerability in case of the study area is based on ease in availing data from the census or other secondary sources. The effect of an indicator on the index value is important to calculate all the indices on the same scale. For example, indicators taking into account the age of children below 6 years and of the old person above 60 years, the higher number of old person and children will indicate high vulnerability.

3.4 *Index Calculation*

The study assigns equal weight to each indicator since the weight of indicators can change for the different study area(Hinkel, 2011). The indicators considered for analysis follow different dimension, in order to use them in the same function, the data was normalized(Dube, Mazumder and Das, 2006). The indicators or variables have been brought to an increasing scale (0 to 1) i.e the higher value of the variable corresponds to the high level of risk. Depending on the relation of the indicator to the risk index the data was converted into decreasing or increasing form.

$$\textit{Index}\ (X_I) = \frac{X - X_{min}}{X_{max} - X_{min}}$$

X_i = the Index value of ith Block, X is the value of the indicator for ith Block

Following are the indicating variables used for the purpose of this study:

Components	***Parameters***	***Indicator Data***	***Effect***
Exposure	Flood Prone Area	Indicates Low lying Area (1-yes, 0-No)	Increases
	Proximity to sea/coast	Distance from coast	Decreases
Population Structure	Population Density	Persons per sq.km	Increases
	Female population	Percentage of Female Population	Increases
	Children population	Percentage of children(<6 years)	Increases
	Demographic Pressure	Population Growth Rate (decadal growth rate of the population)	Increases
Access to Resources	Vehicle Ownership	Percentage of Households having a motorized vehicle	Decreases
	Information devices	Percentage of houses with mobile phones	Decreases
Housing Condition	Building type	Percentage of Semi Pucca Houses	Increases
		Percentage of Kutcha Houses	Increases
Response Infrastructure	Medical Services	Percentage of population with access to Healthcare	Decreases
	Transportation service	Percentage of population with access to Transportation Services	Decreases
	Transport Infrastructure	Percentage of population with access to paved roads	Decreases

Rather than simply summing the standardized variables, values were averaged yielding aggregate index (Exposure and Vulnerability) normalized between zero and one.

$$F = (X_1+X_2.... +X_n)/n$$

The risk Index is calculated based on the following function:

Risk = Hazard x Exposure x Vulnerability

This study considers the frequency of cyclones in each block over the past for estimating the level of impact faced by a community from a hazard.

Hazard incidence probability of the Blocks

The Probability Density Function for describing cyclone arrivals during a specified period follows the Poisson's Distribution (Dube, Mazumder and Das, 2006).

$$F(\mathbf{x}) = \frac{1}{ARI} * e^{-X/ARI})$$

Intervals between successive arrivals follow Negative Exponential Distribution The distribution of time 'x' between successive arrivals of a random event is given by:

$$\mathbf{AEP} = = (1- e^{-1/ARI})$$

***ARI** = Annual Reoccurrence interval, **AEP**= Annual Exceedance Probability*

Hazard Analysis

The cyclones considered for hazard analysis combine both severe cyclonic storm and cyclonic storm data from 1890-2013.

Block	ARI	AEP	Block	ARI	AEP
Panskura	61.5	1.61	Haldia	0	0.00
olaghat	61.5	1.61	Nandigram - I	20.5	4.76
Tamluk	30.75	3.20	Nandigram - II	20.5	4.76
Sahid Matangini	0	0.00	Khejuri - I	61.50	1.61
Nanda Kumar	24.6	3.98	Khejuri - II	30.75	3.20
Mahisadal	41	2.41	Contai - I	17.57	5.53
Moyna	123	0.81	Deshopran	15.38	6.30
Potashpur - I	13.67	7.06	Contai - III	13.67	7.06
Potashpur - II	11.18	8.55	Egra - I	13.67	7.06
Bhagawanpur - II	20.50	4.76	Egra - II	10.25	9.30
Bhagawanpur - I	30.75	3.20	Ramnagar - I	15.38	6.30
Chandipur	30.75	3.20	Ramnagar - II	11.18	8.55
Sutahata	24.6	3.98			

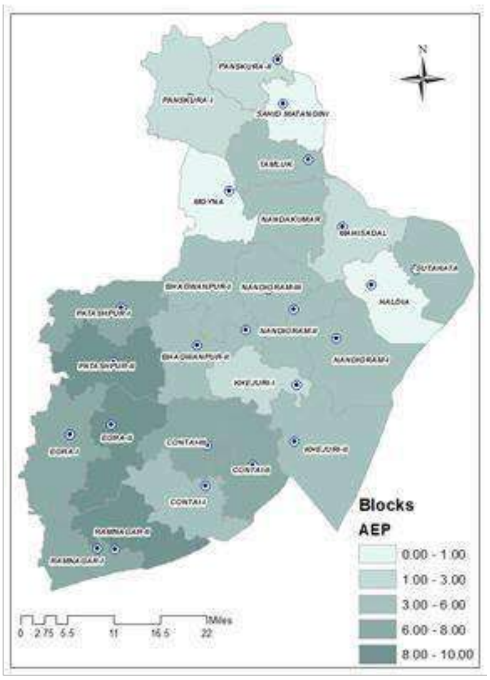

Figure 4: Annual Exceedance Probability of Cyclones

4. Results

The risk index showed that the blocks which had higher number of cyclones passing through them, thus more Annual Exceedance Probability (AEP), face high level of risk. The result shows that the blocks Ramnagar-II, Egra-II and Potashpur-II are at very high risk. Ramnagar-II and Egra-II are at high risk largely due to their exposure while Potashpur-II block ranks second highest in vulnerability. The blocks under high risk are Contai – I, Potashpur – I, Deshopran, Egra – I and Contai – III. Haldia and Shahid Matangini ranked lowest as no cyclones have crossed over these blocks in the past. They had the least probability of receiving a tropical cyclones and are relatively protected from danger.

As risk index mainly presents those blocks as high-risk areas which have had a high occurrence of cyclones in past, thus it is important to compare the exposure and vulnerability of population in a block while preparing for cyclones and for identifying a population that needs to be evacuated in a future hazard. The impact highly depends on the level of exposure and the vulnerability of population exposed.

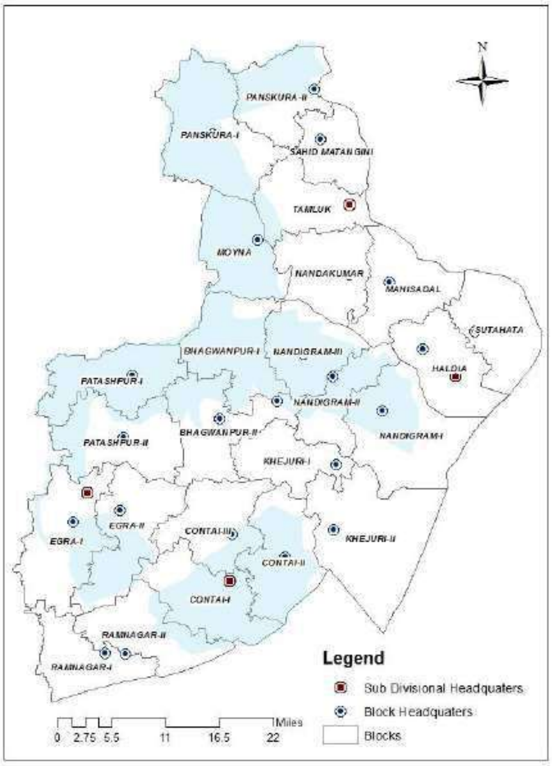

Figure 5: Flood-Prone Areas

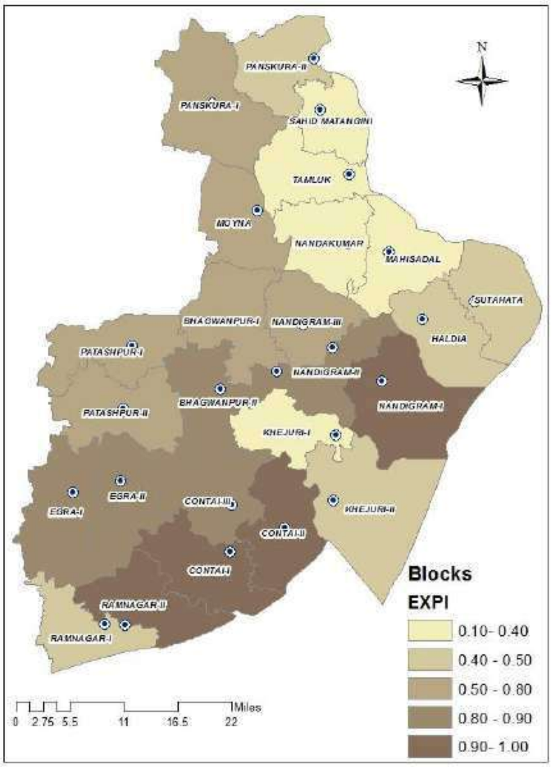

Figure 6: Exposure Index

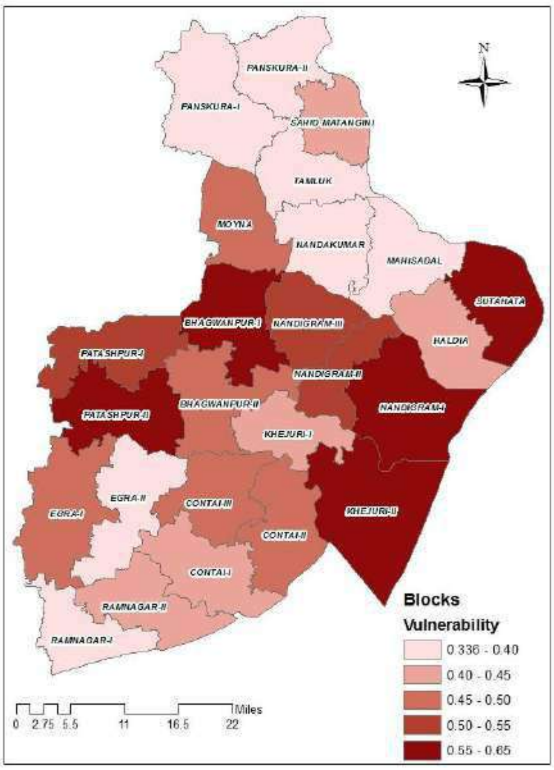

Figure 7: Vulnerability Index

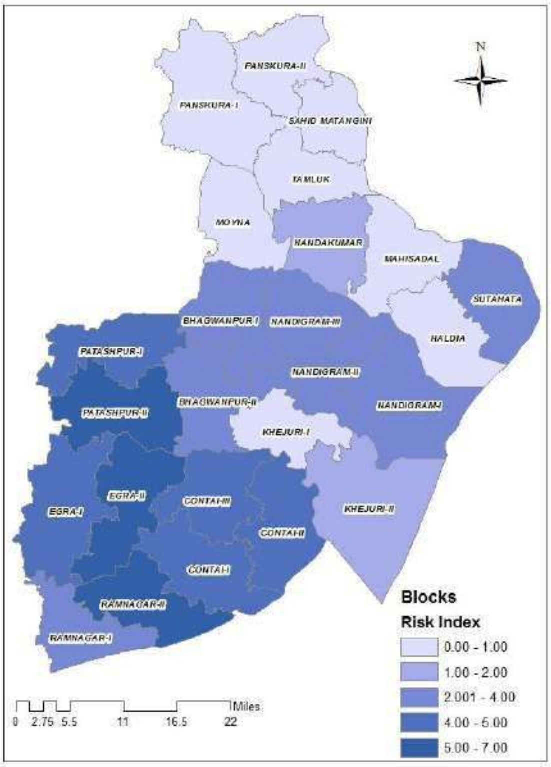

Figure 8: Risk Index

This analysis indicates that reduction in mortality can be achieved by addressing factors of the vulnerability of communities in highly exposed areas. The more complex processes that lead to high mortality can be better understood by examining the local level risks using given indicators.

5. Conclusion

The selected indicators cover dimensions like exposure, vulnerability and response capacities to identify the relative risk of development blocks. It will help us understand how the risks are distributed over geographical space and how it changes over time. In long run, it will help us identify the important factors which are responsible for these changes. These factors could be a good measure to check the effectiveness of the implementation of programs and guiding policies. The level of vulnerability of different blocks will help in decision making in prioritizing the allocation of capital and other resources for pre and post-disaster activities.

In case of evacuation during cyclones, origin zones are concentrated in threatened coastal areas and destination zones are spread inland to neighbouring areas and states. The risk identification can probably indicate the area that is risk-free and could accommodate evacuees from risk areas. The method would help in determining evacuation zones and their risk levels for prioritizing block-wise evacuation. The organization of evacuation according to these risk levels will lead to efficient utilization of resources, personnel and improved traffic management.

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Mitigating the Effects of Climate Change in Strategic Development: the Ibadan City Masterplan

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Abstract

Nigeria's third largest city, Ibadan, is today a bustling centre focused on commerce and markets. Estimated at 6 million in 2017, the city is projected to grow to a population of over 13 million by 2036.

Sprawling urbanisation has resulted in deforestation on the city's outskirts. The resulting decrease in soil permeability has caused an increased rate of water runoff from rainfall, which has affected the city's drainage channels and river system. Coupled with the indiscriminate disposal of waste into the city's river system, bridges and culverts that have been built at too small a capacity, and development of infrastructure that has not kept up with the pace of the city's growth, the result is a city that suffers from regular flooding of increasing intensity.

Upon the initiative of the Oyo State government, the World Bank was brought onboard to support the process to find solutions to resolve the issue of flooding. The outcome was the commissioning of three masterplans to address the issues: a solid waste masterplan, a drainage masterplan, and a land use city masterplan.

Completing the Ibadan City Masterplan in 2018 (the land use city masterplan), Consultant Dar Al-Handasah worked closely with the Oyo State Government throughout the project's progress. An in-depth stakeholder engagement process brought support and knowledge from the local communities, with all responses and comments taken on board in developing the masterplan.

A detailed diagnostic of Ibadan's context was undertaken to form the evidence-base to developing the strategy. The masterplan sets out a policy framework for implementation over the next 20 years. It identifies the direction of growth to accommodate the city's population increase, supported by an adequate provision of infrastructure. It proposes detailed responses on how to address the impact of flooding, including demarcating and protecting flood-prone land from encroachment.

The masterplan is the first city-wide strategic planning framework for Ibadan. If the city is to avoid future potential catastrophic floods and other impacts of a changing climate, it is critical that the masterplan is implemented and delivered.

1 The Rapid Rise of Ibadan

Ibadan (along with Kano and Kumasi (Ghana)) is one of the few major pre-colonial sub-Saharan cities to retain its importance as an urban centre today.

The earliest recording of a settlement in present day Ibadan is an Egba village, which from the 1820s grew because of displaced people from the wider region escaping internal conflict within the Yoruba Empire and exogenous aggression. The location close to the edge of the savannah had the advantage of hills for protection plentiful access to water and good quality agricultural land.

The population later swelled with the arrival of immigrants across what is now western Nigeria. Ibadan grew extensively into a popular hub of commerce and also dominated the political and military scene in Yoruba, filling the vacuum created by the fallen Oyo Empire. People displaced by war saw Ibadan as a sanctuary because of its location, economy and military power.

In 1893, the area became a British Protectorate, by which time the population had grown to 120,000. The city formed the centre for colonial administration of the Western Region, which reinforced the position of the city as a focal point for trade, commerce and fashion. Post-independence Ibadan retained its administrative and political importance as the capital of the Western Region and today as the capital of Oyo state.

Ibadan is defined as the area that includes 11 Local Government Areas, with a land area that covers 3,145.97sqkm. As of 2017, 546sqkm comprises the Ibadan built up area (17.4%) with a further 164.78sqkm of built development within the rural part of Ibadan. The undeveloped area (agricultural land, forests, and open space) totals 2,435sqkm (74.5%).

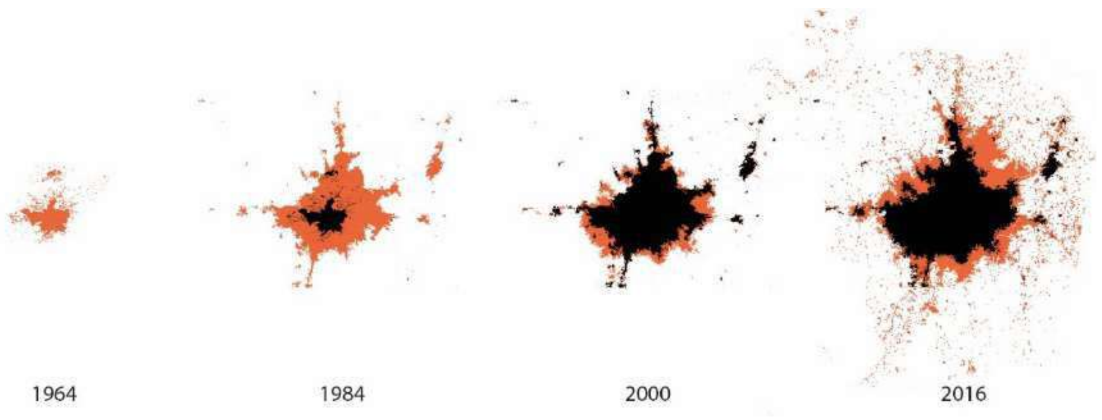

Figure 1.1 Growth stages for Ibadan 1964-2016

Population and spatial growth have been rapid, with a noticeable slowdown during the years of the IMF-World Bank Structural Adjustment Programme in the 1970s, although it has since grown again and now reaches 3.5% per annum.

Expansion of the built-up area has been driven by an increase in population caused by both in-migration (1.3% per annum) and rapid natural population growth (2.2% per annum) resulting from declining death rates and consistently high birth rates.

Ibadan is a rapidly growing city that continues to expand in all directions. In the absence of any strategic plan or official development management strategy for the city, its expansion is taking place in an ad-hoc organic manner.

2 The Effects of Climate Change

Ibadan has a distinctive wet season which starts around the third week of March and ends around mid-October. The rainiest month is June when the average rainfall reaches about 200.6 mm. Average rainfall reaches around 1,340 mm annually.

A major impact of sprawl is loss of forest cover, which means that when it rains, the ability for the water to seep naturally into the ground is decreased. Vegetated cover has better retention abilities.

Decreased forest cover also means there is less time for moisture to be absorbed into the atmosphere, which creates an imbalance of CO_2.

The greater the expanse of urban areas, the greater the volumes of water build up on the ground. Greater volumes subsequently flow at an increased velocity. The drainage system that has developed naturally over time is inevitably affected: greater volumes of water flowing at faster rates have an impact on the profile of the rivers, which erode and therefore change the landscape. This has inevitable consequences as the volumes of water affect the existing built-up areas of the city further downstream. There is increasing evidence of this happening as damage to historic buildings are testament to the severity of flooding impacts.

Figure 2.1 Historic buildings are increasingly at risk of erosion from neighbouring river corridors

It is predicted that the impact of climate change will increase by 1 to 2 days the levels by which extreme rainfall is experienced over most of Nigeria for B1 (low) and A2 (high) emissions scenarios by middle (2046-2065) and late (2081-2100) century. Sudden flood events are therefore increasingly likely to negatively affect Ibadan.

It is worth noting that the river basins that cross the city lie largely within the boundaries of the city region, and the impact of flooding is therefore a localised issue, that can and must also be addressed locally. The topography of the city means that water drains naturally from the higher ground in the north, with water flowing south through the built-up areas of the city. Downpours regularly result in sudden swelling of the rivers, which the majority of the time only contain small flow levels.

The incidence of flooding in Ibadan is not new. Floods have been recorded over many decades. However, as the city grows, and as the pressures on the city increase, the volumes and intensity of the water inevitably has impacts that are more widely felt.

Adding further pressures to the established drainage channels is encroachment of informal settlements in the drainage channels and flood plains. This further reduces the space available for drainage, which increases the potential for flooding.

Figure 2.2 The build-up of waste in the river system is an issue in Ibadan

Another critical issue is the indiscriminate disposal of waste across the city. Rivers are traditionally used to dispose of waste as the water pushes it downstream. However, in a city of over 6 million, the impacts of these actions are exacerbated. To date, the refuse collection services have been unable to effectively remedy the issue, and the three existing dumpsites in the city have reached capacity. The character of the city’s traditional Core Areas, with their densely packed buildings, means that many areas are also difficult to access.

The impact of waste disposal in the drainage system is it accumulates and ends up blocking the channels: the bridges and culverts are not built to the capacity needs of the rivers and streams, with waste build-up frequently leading to blockage.

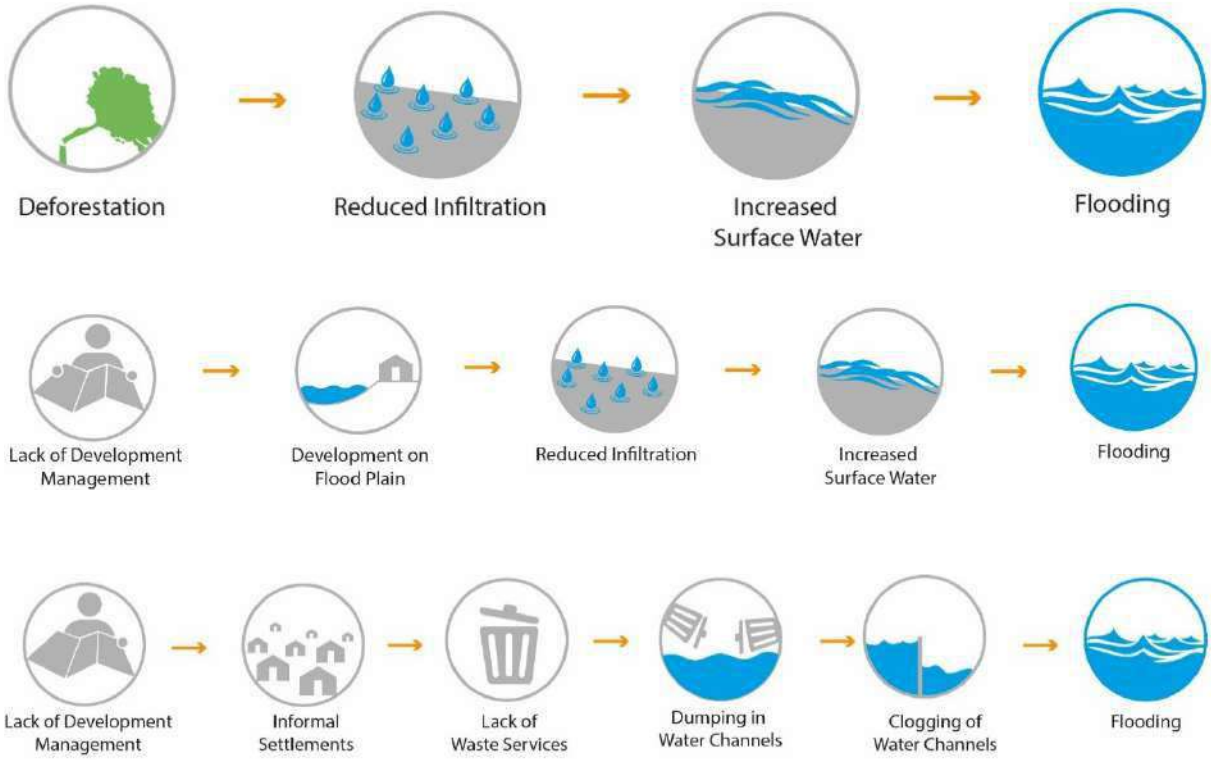

Figure 2.3 The causes of flooding in Ibadan

The absence of a formal spatial planning framework for the city has numerous impacts, together which result in urban stresses. Figure 2.4 illustrates how these factors are interconnected and how many impacts have ongoing repercussions. The longer these issues are left, the more difficult and complex it gets to eventually resolve them.

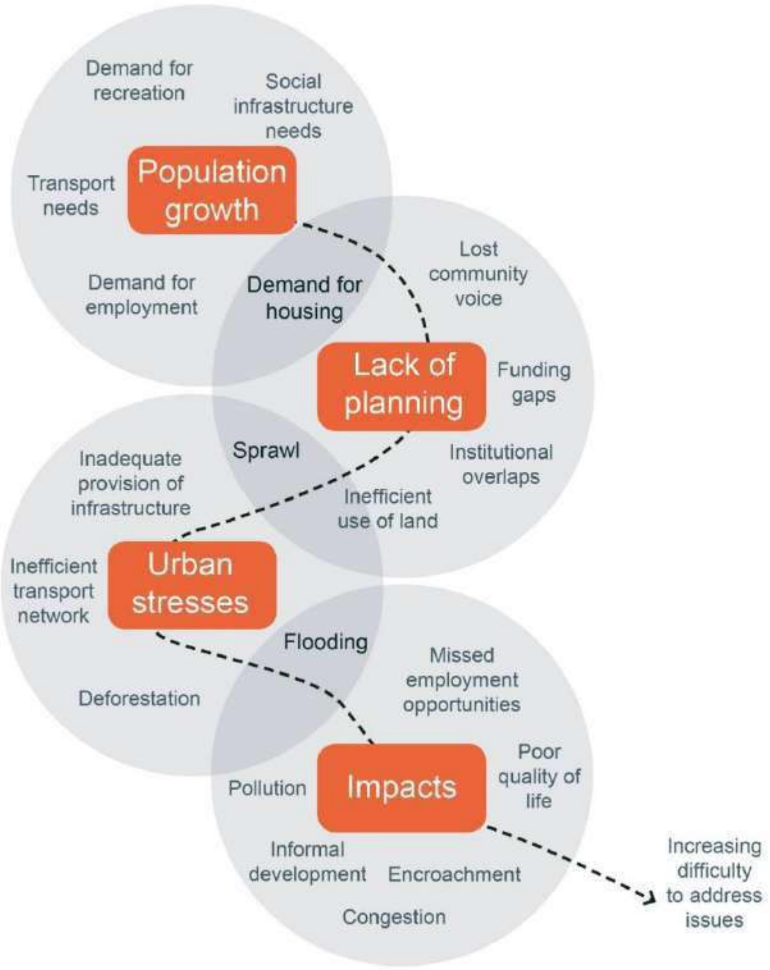

Figure 2.4 The causes of flooding in Ibadan

3 Addressing the Impacts

On the 26th August 2011 a rainfall downpour of 187.5 mm occurred in about 4-5 hours and resulted in the overflow of the Eleyele reservoir. The event resulted in the death of more than 120 people and inflicted serious damage to infrastructure (many bridges collapsed, roads were washed away, and substantial property was damaged).

This event was the trigger to the decision that something had to be done to address the issue. Assistance was sought from the World Bank to identify solutions to the problems. The first result was the establishment of the Ibadan Urban Flood Management Project (IUFMP), a task force on flood prevention and management "*to improve the capacity of Oyo State to effectively manage flood risk in the city of Ibadan*". The outcome was a report containing short, medium and long term recommendations to the state government, which identified the need to prepare three masterplans for the city:

- Ibadan City Masterplan (this project)
- Solid Waste Masterplan
- Drainage Masterplan

The Ibadan City Masterplan is the first strategic city-wide masterplan for Ibadan: it provides a policy-based framework that guides the future direction of growth of the city. These policies give the Government a set of actions that ensure they put forward a coordinated strategy for the implementation of the masterplan.

The Ibadan City Masterplan incorporates policy to address:

- Drainage
- Land use planning
- Tranportation, including walking, cycling mass transit, public transport, roads and rail
- Residential density distribution
- Distribution of social infrastructure
- Culture, heritage and tourism
- Economic development
- Utility infrastructure

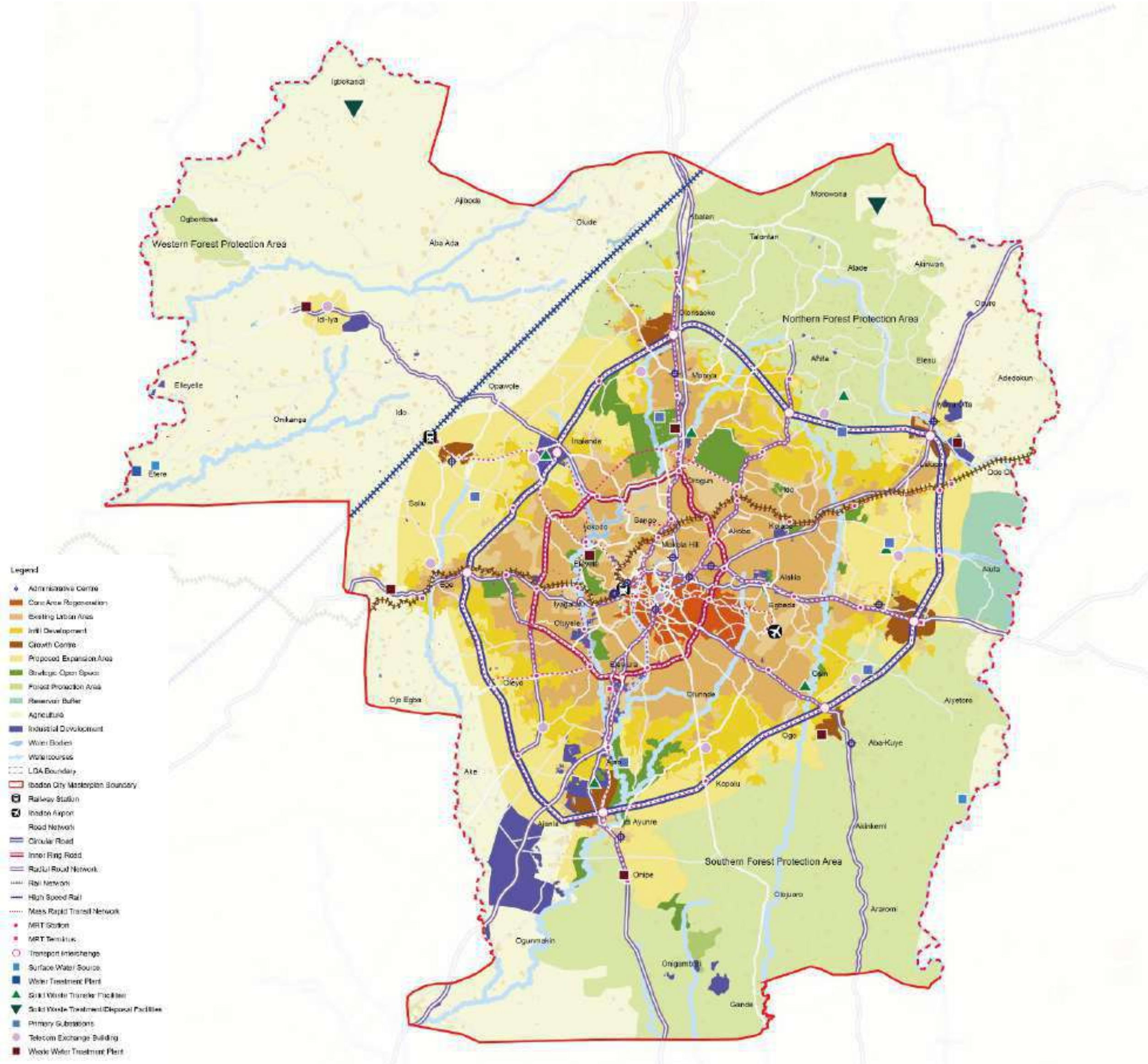

Figure 3.1 The Ibadan City Masterplan Key Diagram

The lack of a strategic plan for the city has been recognised as an impediment to the managed and safe growth of Ibadan. In effect, the masterplan provides a strategy to ensure Ibadan is resilient and prepared against future shocks.

Once completed, the three masterplans will provide a comprehensive set of plans to addressing the needs of the city over the next 20 years.

4 Finding Solutions

Typical of work undertaken in a context such as that of Nigeria, there was initially very little relevant or up to date data that could be relied upon. A mapping base therefore had to be initiated from basics, supported by gathering data, but also through field surveys. With the aid of GIS, a comprehensive mapping base covering the whole of the Ibadan area was created.

One of the first assessments was to identify across all of Ibadan's urban areas the extent of the areas prone to flooding. Every river and stream was surveyed and assessed. Each was classified over its potential flooding impact, to which standard set-backs were recommended, as shown in Table 4.1.

Table 4.1 Proposed Setbacks for Rivers and Streams

	DRAINAGE CATEGORY AND CATCHMENT AREA COVERAGE	PROPOSED RIVER CORRIDOR WIDTH	SETBACK FROM RIVER'S CENTERLINE	EXAMPLES OF RIVERS
1	Major River (50km^2)	120m to 200m according to analysis. Refer to flood corridor map shown in Appendix 3	60m to 100m	Ona, Omi, Iddo
2	Minor River (25km^2)	100m	50m	Alapata, Alaro, Ogunpa, Kudeti, Ogbere
3	Major Branch (5km^2)	80m	40m	
4	Minor Branch (2km^2)	60m	30m	
5	Major Stream (0.5km^2)	40m	20m	
6	Minor Stream (0.1km^2)	20m	10m	

This provided a picture of the annual, 10 year and 100 year potential for flooding. While this was only an initial assessment at first, it did highlight the established urban areas that were at greatest risk of experiencing flooding.

The results offered the opportunity to classify the river banks into several categories according to the degree with which they could be affected, and recommend solutions to how they could be used. The resulting varying widths identified were also an opportunity to mark out different levels of acceptable uses, as illustrated in Figure 4.1.

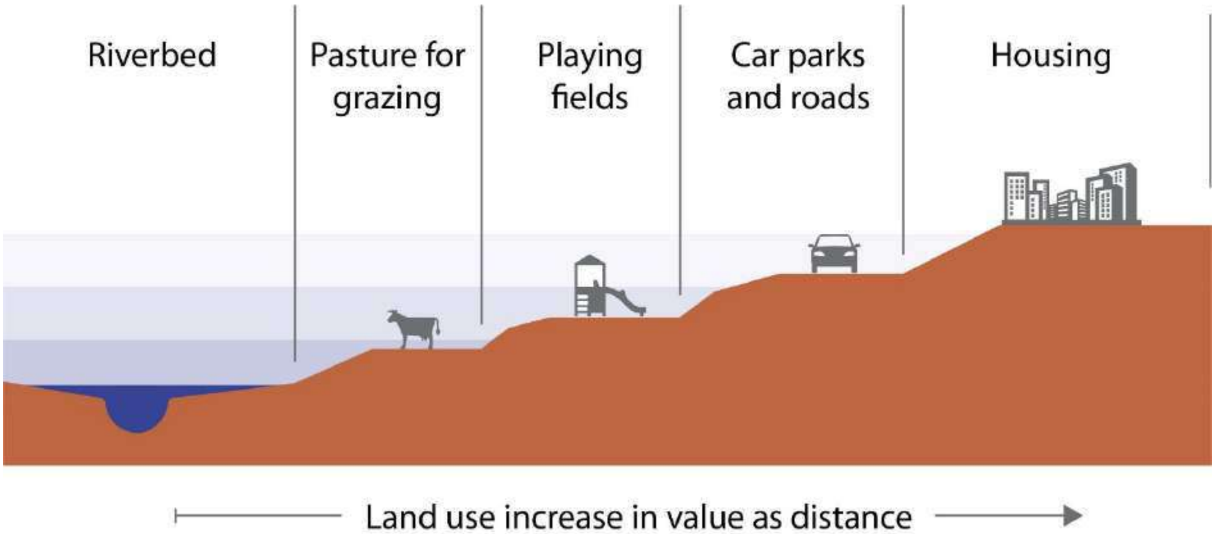

Figure 4.1 Floodplain Land Use Concept

A key aspect is about ensuring that encroachment into the flood prone areas does not reoccur. Finding solutions and getting communities to take ownership of the river corridors is critical to ensuring there is no urban development returning to these areas. This is about getting communities to recognise the areas as community assets.

Urban development is to be avoided within all areas identified as prone to flooding. In order to ensure this does not happen, alternative uses are therefore proposed. This includes the following:

- Urban agriculture, where local communities can use the river banks to grow crops, which is key to diversifying urban diets and providing local food security;
- Parks, providing accessible green space to local communities such as for sports facilities;
- Public open spaces, such as squares or markets;
- Channelisation – this enables the protection of established urban areas, minimising the needs for removal – only in exceptional circumstances is removal recommended.

One critical aspect to preventing future flood events is through the protection and preservation of the existing forest cover, in particular that in the north as it has the role of absorbing and retaining rainwater. Within Ibadan itself, a policy of greening the city through planting trees and shrubs will reduce runoff and therefore flooding, will preserve soil moisture and will reduce the rate of atmospheric warming.

Figure 4.2 One idea is to build public spaces that can flood and absorb overflow water

Figure 4.3 Sports fields are uses that can typically flood without affecting the urban environment

The Ibadan City Masterplan is supported by a Strategic Environmental and Social Assessment (SESA) which assesses the policy framework put forward. It ensures that sound decisions were taken in the establishment of the policies put forward and finally adopted.

5 The Institutional Framework

The masterplans developed for Ibadan are the first to address the city's many challenges in a holistic manner. This new set-up therefore requires a new approach to delivery: who will be responsible for implementing the plans, and how can we ensure that they are well and truly implemented. There are critical concerns that must be addressed so that this is not a plan that sits on the shelf.

The Ibadan City Masterplan therefore put forward an institutional framework strategy.

Three options were put forward for how the masterplan could be delivered – the preference being that the existing mechanisms are retained, but supported by capacity building to ensure that the existing state ministries and departments are well-versed on their own specific tasks in implementing the masterplan.

6 Conclusion

The city of Ibadan is projected to grow in population by 90% over the next 20 years. While it is affected by flooding events on a regular basis, the uncontrolled growth of the city, coupled with potential increases in extreme rainfall events brought about by climate change will mean that the city must address the challenges today.

The first strategic spatial planning framework for the city is a major achievement that provides implementable guidance to direct the future development of Ibadan. There are many issues that need addressing; it is now essential that the Ministries and Departments of Oyo State do not lose the momentum that has now been set and deliver on the proposals in the plan. This will lead to a more prosperous Ibadan in the future.

Evaluation of the impact of the urban morphology on building energy consumption in severe cold region cities-- Take the office building in Harbin, China as an example

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1. Introduction

China has been experiencing the world's greatest and most rapid process of urbanization, leading to both the urban population and the building area have been increasing greatly, and the proportion of urban building energy consumption to the gross has been growing consistently as well. As a consequence, this results in the ascending trend of CO_2 emission, and makes the construction of cooler city (i.e. low-carbon city) become more arduous. For people in cold region have to experience a long heating period during winter to overcome the cold weather which causes a heavy heating demand for buildings, with heating energy consumption in China northern cities accounted for 24.1% of the total energy consumption of buildings in 2010 (Zhang Y. 2012), while in Europe, the proportion of heating related energy utilized in residential buildings was approximately 70% of the whole (WBCSD, 2009). And it is natural to believe that the energy consumption must be greater for the severe cold regions with much higher latitudes. Therefore, more challenges of building energy-saving are faced by severe cold region cities.

Cities are the main positions to cope with global climate change (Lindseth, G. 2004). Its form or morphology plays an important role in reducing urban energy consumption (Chen et al.2011; Urquizo, J. et al. 2017), including transportation energy consumption, infrastructure energy consumption and so on (Grazi F et al. 2008), but also daily life living energy consumption, with building energy consumption as one big part (Ishii, S et al. 2010). In order to slow down the fast-growing consumption of energy from buildings, it is especially necessary to figure out the mechanism about how urban morphology impacts building energy consumption performance and then propose energy-saving oriented planning strategies in the process of urban planning. As the initial step to come up with related strategies, studying the relationship between urban morphology and building energy consumption should be carried out urgently in the discipline of urban planning.

Recent studies have shown that the variation of urban morphology (urban form; spatial configuration of cities) could affect building energy consumption directly or indirectly. Examples are: Ratti, et al. (Ratti, et al. 2005) demonstrated that the variance in building energy consumption on urban geometry was a considerable value; research of Wilson B. (Wilson B. 2013) revealed that density and adjacent structures mattered for residential electricity use at the subdivision level; Rode P. et al. (Rode P. et al. 2014) testified that denser and taller building type could contribute to a higher heat-energy efficiency at the neighborhood scale. In terms of indirect impact, Wong N. H. et al. (Wong N. H. et al. 2011) identified that air temperature varied because of different urban morphology which could lead to the building energy consumption variation in Singapore. Similarly, Zhou Y, et al. (Zhou Y, et al. 2017) also proved that the surrounding green space ratio, building density, floor area ratio affected the energy consumption of the building by impacting the intensity and frequency of heat island.

The approaches about the urban morphology factors affecting the building energy consumption has become relatively mature. According to the purpose of research and the situation of data collection, and the existing literature involves different (sometimes linked) approaches including the statistical analysis methods based on historical data (Wilson B. 2013; Tso, G. K. F. at el. 2014; Steadman, P. at el. 2014; Tian, W. at el. 2016) and the numerical simulation methods (Ratti, et al. 2005; Rode P. et al. 2014; Palme, M. et al. 2017; Zhou Y, et al. 2017). However, there are less research about the relationship between urban morphology and building heating energy consumption in winter, especially study referring to heating consumption in severe cold region. And the high resolution or district-based quantitative investigation has been less sufficient as well.

Therefore, the aim of this work is to quantitatively analyze the impact of urban morphology on building heating energy consumption in severe cold region cities, and help put forward corresponding suggestions in carrying out energy efficiently-consuming oriented urban planning.

This paper selects the winter heating energy consumption of sixty-nine sample office buildings in severe cold region City Harbin, China to carry out the research. It starts with proposing the significance of digging out the impact of the urban morphology on building heating energy consumption of winter cold cities in the first section. The second section explains the study area, spatial scale and the methodological approach. In the third section, we present the results in two subsections: results on data statistical analysis of the correlation between building heating energy consumption and six urban morphology indexes, and further analysis on how the urban morphology influences the energy consumption. The forth section is dedicated to the final conclusion and putting forward the possible urban morphological planning strategies for mitigating the heating energy consumption and even gross energy consumption of buildings for cities in severe cold region.

2. Data and Methodology

2.1 Study area and spatial scale

Figure 1: Two Categories of Urban Morphology in Harbin

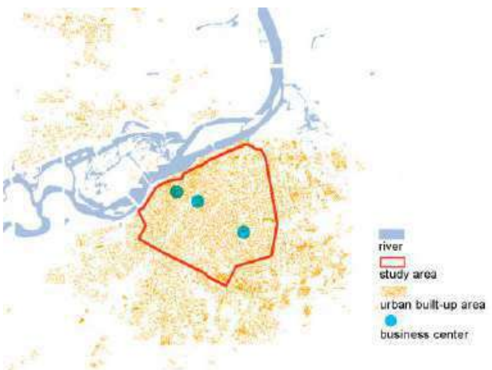


Figure 2: Study Area in Harbin

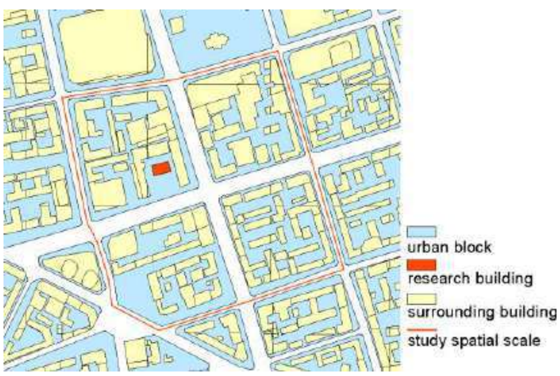


Figure 3: Spatial Scale of Study

2.1.1 Study area: climate and urban morphology characteristics of Harbin

In China, the severe cold region mainly refers to the area where the average temperature of the cold month is less than -10℃, and the average daily temperature is less than 5 ℃ for more than 145 days (GB 50178-93,1993). Harbin is one of the most representative cities in this region with a total 180-day heating period. In terms of morphology, Harbin can be divided into two categories: high construction intensity areas generally with medium and high rise buildings located in three business districts, and low construction intensity areas mainly with 3 to 6-storey buildings located around the three business districts (Figure 1 & 2). This indicates that the urban spatial construction intensity decreases from three commercial or business centers to the periphery of the city. Therefore, in order to ensure the diversity of urban spatial morphology, and according to the geographical location distribution of buildings as well as we can obtain energy consumption data, this study selects the built-up area within the Second Ring Road of Harbin as the study area (Figure 2).

2.1.2 Study spatial scale

For each individual building, this study defines the block where a building located in, and its surrounding blocks as the study spatial scale or scope of investigation (Figure 3) to calculate the urban morphology indexes. Usually, the scale of an urban block in Harbin is from 15000 square meters to 60000 square meters with the corresponding length from 80 meters to 300 meters. Choosing this spatial scale is mainly because urban morphology can indirectly affect building energy consumption by influencing daylighting, microclimate, users' behaviors and other ways, whereas only one block is not enough to influence microclimatic environment and users behaviors. Therefore, this study is supposed to be placed in a larger spatial context within city. Another reason is that urban block, as the basic unit of the city texture, forms a connecting link between the preceding planning conditions of urban planning or zoning to achieve the goals of planning and the following stage of urban design or architecture design to guide the construction, which lead to better implementability and practical significance for regulating the urban morphology.

2.2 Data set

2.2.1 Data of building energy consumption

The energy consumption of office buildings in severe cold regions mainly includes heating, air conditioning, lighting, office equipment and so on. According to the characteristics and statistical system of building energy in Harbin, the energy consumption of office buildings in Harbin is divided into two categories: building heating energy consumption (heating and hot water) and building electricity consumption (air conditioning system electricity, lighting power, office equipment, elevator electricity, other spare power). In this study, we only concentrate on the heating energy consumption which produces the greatest demand in buildings of severe cold region.

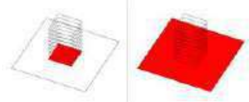
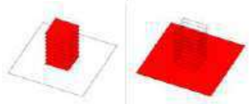
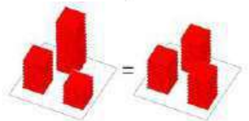
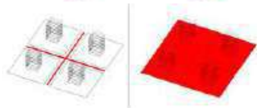
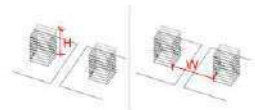
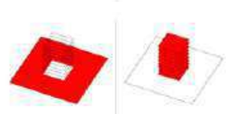
69 sample office buildings are selected in this paper as the study objects. In order to ensure that these energy data can reflect the spatial heterogeneity of urban morphology effectively, these buildings we choose are relatively evenly distributed in various positions of Harbin, from downtown to peripheral area, where the characteristics of urban morphology around them are different from each other. The winter heating energy consumption data used in this study comes from 2016-2017 Energy Saving Supervision Platform for Office Buildings and Large Public Buildings of Heilongjiang Province and 2016 Statistical Data of Building Energy Consumption from Harbin Statistical Bureau.

2.1.1 Data of urban morphology

"The urban morphology refers to the spatial configuration of urban land use within an urban area."(Urquizo, J. et al. 2018) And previous study (Ewing, R. et al. 2008) had shown three ways through which urban morphology have effects on buildings, with electric transmission and distribution losses as a direct way, and features of housing stocks, local temperature as two indirect ways. This study concentrates on the indirect ways which are more related to urban planning. Six indexes of urban morphology are calculated to evaluate the impacts on building energy consumption, which are surrounding Building Site Cover (BSC), Floor Area Ratio (FAR), Building Height (BH), Road Network Density (RND), Road Height-width Ratio (RHR) and Open Space Ratio (OSR) according previous studies (Wong N. H. et al. 2011; Rode P. et al. 2014; Zhou Y, et al. 2017).

In this paper, the building data including geographical location, bottom contour of building, building storey, building function, and green space data of Harbin city in GAD map are obtained by Parametric Language Python to establish the urban morphology model in ArcGIS software. based on this model, the urban morphology of each building is calculated quantitatively according to the definition and calculation formula of each index (Table 1).

Table 1: Definition and calculation formula of urban morphology indexes

	Definition	Calculation formula	Diagram of indexes
Building Site Cover (BSC)	The ratio of built ground to that of the sample district area.	BSC=footprint area/sample district area	
Floor Area Ratio (FAR)	The ratio of the sum of the areas of all building floors to that of the sample district area	FAR=gross floor area/sample district area	
Building Height (BH)	The average height of buildings within the sample district area	BH=[∑(footprint area× height)]/gross footprint area	
Road Network Density (RND)	In a certain sample district, the ratio of the sum of the length of road network to the sample district area.	RND=gross length of road/sample district area	
Road Height-width Ratio (RHR)	The average ratio of the height of the building on both sides of the road to the width of the road	RHR=[∑length of road (height of road/width of road)]/gross length of road	
Open Space Ratio (OSR)	the ratio between the open space area and the gross floor area	OSR=gross green space area/sample district area	

Note: the first two diagrams of indexes referred from literature (Wei, R. at el. 2016)

2.3 Methods

First, the basic energy consumption of each building is calculated by OpenStutio software. On this basis, the measured building energy consumption is split into basic energy consumption (BEC) and external influence energy consumption (EIEC). Finally, the correlation analysis is carried out to analyze the correlation between building heating energy consumption and six urban morphological indexes, and multiple linear regression analysis is applied to identify the key factors of urban morphology affecting the performance of building energy consumption.

2.3.1 Step1: Calculating the basic building energy consumption

The measured energy consumption of a building in a city can be divided into two parts: basic energy consumption (BEC) which is dominated by the physical characteristics of a building and external influence energy consumption (EIEC) affected by the surrounding environment (Hong L. et al. 2015). In order to eliminate the influence from building physical features, such as shape factor, window to wall ratio and heat transfer coefficient of building envelope, on the total energy consumption, the EIEC should be used in the following statistical analysis of urban morphology and building energy consumption to increase the accuracy and rationality of the analysis results. For this reason, calculating the BEC of building shall be the initial step.

In this study, we choose the way of simulation to calculate the BEC of buildings. OpenStudio software, as a visual user interface of EnergyPlus which is an international commonly-used building energy simulation software (What is OpenStudio. 2015), is selected to conduct the BEC simulation.

2.3.2 Step2: Calculating the external influence building energy consumption

For measurement on building energy consumption level, most studies adopt the calculation method of energy use intensity (EUI) (Kavgic, M. et al. 2010; Howard, B. et al. 2012). EUI refers to the annual energy consumption per unit area of a building, usually expressed in units $kWh \cdot m^{-2} a^{-1}$, that is, EUI= Energy consumption per year / building area (Hong L. et al. 2015), hence this paper use EUI to represent the efficiency of building energy consumption. On the basis of the total annual energy consumption data and the basic building energy consumption calculated by step 1, the external influence EUI of each building can be obtained according to the formula $EUI_{EIEC}=EUI-EUI_{BEC}$. it is followed by locating the data of building energy consumption in the urban spatial model based on geographic information system and visualizing the distribution of building energy consumption with ArcGIS, and the spatial distribution of building energy consumption can be grasped in general, and the relationship between building energy consumption and urban morphology can be preliminarily understood.

2.3.3 Step3:Correlation analysis

In this study, statistical analysis is used as an analytical methods, including correlation analysis and multiple linear regression analysis. Before proceeding regression analysis, it is necessary to conduct correlation analysis between dependent variable and independent variables, so as to have a general understanding of their influence relationships.

Correlation analysis is a tool measuring the strength of statistical relationship between objects, which aims at measuring the degree of linear correlation between variables (Sun, Y. 2007). In other words, the task of correlation analysis is to give a quantitative description of the correlation. Correlation coefficient “r” is a value used to describe the degree and direction of linear relationship. If the variable y and x are functional relations, then r=1 or r=-1; if the variable y and x are statistical relations, then $-1 < r < 1$; if x, y has the same trend, then it is called the positive correlation; if the trend of x and y is opposite, then it is called negative correlation. In general, $|r|\geq 0.95$, $0.8\leq|r|<0.95$, $0.5\leq|r|<0.8$, $0.3\leq|r|<0.5$ $|r|<0.3$ mean significantly correlated, highly correlated, moderate correlation, low correlation, very weak correlation, respectively,. The correlation analysis results between urban morphology variables and building heating EUI are obtained by Pearson correlation coefficient in data analysis software SPSS Statistics 22.0 (hereinafter referred to as SPSS).

2.3.4 Step4: Multiple linear regression analysis

The relationship between building energy consumption and urban morphology indexes obtained by correlation analysis is only qualitative, so it is necessary to further analyze the quantitative relationship between the two with regression analysis.

Regression analysis is a commonly used analytical method in statistical analysis. The case of one independent variable is called simple linear regression. For more than one independent variable, the process is called multiple linear regression (David A. Freedman 2009). Multiple linear regression attempts to model the relationship between independent variables and a dependent variable by fitting a linear equation to observed data. Every value of the independent variable x is associated with a value of the dependent variable y. This means scholars can analyze the effect of an independent variable on building energy consumption when controlling other independent variables. Therefore, with SPSS, multiple linear regression analysis is used to explain the impact of urban morphology on Harbin office building energy consumption of heating.

3. Results and Analysis

3.1 Data Results

3.3.1 Simulation results of building basic energy consumption

According to the architectural form, the office buildings in Harbin can be divided into two categories--slab-type building and point-type building, and we abstract relevant parameters (Table 2) of these two kind of building type respectively on the basis of the sixty-nine sample buildings to set up models in the energy analysis software. Outdoor weather data are derived from the Chinese Standard Weather Data (CSWD). Winter heating period is set from October to April next year. Heating parameters are set as shown in Table 3, and other related parameters are designed based on appendix B data in the "Design Standard for Energy Efficiency of Public Buildings (GB50189)" (PGB50189. 2015).

Table 2: Relevant parameters of slab-type building and point-type building used in simulation

Item	Slab-type	Point-type	Item		Slab-type	Point-type
Model diagram in OpenStudio			Height of floor		3 m	3.5 m
			Glazing ratio		0.249	0.294
			Shape coefficient		0.1546	0.1558
Footprint area	2280 m^2	784 m^2	Heat transfer coefficient	Roofing	0.35 $W/(m^2 \cdot K)$	0.35 $W/(m^2 \cdot K)$
Gross floor area	20520 m^2	17248 m^2		Wall	0.45 $W/(m^2 \cdot K)$	0.45 $W/(m^2 \cdot K)$
Number of floor	9	22		Window	3.1$W/(m^2 \cdot K)$	2.5$W/(m^2 \cdot K)$

Table 3: Heating parameters set in OpenStutio

		Office	Lobby	Meeting Room	Corridor	Toilet	Lift
Heating set point(°C)		20	18	18	16	16	16
Density of occupation/(m^2/person)		12	3	3	50	50	50
Air change time(times/h)		0.5	0.5	0.5	0.5	0.5	0.5
Sensible heat gain(W/m^2)	Lighting	10	15	15	5	5	5
	Equipment	15	5	5	0	1	0

Table 4: Actual energy use intensity and simulation results

(Kwh/m2/a)	EUI	EUI-H	EUI-H_{BEC}	EUI-H_{EIEC}
Slab-type	217.52	165.03	146.09	18.94
Point-type	214.19	166.30	186.63	-20.33

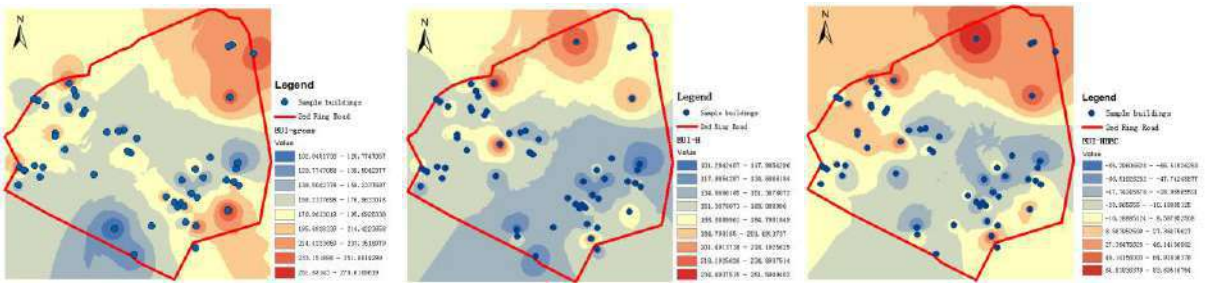
Based on the above parameters, this study run simulation in OpenStutio2.5.0 to get the basic average heating energy consumption intensity (EUI-H_{BEC}) of the two types of buildings respectively. As shown by the simulation results in Table 4, although the actual average heating energy consumption intensity (EUI-H) of the two is extremely close, the average EUI-H_{BEC} of slab-type building is much less than that of point-type building. Consequently, the calculated external influence heating energy use intensity (EUI-H_{EIEC}) of slab-type building shows a positive value of 18.94, while that of the point-type building is a negative value of -20.33. This indicates that the external space context, where the building located in, has reduced the heating energy consumption for most of the point-type buildings, whereas that of a majority of slab-type buildings has been raised by their surrounding environment.

3.3.2 Distribution results of external influence building energy consumption

Based on the simulation results of EUI-H_{BEC}, we calculate the EUI-H_{EIEC} of the sixty-nine sample buildings by deducting the EUI-H_{BEC} from EUI-H according to whether they are slab-type or point-type. Then, the actual gross energy consumption intensity (EUI), actual heating energy consumption intensity (EUI-H), and calculated EUI-H_{EIEC} data are placed in the corresponding sample office buildings of the urban model established in ArcGIS10.0. Further by using the Inverse distance weighted (IDW) tool in Spatial Analyst tool of ArcGIS, the three kinds of building energy consumption are interpolated to preliminarily estimate if there is any regularity for the spatial distribution of annual office building energy consumption in the study area. The results are shown in Figure 4.

As one would expect the three kinds of consumption located in the city did show different regularities. In terms of actual heating energy consumption, major parts with high EUI-H are located primarily in the north-eastern and south-eastern margin near the Second Ring Road of Harbin, and the areas consuming less heating energy are located in the central business districts which are made up with compact and tall buildings. Meanwhile, the external influence heating energy use intensity (EUI-H_{EIEC}) presents a more remarkable pattern compared with the distribution of EUI-H, with the largest concentration of building EUI-H_{EIEC} distributing mainly in the northern fringe and partly in the southern side of the city, while the lower EUI-H_{EIEC} locates around the midtown that consist primarily of tall buildings.

In order to conduct the comparation on the distribution of building gross energy consumption, we also visualizes the gross annual EUI distribution in ArcGIS. Interestingly, contrary to expectation that the highest EUI should be located in the business center of the city, it shows a similar pattern with heating energy consumption. This distribution regularity can be explained by the dominant position of heating energy consumption in the gross energy consumption, because the EUI-H (152.74 Kwh/m^2/a in average) is significantly larger than EUI-E (27.90 Kwh/m^2/a on average) for office buildings in Harbin. This distribution results imply that it do exist a certain rule of heating energy consumption distribution in different urban construction intensity of different geographical locations.



(a) EUI *(b) EUI-H* *(c) EUI-H_{EIEC}*

Figure 4: Spatial distribution of office building energy consumption

Table 5: Results of correlation analysis

Variables	EUI-H_{EIEC}		Sample size(N)	Mean	Standard deviation
	Cor.	Sig.			
EUI-H_{EIEC}	1	--	66	-9.87	36.96
BSC	-0.401	0.003	66	0.36	0.09
FAR	-0.518	0.000	66	2.30	0.82
BH	-0.613	0.003	66	23.10	5.30
RND	-0.521	0.202	66	0.022	0.0046
RHR	-0.552	0.000	66	0.85	0.17
OSR	0.456	0.000	66	0.64	0.09

Notes: Cor. refers to Pearson correlation; Sig. refers to significance.
When the significance is less than 0.05, the result of correlation analysis is significant.

3.3.3 Data results of correlation analysis

In order to have a general understanding between the urban morphology and the building energy consumption, this study takes the six calculated urban morphological indexes—Building Site Cover (BSC), Floor Area Ratio (FAR), Building Height (BH), Road Network Density (RND), Road Height-width Ratio (RHR) and Open Space Ratio (OSR),and external influence heating energy use intensity (EUI-H_{EIEC}) severally to produce the correlation analysis. After removing the three particular value points, the results of the correlation analysis are presented in Table 5.

According to the correlation analysis, it can be seen that the external influence Heating Energy Use Intensity (EUI-H_{EIEC}) has significant correlation with the respective independent variables except Road Network Density (RND). Among these significant independent variables, there is a significant negative correlation with Building Site Cover (BSC), Floor Area Ratio (FAR), Building Height (BH) and Road Height-width Ratio (RHR) indicating that these four variables have a inhibitory effect on EUI-H_{EIEC}, whereas a significant positive correlation with the Open Space Ratio (OSR) suggesting that GSR plays a positive role in promoting the value of EUI-H_{EIEC}. BH and RHR are demonstrated with the relative higher correlation with |r| being at 0.613 and 0.552 respectively, and Building Site Cover (BSC) shows a lowest correlation (|r|=0.401) with EUI-H_{EIEC}.

3.3.4 Data results of multiple linear regression analysis

The results obtained by regression analysis which constitute both significant and non-significant independent variables are unreliable. Therefore, according to the results of correlation analysis, this study removes non-significant correlation variables. Then the significant correlated urban morphological variables are retained as independent variables, and EUI-H_{EIEC} are regarded as dependent variables for proceeding multiple regression analysis in SPSS software. In order to eliminate the influence of collinearity variables, the regression method are selected as stepwise regression, and the final regression equation is as follows:

$$\text{EUI-}H_{EIEC} = -11.785FAR - 3.464BH + 122.678GSR + 81.203$$

The values of multiple correlation coefficient R is 0.780, indicating that the urban morphological variables are satisfactorily and linearly related to the dependent variable EUI-H_{EIEC}. For the determination coefficient R Square (R^2), it can be known from the statistics that the closer its value is to 1, the better the fitting degree of the model is to the data, so the relatively high fitting degree of the equation suggests that the interpretation of regression equation for EUI-H_{EIEC} is quite credible. The result can be used as a strong reference for studying the relationship between building heating energy consumption and urban morphology in severe cold regions. At the same time, the regression analysis result also outputs the Standardized Coefficients (Table 6) by which the effect of urban morphological variables, with different magnitude and units, on the dependent variables can be compared.

Table 6: Results of Standardized Coefficients

Dependent variables	R	R square(R^2)	Standardized Coefficients					
			BSC	FAR	BH	RND	RHR	OSR
EUI-H_{EIEC}	0.780	0.608	--	-0.263	-0.497	--	--	0.247

Based on the above multiple linear regression result, we can find:

(a) Because of the non-significant influence of Road Network Density (RND) on EUI-H_{EIEC} and the co-linear relationship with other variables of Building Site Cover (BSC) and Road Height-width Ratio (RHR), these three variables do not appear in the equation.

(b) It can be drawn from the R square that the surrounding urban morphology do produce impact on heating energy consumption of office building in the severe cold regions.

(c) Among the three urban morphological variables, floor area ratio (FAR) and building height (BH) present a negative influence on the annual external influence heating energy use intensity (EUI-H_{EIEC}) of the office buildings, which means the higher the average floor area ratio and building height of a district are, the lower the EUI-H_{EIEC} of the building will be, which will be more conducive to improving building energy efficiency. Specifically, if the floor area ratio (FAR) ascended by one, the total annual EUI-H_{EIEC} of the office building would be slumped by 11.785 Kwh/m^2/a; if the average building height of a district increased by one meter per year, the total annual EUI-H_{EIEC} of building would be reduced by 3.464 Kwh/m^2/a.

(d) The correlation between Open Space Ratio (OSR) and EUI-H_{EIEC} is positive. That is, the greater the OSR of the district is, the higher the heating energy consumption for office buildings would be, and less beneficial to improving heat-energy efficiencies. According to the regression equation, the EUI-H_{EIEC} will experience a 1.2267 Kwh/m^2/a increase for every one percentage point grow in OSR, which means the annual heating energy consumption intensity (EUI-H) will have a 1.2267 Kwh/m^2/a rise as well.

(e) Due to the absolute value of standardized coefficients, it can be known that the building height (BH) contributes the greatest impact to the heating energy consumption of office building (0.497) among the three urban morphological variables; next is floor area ratio (FAR) with 0.263; followed by open space ratio (OSR) at 0.247.

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3.2 Analysis on the relationship between urban morphology and building energy consumption

Data results from statistical analysis displays that the different kinds of urban morphological indexes lead to distinctively different heat-energy demands of office buildings in severe cold region cities. However, the mechanism of urban spatial configuration affecting heating energy efficiency behind these data needs to be explored, so as to put forward effective planning suggestions at the fundamental level--urban design.

3.2.1 Building Site Cover, Floor Area Ratio and Building Height

Building site cover, floor area ratio and building height are three main indexes used to describe urban spatial intensity. Usually, a higher spatial intensity district combines a higher floor area ratio with a more compact building density and taller building height, and a lower spatial intensity area is characterized as lower floor area ratio with sparse building density and low-rise buildings. Our urban district morphology samples where the selected buildings seat in also confirms this factual regularity.

According to the data results, BSC, FAR and BH have negative correlation with building heating energy consumption. In other words, the higher the spatial intensity of construction, the more conducive to promoting the performance of building heat-energy efficiency. Moreover, the impacts from FAR and BH on building energy efficiency are proved more obvious.

From the perspective of urban climate, it can be argued that high intensity urban districts (usually city center) alter their thermal environment in the form of lifting temperatures relative to outskirts (usually the peripheral areas). Our previous study (Hong L. at el. 2018) on “the relationship between urban morphology and urban thermal environment in Harbin” also confirms this view. The study proves that the average district temperature grows up relatively significantly with the increase of floor area ratio and building height in winter, but the building site cover (building density) has little effect on the improvement of the surrounding thermal environment. At the same time, high intensity urban construction slows down the ventilation efficiency in district which contributes to less heat loss of building.

From the point of view of equipment use, high construction intensity areas in Harbin are the commercial and financial centers in where high intensity economic activities and work happen consistently. This causes more users, electrical equipment and lighting to release a more heat which leads to less heat-energy consumption. The above analysis also explains why the office buildings in the downtown of Harbin show better heat-energy efficiency in the results of EUI-H and EUI-H_{EIEC} distribution.

3.2.2. Road Network Density and Road Height-width Ratio

As urban ventilation corridors, roads play an important role in microclimate and thereby affect the energy consumption of buildings. Road network density (RND) and road height-width ratio (RHR) are important indicators for measuring road compactness and three-dimensional road morphology.

Looking at *Road Network Density ,* statistical analysis shows that road network density (RND) has little effect on building heating energy consumption. The possible reason, as the definition of road density shows, is that it is mainly used to reflect the number of roads, and only the length information of the road network is counted, but it does not reflect the road width that affects the urban ventilation. Hence, road network density is not an effective urban morphological index evaluating impacts on building energy consumption, and road area ratio might be a better indicator.

With regards to *Road Height-width Ratio,* it has a significant negative correlation with heating energy consumption, and can reduce the external impact energy consumption of buildings. One possible reason is the increase of surrounding RHR reduces the wind speed in ventilation corridors and facilitate the heat preservation in the city, which creates a warmer outdoor temperature to buildings and thereby promotes building energy conservation.

3.2.3 Open space ratio

A high Open space ratio (OSR) means there are more open space around the vicinity. The results of correlation analysis and regression analysis all show that the higher OSR is, the more unfavorable it is for building heat-energy saving in severe cold region cities. The microclimate influenced by OSR should be responsible for it indirectly. It can be known from the previous study that the place with lower open space ratio is found to be warmer as compared to the district with more OSR value in winter (Hong L. at el. 2018). It is because the lower ventilation rate and higher heat storage capacity reduce the heat loss efficiency of buildings. For this reason, OSR shall be regarded as an effective parameter to appraise the heating energy efficiency of urban morphology.

4. Conclusion and Discussion

4.1 Conclusion

In summary, this paper analyzes the influences that urban morphology factors exert on building energy consumption quantitatively in severe cold region, with Harbin as a case study. Sixty-nine office buildings' energy consumption data and six urban morphology indexes surrounding these buildings are studied in detail with a statistical approach.

From a theoretical perspective, the final results demonstrate that: (a) Urban morphology do has a remarkable effects on heating energy consumption of office buildings in severe cold region cities. (b) Higher construction intensity with taller buildings, denser building layout and higher floor area ratio feature greater heating energy efficiency of office buildings, while greater open space ratio leads to lower heating energy efficiency. (c) For estimating the heating energy efficiency of urban morphology, urban spatial intensity (BSC, FAR and BH), road height-width ratio and open space ratio are all effective urban morphological indexes.

With regard to methodology, our research increased the rigour of research through the combination of building energy consumption simulation and statistical analysis. Before the statistical analysis, the basic energy consumption(BEC) of buildings are simulated by OpenStutio software to obtain the external influence energy consumption(EIEC) of buildings which are used for statistical analysis to eliminate the influence of variables such as building construction, building equipment and other variables. This greatly increases the accuracy and scientificity of the analysis results.

It should be noted that other energy consumption of office buildings such as electricity which might have opposite correlation with some urban morphological indicators has not been included in this study. Therefore, it might be necessary to find the best urban morphology that can balance the energy consumption of electricity and heating energy in severe cold region cities in the future.

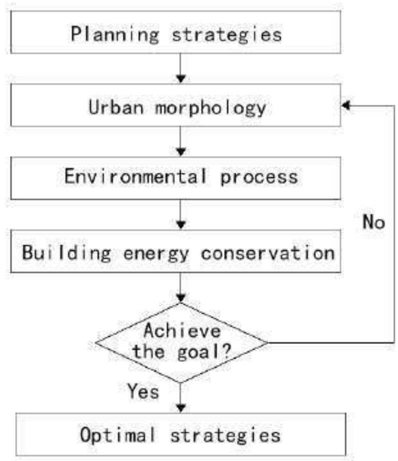

Figure 5: The relationship between planning strategy and building energy conservation

4.2 Discussion：Possible planning strategies

The same urban density, same volume rate or same population size can be realized by diverse urban morphologies, but there are different effects on the environment (Rogers R.G. 2007) or on the urban building energy consumption specifically. The close relationship between urban morphology and building heating energy consumption identified in this study also emphasis that urban morphology can be used as a valid way to save building energy and reduce carbon emissions in cold region cities. Consequently, the significance of energy-saving oriented urban planning strategies can be foreseen. To be precise, a preliminary planning framework (Figure 5) can be established theoretically: First, study the quantitative relationship between building energy efficiency and urban morphology of the city which is what we have done in this study; Afterwards, come up with energy-saving oriented urban planning strategies based on the above correlation; Finally, evaluate and compare the ability of different morphology scenarios until achieving building energy conservation goals.

For this study, after obtaining the above analysis results, the possible planning strategies in district scale can be put forward for severe cold region cities: compact building layout; appropriate high development intensity, building height and road aspect ratio; moderately reducing open space ratio. However, we must take the impacts of these strategies on other factors such as urban society, transportation efficiency into consideration comprehensively and deliberately.

Overall, introducing the concept of building energy conservation in urban planning and proposing energy-saving oriented urban planning strategies in cities are significant for the mitigation of climate change and the development of cooler cities.

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Construction of Resilience in Urban Fringe Based on Sponge City: an Example of Green Space Planning of Shahe in Beijing, China

（Construction of Resilience in Urban Fringe Based on Sponge City：an Example of Green Space Planning of Shahe in Beijing, China）

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Abstract：Urban fringe area is important to maintain the sustainable development of ecological safety and security. Under the background of rapid urbanization, the ecological environment in the urban fringe is facing great threat to urban and rural construction. The acceleration of urbanization has brought a series of problems, such as the deterioration of the ecological environment and so on.

This article summarizes the inadequacies of the urban fringe area and the future direction of development from the perspective of landscape architecture through literature surveys, conceptual analysis and related historical research. Clearing research direction is construction of resilient landscape in urban fringe. The study object is the Shahe area in Beijing, China. I analyze the status of the macro and meso level of the site using the 2017 Remote Sensing Images and Field Survey Data. In response to the current status issues, the potential characteristics of water elasticity in this area are proposed. The current status is severe soil desertification, non-point source pollution, pollution of water bodies, imperfect drainage systems, serious water pollution, lacking of systematic green areas, etc. Different resilient solutions are proposed for within the embankment and outside the embankment.

1) Within the embankment: giving space for the river
   Opening the local embankment and adding the ecological embankment; setting the pond to resist the impact of heavy rain; adding wet meadows, increasing ecological habitat.
2) outside the embankment: providing site for the storm-water
   Adding permeable paving and roof greening; organizing storm-water discharge; Designing storm-water pond.

According to Sponge City's control standards formulate storm-water runoff control objectives and conduct catchment zoning planning and calculation. According to the results of the calculation adjust the green area within the studying area. The benefit evaluation of ordinary rainfall mode and rainstorm mode is carried out.

Keywords：Urban fringe area，Low impact development of rainwater system，Elasticity landscape

1. Introduction

1.1 Urban fringe area

Urban fringe is the transition zone of urban and rural areas with the nature of urban and rural land use property. It is an important area to maintain urban and rural ecological security and ensure sustainable development. There are obvious differences in the landscape between the early cities and the countryside. With the rapid urbanization process, the city continues to expand to the periphery. The land use adjacent to the rural areas has changed from agriculture to industry, commerce, residential area and other functions. Compared with the suburban or urban central areas, the urban fringe area has a low population density, lack of planning guidance and infrastructure.

1.2 The urban fringe of Beijing

Beijing is located in the north of the North China Plain. It is the capital of China, a super large city and an international city. Since the founding of new China, the social and economic development in Beijing has been sustained, rapid and healthy. At the same time, the problem of urban space has also been exposed. The single center focus of Beijing leads to the unordered development of urban construction in the urban fringe area. With the continuous development of urban space, the urban fringe area is gradually reduced to the obstacle of urban development. Through literature review and field investigation, from the perspective of landscape architecture, it is found that there are the following problems in the urban fringe of Beijing:

1)Due to the rapid development of the city, agricultural land has been greatly reduced. The urban fringe area of Beijing covers most of the plain areas, which is the main distribution area of cultivated land, and the fringe area is also the pioneer zone in the process of urban expansion and urbanization. Since 1980s, land use in the urban fringe of Beijing has shown obvious transformation characteristics. In the case of a large number of agricultural cultivated land, a series of problems such as soil fertility decline, soil desertification, soil pollution and so on are caused by the high exploitation and utilization depth of cultivated land and the intensity of exploitation and utilization.

2)The large influx of the floating population and the migration of urban population caused the growth and the irrational spatial distribution of the population size of the urban fringe. The distribution of Beijing population is the trend of urban expansion, mainly concentrated in the inner border area of the urban fringe.

3) The climate in Beijing is a typical semi humid continental monsoon climate in the north temperate zone. The average annual rainfall is 500 mm, which is one of the most rainfall regions in North China. The seasonal distribution of precipitation is uneven. 80% of the annual precipitation is concentrated in June July August for three months, and heavy rain often occur in July and August. Due to the weather characteristics, the urban fringe area often occurs waterlogging, some small and medium rivers and reservoirs will have flood situation, causing serious economic loss and inconvenience of people travel.

2. The elastic landscape in the urban fringe area

Through the summary of the above problems, we found that the urban fringe area has developed rapidly and has many problems, the land and population in the urban fringe are not stable, and the elasticity of resisting the influence of natural weather is small. Based on this feature, it is very important to design flexible landscape in the urban fringe.

Resilience is "the ability of ecosystems to tolerate disruption without breaking down". Elastic landscape is an artificial and natural landscape with flexibility in response to weather conditions and external disturbances. It can maintain or try to maintain the traditional values and natural harmony. The elastic landscape includes the capacity to accommodate and adapt to rainwater. Sponge city (low impact development rainwater system) is one of the elastic landscape. Sponge city is a "flexible city" for cities to adapt to environmental changes and cope with natural disasters caused by rainwater. When it rains, absorb water, store water, seep water and clean water. When it needed, the stored rainwater will be released and utilized.

3. Taking the Shahe reservoir area in Beijing as an example

3.1 Background introduction

The area is located in Shahe to the Wenyu River Basin, Changping District, Beijing（Figure 1）. There are two subway lines across the channel. This area is an important node in the development belt of Western Beijing. It is the key area for the industry and population of the evacuation center city. It is an important industrial base in the northwest of Beijing, mainly with high and new technology and R & D production; it is one of the important higher education bases in Beijing, and one of the important tourist areas

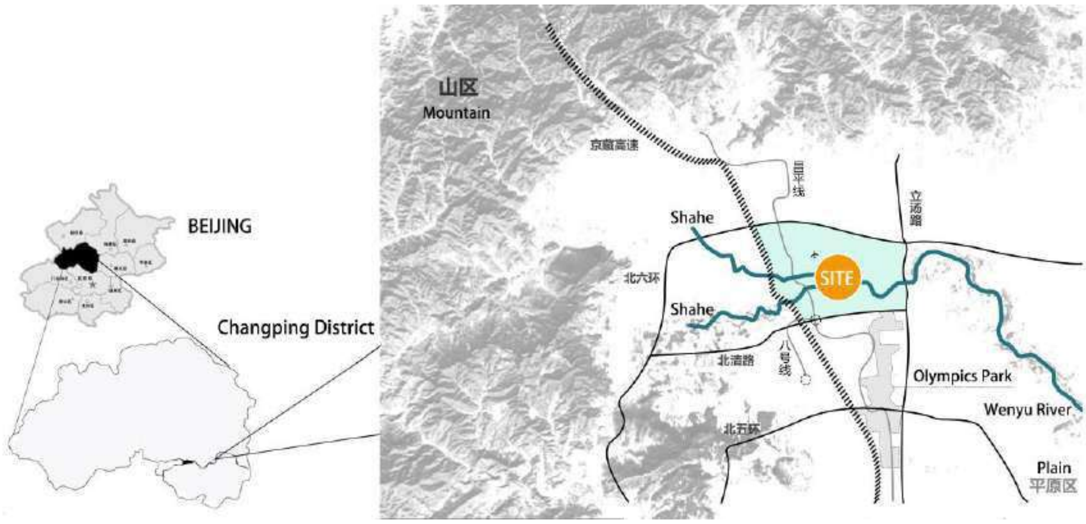

Figure 1: Location diagram

The location of the site in the space layout of the green space system is a green isolation, a green isolation belt between the central Jingmi diversion canal and the six ring, which is the main part of the second road greening and isolation belt in Beijing. Two sides barrier, North upper body green belt, southeastern part of the Wenyu River as the main wedge-shaped green space. In the five ecological corridors, there are 2 green corridors along the highway and three blue ecological corridors along the water. There are nine important urban parks.

3.2 Present situation analysis

3.2.1 Site analysis

On the basis of site investigation and data sampling, the arcGIS software is used to analyze the status of the site.

1）Altitude: the height of the northwest and south of the site is relatively high, showing a trend of gradual decline to both sides of the river, and the overall topography of the site is relatively flat. 2）Slope: the status quo of the site is relatively flat, with easy water accumulation. 3）Rainwater confluence: according to the elevation, the flow direction and the confluence accumulation can be calculated. It can be seen that the drainage of the land on the dyke is disorder, and there are several obvious drainage lines. 4) Soil: the soil in the field is mainly loam and sandy loam, and the permeability of sandy loam, loam and sandy loam is good, which provides nutrition and fertility for plant growth. 5) Water conservancy facilities: there are dams on both sides of Shahe to Wenyu River Basin. There are Shahe gates at the junction of Shahe and Wenyu River, and there are many drain outlets along the river. 6) Vegetation: using NDVI software to analyze the current vegetation status, identify the appearance of dense forest area, and try to preserve it in the future. There are large areas of farmland in the current situation, and the plant species are relatively simple. （Figure 2）

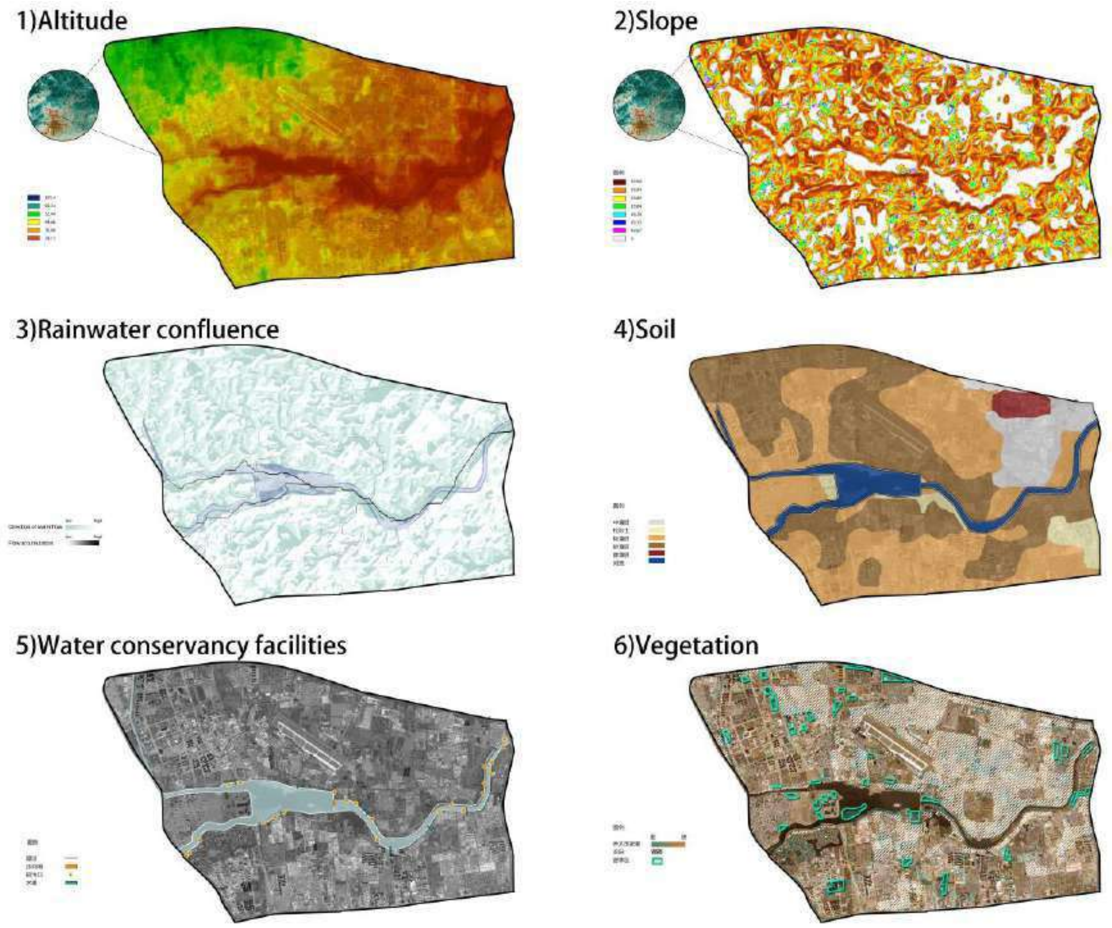

Figure 2: Site analysis diagram

3.2.2 Land-use analysis

According to the site investigation and land use planning, the nature of the current land use is analyzed.

1) Green space: the overall distribution of green space is scattered and poor coherence. The green space for public activities is small. There is a lack of active sites in the current park. It has a single function and poor openness. It can't meet the needs of use and ornamental. In some areas, the green plants are in good shape and can be retained. 2) Farmland: the proportion of farmland in the field is significant. 3) Residential land: in the scope of the study, the current situation of residential land is very polarized, and most of them are rural construction land with poor features. At the same time, there are several high end residential areas being built, and the roof afforestation can be built in the future. Measures are taken on the pervious pavement. 4) Village land: village land scattered scattered in the site, compact space, more crowded, poor accessibility, lack of space, can't meet the needs of the use of the status quo. 5) Industrial land: the parts of industrial land are distributed in pieces, partly scattered in the field, with general accessibility and poor environment, and industrial land is easily affected by other surrounding land. 6) Education and scientific research land: mainly concentrated in Shahe High Education Park, partly

scattered in the field, with general connectivity, poor surrounding environment, and good interior landscape conditions. 7) Road: the traffic of the site to the traffic is unimpeded, the North-South part of the road is not connected because of the obstructed part of the reservoir and the river; the internal roads are separated by the wall to form the broken road, and the connectivity is poor. （Figure 3）

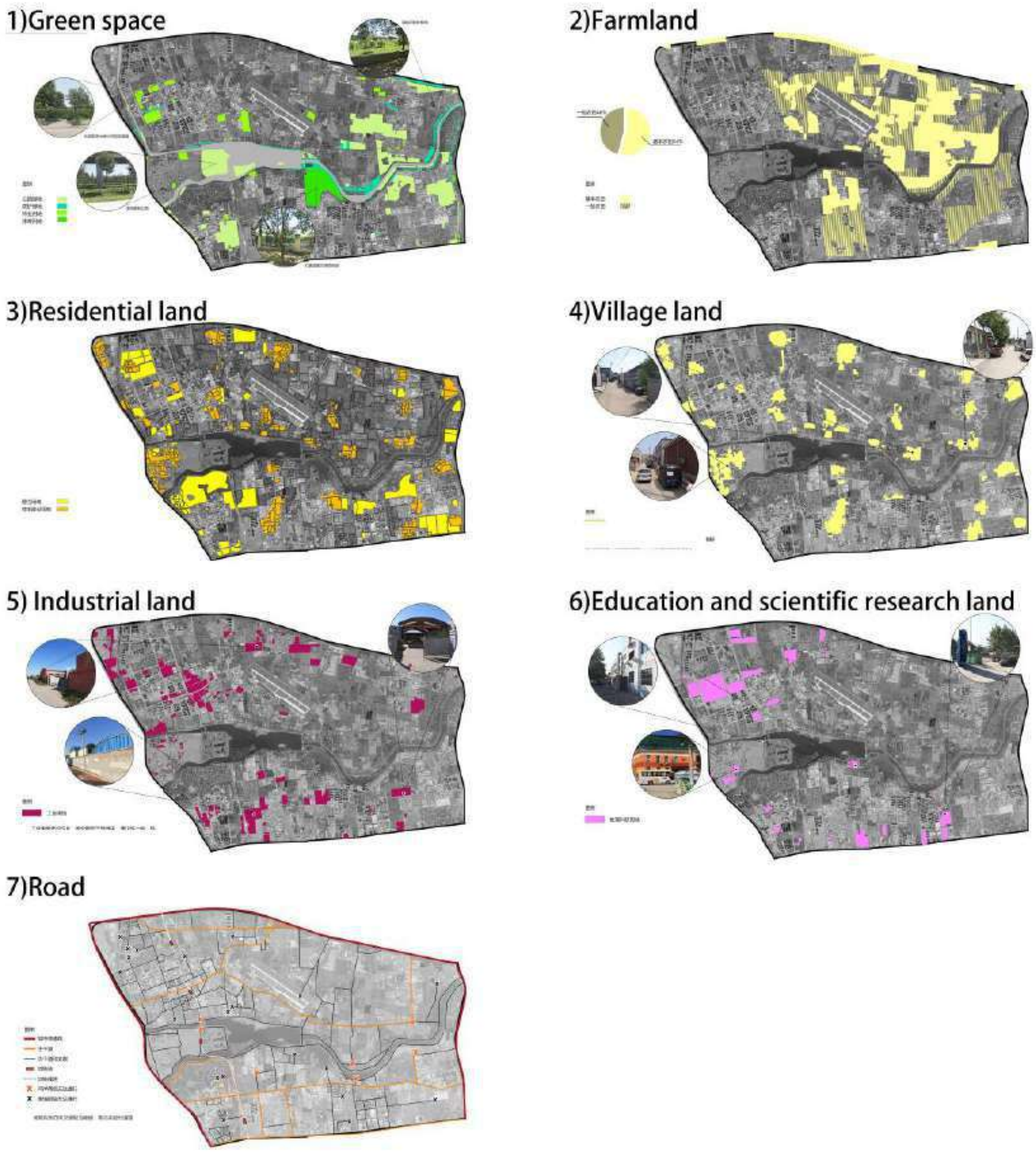

Figure3: Land-use analysis diagram

3.2.3 Summary of current problems

1) Excessive use of groundwater led to the desertification of soil: according to the literature, it can be seen that the water demand of living and agricultural land is large, while the site life and agricultural land occupy a large amount, while the surface water quality is not good, so a lot of groundwater is exploited in the field. Due to long-term over exploitation, the groundwater level decreases at the rate of 1.3m per year, which indirectly leads to soil desertification. 2) Non-point source pollution in water system is serious: non-point source pollution is caused by dissolving and solid pollutants from non-specific sites, under the action of precipitation or snow melting, through the flow of runoff into the water body. Frequent rainfall in summer produces more runoff, resulting in an increase in the proportion of non-

point source pollution. Due to the rain runoff produced by precipitation in the process of different underlying surface, pollutants are carried, and the water pollution problem will be caused by the entry of the urban drainage pipe network into the Shahe reservoir under untreated conditions.

3.3 Planning concept

After combing the research area, we hope to manage rainwater through the intervention of the elastic landscape, give priority to the natural drainage system, build the ecological drainage facilities, make full use of the effect of the urban green space, road and water system on the absorption, infiltration and slow release of the rainwater, and effectively slow the solution of urban waterlogging and reduce urban runoff pollution. Load, saving water resources, replenish the water level of the city, thus improve the urban ecological environment, and provide important guarantee for the construction of the sponge city with natural accumulation, natural infiltration and natural purification. In addition, integrate the current green space, add green space to the demand, and put in the function. Through the planning and design of the park under the management target of rain and flood, "the cold gray zone" is transformed into the "active green open space" in the city, the urban ecological environment is improved, the traffic system of the district is perfected, the slow running system of the riverside is built, and the living quality of the surrounding residents is improved.

In the construction of the "Hydroelasticity" system, the embankment space and the outer space of the embankment from the Shahe to Wenyu Reservoir River Basin are respectively taken into consideration. Inside the levee, second ecological embankments are added to the local dam(Figure 4), and the pit is set up as a rainstorm reservoir, dredging the silt at the bottom of the river, expanding the flood area, adding the submerged meadow, and increasing the ecological habitat. Provide greater space for the river to accommodate rainwater.

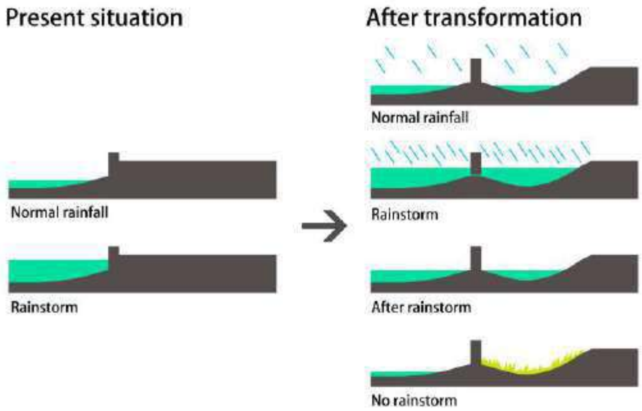

Figure4: ecological embankments diagram

Outside the levee, the source of rainwater is reduced, the middle section is transported and the terminal is absorbed, and the grass planting ditch, the concave green land, the reservoir and other passageways and sites are set up. Guide rain, give space to rain. At the same time, landscape design methods such as plant landscaping make the site more eco efficiency and landscape effect.

3.4 Hydroelasticity strategy

3.4.1 Rainwater runoff control

In the field investigation and analysis, there are many low runoff coefficient agricultural land underlying surfaces. We expect that under the condition of one year's 24h rainfall, the site controlled rainfall event is 85% and the designed rainfall is h=33.6mm. The area of the study area is F=9555ha, and the total runoff control rate is 85%. The design rainfall is h=33.6mm, and the overall runoff coefficient of the field is Ψ=0.49 (ideal water surface Ψ=1, green space Ψ=0.15, hard roof and asphalt roof Ψ=0.3, concrete and asphalt pavement Ψ=0.85), and the total volume is $W=157*10^3m^3$ in the study range.

$$W=10\Psi hF$$

3.4.2 Water collecting zoning planning

The rainwater collection area layout should first be based on the total amount control index of the rainwater runoff in the region, to convert the required volume of the sponge facilities, and to carry out the construction of the sponge facilities in the present situation and the future new park green land. In the layout, using the current high - range low-lying land, ditch and so on, the terrain design is carried out and the direction of rainwater runoff is arranged reasonably so that the sponge facilities can collect the rainwater effectively, avoid the intensive planting area of the present trees, transplant the trees, and empty the space for the construction of the sponge facilities.

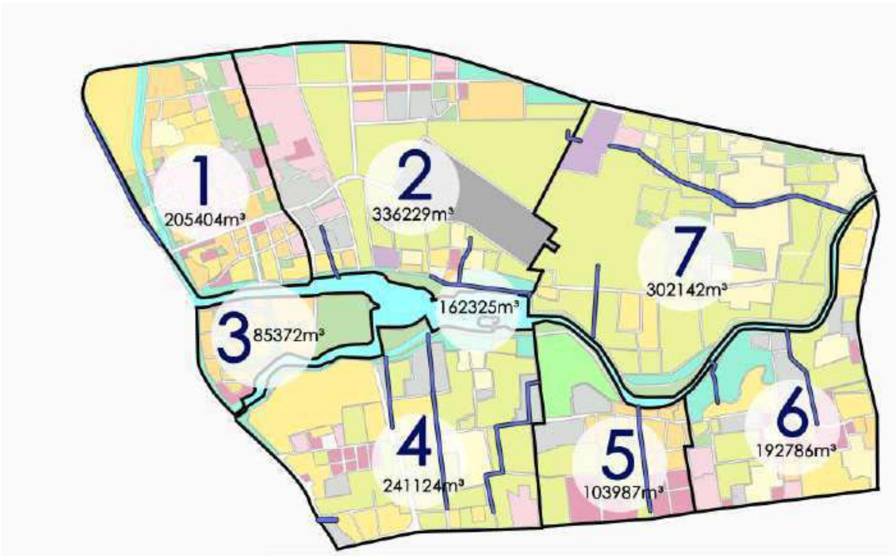

Figure5: Water collecting zoning planning diagram

There is a difference in the spatial distribution of land use in the scope of study, which leads to a large difference in the underlying surface of the different plots. In order to achieve the total runoff control rate of 85%, the study area is divided into the area of water collection, according to the hardening degree of different land use, the position of the water channel and so on, according to the principle of near emission. The scope of the study is divided into 7 water collecting zones(Figure 5). The discharge volume required for each partition to be controlled (Figure 6) is calculated. The discharge volume of each zone is $163*10^3m^3$, which is close to the $157*10^3m^3$ of the total runoff volume.

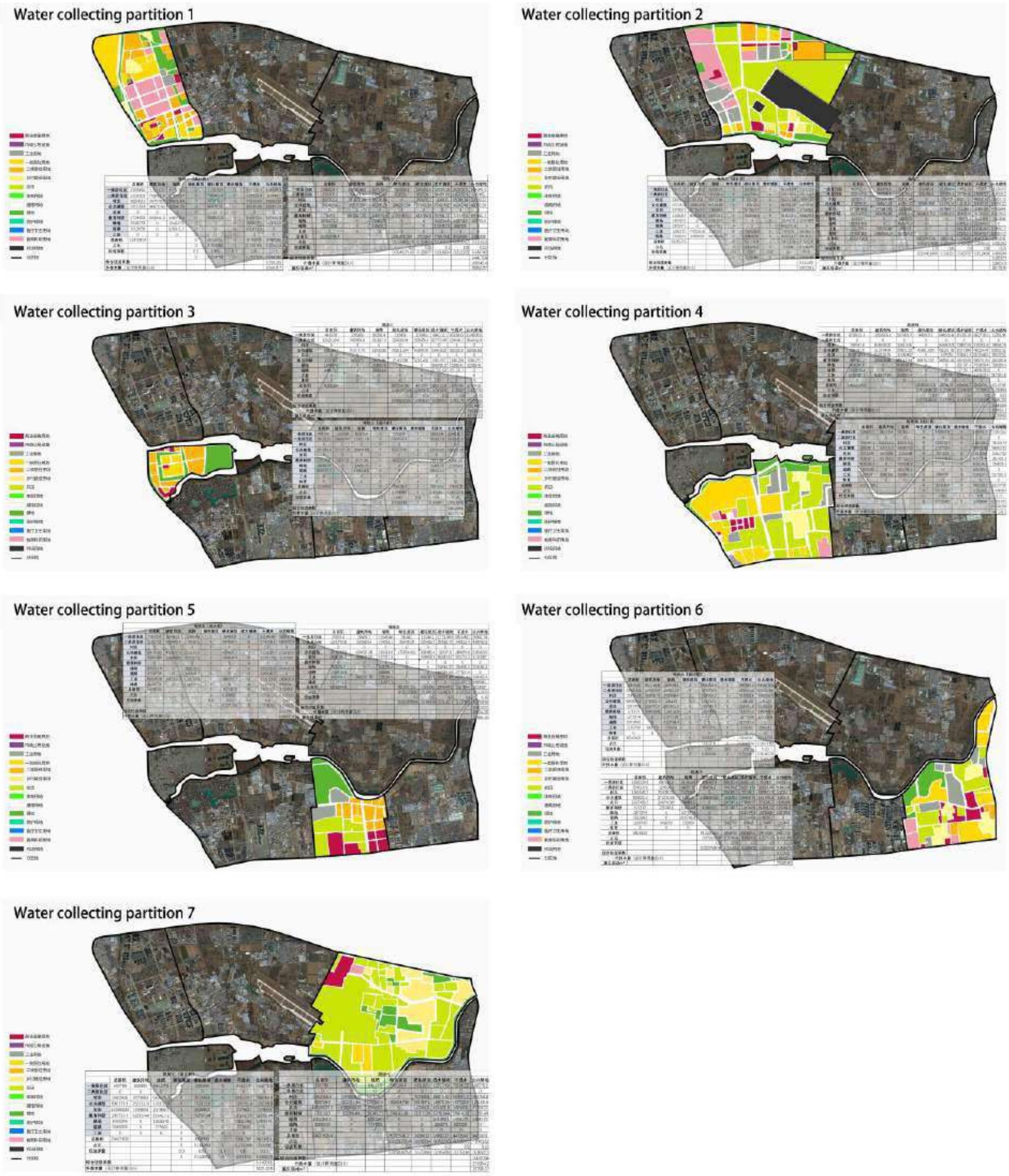

Figure6: Water collecting partition calculation diagram

1）Source reduction

The building area, road area, road area, road area, green roof area, hardened roof area, permeable paving area, water permeable paving area and public green space area are calculated and the runoff coefficient is calculated and the amount of external drainage is V1. In the design, the green roof, hardened roof, and water permeable of all kinds of land are designed. The area of loading, permeable pavement and public green space was redistributed, and the external drainage volume after design was V2. The rainwater volume at the source was V3. (Figure7)

<u>V3=V1-V2</u>

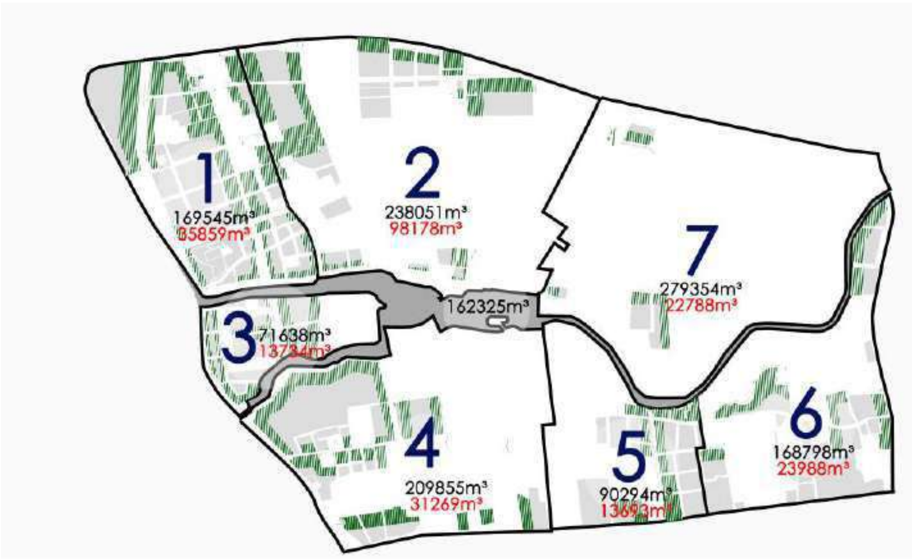

Figure7: Source reduction calculation diagram

2）Middle end transmission

During the middle end transmission, the water conveyance corridor is used to transmit rainwater. The water corridor is divided into two grades. The first grade corridor is the surface runoff from hard pavement to the lower concave green space in the vicinity of rain. The second corridor is after the rainwater passes through the first grade water transport corridor to the concave green space, which is stagnant in the green space, and finally into the green wet pond in the dike dam through the grass planting gully side of the road. Selecting the road side ditch in the research area as the water conveyance corridor and connecting the water conveyance corridor into a system. (Figure8)

Figure8: Middle end transmission diagram

3) Terminal elimination

New green spaces are placed in each catchment area to store rainwater transported by water conveyance corridors. The newly increased green space should be chosen from the general farmland close to the canal or the current green space, and the principle of distribution should be distributed as evenly as possible. After the increase of green space, the depth of the sunken green space is 0.3m, and the V4 of the newly increased green space should be greater than or equal to V2 of the external drainage after design. (Figure9)

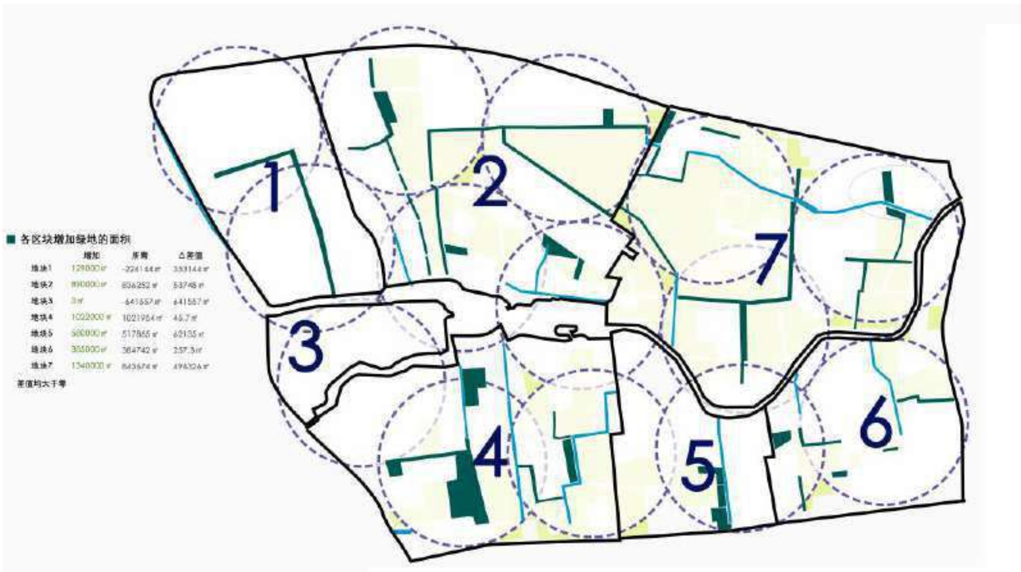

Figure9: Terminal elimination diagram

3.5 rainfall model simulation

In ordinary rainfall, the hard surface runoff is brought into the nearby green space, the green space is permeated with the rainwater, the orderly transport in the first grade corridor, the green and wet pond in the embankment and the dam, and eventually into the river. The total runoff of the area is $157*10^3m^3$, the total runoff is $157*10^3m^3$, the total runoff is $134*10^3m^3$, the source reduction rainfall is $24*10^3m^3$, the terminal elimination rainfall is

124*$10^3 m^3$, and the total amount of control runoff is 130*$10^3 m^3$. The target of total annual runoff control rate of 85% can be achieved in the region. （Figure10）

Figure10: Model simulation of ordinary rainwater diagram

In the rainstorm model, the runoff of hard surface flows into the nearby green space, the green space permeates the rainwater, and the remaining rainwater is discharged into the city pipe network through the spilled water pipe, and the rainwater collected in the city pipe network is arranged into the river. （Figure11）

Figure11: Model rainstorm diagram

4. Summary

The green space planning of the Shahe reservoir in Beijing is a controlled detailed planning case. The plan reflects that the theory and planning method of "sponge city" is suitable for multi-layer and multi scale. The trend of landscape construction in the urban fringe is an elastic landscape. The construction of "sponge city" has opened a hopeful journey to solve the problems of water and related ecological and environmental problems in the border area of China, including the management of rain and flood, ecological flood control, water purification, groundwater replenishment, palm restoration and habitat construction. Park green space construction, as well as urban micro climate regulation.

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Towards a sustainable and eco-civilized era: a national-wide project of pairing Ecological Restoration with Urban Repair (ERUR) in China

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ABSTRACT:

40-year rapid and massive urbanization and industrialization has caused serious problems of environmental pollution, ecological degradation, and function deterioration of urban habitat in China. Meanwhile, climate change put forward a new challenge of sustainable and resilient development on cities globally. Aware of those challenges, the government and the public in China has raised their interest and made efforts on restoring urban ecological system. As a pilot step, a national-wide project called “Ecological Restoration and Urban Repair (ERUR)” has launched in 2015 by the Ministry of Housing and Urban-Rural Development. Ecological restoration is quite a well-known, universal approach to restore the natural settings. Different from traditional ecological restoration projects, ERUR attempted to pair the ecological restoration with efforts to tackle with issues concerning human habitats, such as quality enhancement of urban built environment, urban disaster prevention, storm water management, brownfield restoration, historical and cultural heritage preservation etc. The urban repair component has therefore been well-integrated into the whole picture of ecological restoration. In this paper, the overall initiatives and objectives of the ERUR project will firstly be addressed. Following that, several cases will be discussed to identify the key features and main approaches on addressing both ecological restoration and urban repair within one project.

Study on microclimate Environment of Jiaodong Seaweed house -- Taking Dongpudao Village as an Example

(Study on microclimate Environment of Jiaodong seaweed house)

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Fang Yanan, TianJin University, China.

【Abstract】 Taking the seaweed house settlement in Jiaodong as the research object, this paper study the microclimate of seaweed house through experimental data, wind environment and thermal environment simulation. The analysis of seaweed house under the coastal climate conditions have three aspects: macroscopic settlement form, middle view block form and microscopic courtyard.

【Keywords】 seaweed house, settlement, ecology, microclimate

In the long history of farming in China, the unique geographical, climatic characteristics, historical , cultural of various places have created many traditional settlements, such as the settlement of cave dwellings in Shanxi, the settlement of Tulou in Fujian, and the settlement of bamboo buildings in Yunnan. Although these traditional settlements have different forms, they all contain ecological wisdom that is ingeniously adapted to the regional climate. The settlement of Jiaodong seaweed houses(Figure 1) is one of them. The existing traditional seaweed house settlements are mainly distributed in the coastal areas of Weihai, Yantai and Qingdao. The complex and diverse climatic conditions of the region (wet and rainy, high salinity, windy, strong radiation) and the geographical features of the integration of mountains and seas have an impact on the settlement pattern of seaweed houses. At the same time, the settlements of seaweed houses also form from macroscopic settlements. The settlement form, block form and micro-court form respond to the local geographical climate. After long-term development, the seaweed house settlement not only forms a simple and beautiful settlement environment, but also has ecological characteristics, realizing the unification of ecology and modality, and is a precious ecologically sustainable architectural cultural heritage in the northern coastal of China.

Figure 1 :seaweed houses

1. Macro ecological strategy

At the settlement level, temperature, ventilation and drainage are the main factors affecting the settlement pattern of seaweed houses. The seaweed house settlement creates comfortable temperature and ventilation conditions through the location of facing the sea with the hills for a background, the compact layout, reasonable orientation and the sand surface with big specific heat capacity increase the thermal stability of the settlement, at the same time, The good permeability of sand land and open ditch can effectively reduce the impact of the torrential rain disaster that is prone to occur in the coastal area. The macro-settlement ecological strategy of seaweed houses includes,

1.1 Settlement site of facing the sea with the hills for a background

The seaweed house settlement is generally located on the adret in the coastal zone. This traditional location of facing the sea with the hills for a background can make full use of the climatic characteristics of the land and sea junctions in the coastal area of Jiaodong to create a comfortable and livable settlement.

Utilization of coastal climate: Seaweed house settlements are generally distributed within a certain distance from the coastline but not more than 10km. This kind of sites can take full use of the climatic characteristics of the summer and winter temperatures in the coastal zone, and avoid the humid climate in the coastal area. Living close to the sea is also facilitates fishermen to go out to sea and effectively improve the comfort of living (Figure 2). Relevant meteorological data show that the distribution area of seaweed houses is obviously affected by ocean climate. The temperature in summer is 4℃~6℃ lower than that in inland areas in the same latitude, and the temperature in winter is 3℃~5℃ higher than that in inland areas in the same latitude.

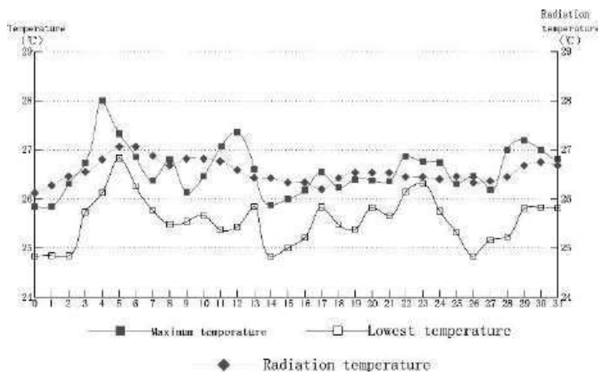

Figure 2 : Indoor daily highest (lowest) temperature measured in August

Use of altitude difference: Most of the mountains in Jiaodong are wide and gentle. The settlement of seaweed houses is generally located in the area with suitable slope and open terrain on the south side of the mountain. The flat land below the mountain is reserved for cultivated land. The building gradually rises with the hillside in order to obtain good sunshine, while the good ventilation of the sunny slope helps to accelerate the diffusion of humid air. In the winter, the mountain can also block the cold wind for the settlement.

1.2 The settlement form on the mountain

Affected by mountains and coastlines, the construction base of seaweed houses is relatively small, so the settlement is compact (Figure 3). Take Dongchuudao Village for example, the settlement covers an area of 2,160 ㎡, its total construction area is 90,65 ㎡ and building density is 42%. This compact space shape can maximizes the impact of the external environment and creates a comfortable thermal environment inside the settlement. In summer, the high-density settlement form allows buildings to block each other, greatly reduce the area and time of exposure the sun and increase indoor thermal comfort (Figure 3). In winter, the cold wind passes over the roof of the seaweed house and the Internal space forms a continuous wind shadow, which can effectively reduce the wind speed inside the settlement (Figure 4) and reduce heat loss.

Figure 3 ： Seaweed house courtyard form

1.3 Sandy and soil mixed ground

The ground of the of seaweed house settlement is the sand formed by the weathered mountain stone, which has good thermal stability and drainage performance. First of all, the specific heat capacity of the sand is large and a large amount of solar radiation is absorbed during the daytime, so that the temperature inside the settlement is lower near the ground. At night, the sand has good air permeability, fully releasing the heat accumulated during the day and maintaining the temperature stability at night. Secondly, the porosity of sand is high, a large amount of rainwater can quickly infiltrate into the sand during the rainy season. The remaining rainwater flows into the open channel and is discharged into the sea, so that the settlement avoids the impact of rain and flood disasters (Figure 4). In addition, the sand is not easy to produce muddy water after the rain, so it has little impact on the outdoor activities of the fishermen after the rain.

Figure 4 ： *After the rainstorm*

2. Block Ecological Strategy

The streets are not only the transportation spaces of the seaweed house settlement, but also important places for outdoor activities of local fishermen. Therefore, the microclimate environment of street space directly affects the quality of outdoor activities of fishermen. The microclimate environment in the street space is mainly affected by two ecological factors, wind and solar radiation. The seaweed house settlement can provide fishermen with a cool space through the appropriate street height-width ratio .The streets can also guides the summer ventilation and blocks the winter cold wind with reasonable street orientation; The ‘long street short lane mode’can effectively stabilize the wind and thermal environment of the street space. The ecological strategy of the seaweed house street space includes,

2.1 Shade-cooled street aspect ratio

The air permeability in the coastal areas is high. The ultraviolet rays can effectively pass through the atmosphere to reach the ground. In addition, the reflection of ultraviolet rays by seawater and the stimulation of human skin by saline-alkali air can easily cause ultraviolet burns on the skin. In the summer, reasonable street height ratio of seaweed houses helps to create more shaded areas street space, effectively alleviating the effects of ultraviolet rays, and avoiding the radiation warming effect caused by direct sunlight. It is important for seaweed house settlements to improve the comfort of summer street space.

In the seaweed house settlement area (latitude 37°north), the influence of solar radiation on the thermal environment of the north-south roadway is greater than that of the east-west street. Therefore, the seaweed house settlement is usually have east-west street and north-south narrow alley. Take the street space of Dongchudao Village as an example, the height-width ratio of the street of east-west streets effectively reduce the solar radiation entering the street. At night, the sky space

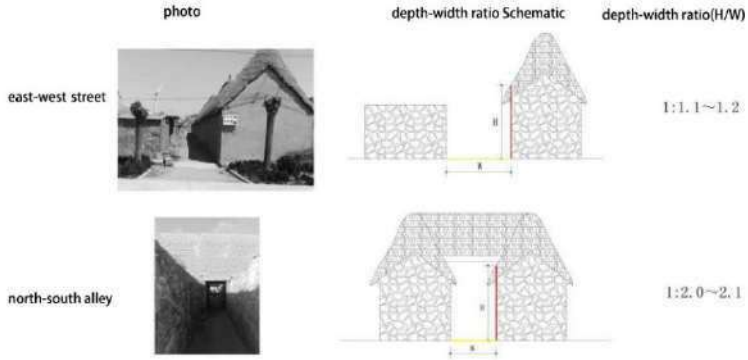

Figure 4 ： *street (alley)shade*

factor of the seaweed house street space is large, and the heat dissipation through long-wave radiation with less hindered. The heat accumulated during the day can spread rapidly so that the street space in summer is very cool. For the north-south narrow alley, although it is exposed to direct sunlight at noon, its small width prevent solar radiation from entering the alley so the solar radiation has little impact on the outdoor activities of fishermen. Local fishermen often use the method of riding the roof to enhance the shading effect (Figure 6). In addition, because the sunshade effect of the seaweed house settlement space is good, the air temperature in the street space is lower during the daytime, and the high temperature air above the roof cannot enter the street space, so the street space can be keep cool.At night, the solar radiation

disappears, the temperature of the air above the roof drops sharply, the temperature is lower than the temperature of the street space, and the cold air enters the street space and forms a convective wind, which makes the micro-climate in the street space cool and pleasant.

2.2 The influence of street orientation on the wind

The seaweed house settlement street is about 15°eastward from the south of the settlement, which can effectively guide the summer ventilation and block the winter cold wind. In summer, the local wind direction (southeast wind) and the street direction (east-west street) are at an angle of 60°. The wind environment simulation software PHOENICS was used to simulate the wind environment of the seaweed house street space. It can be seen from the simulation result 1 (Figure 5) that when the street interface and the airflow direction are at an angle of 60°, the effective span becomes smaller, which can effectively guide the airflow . so that the wind speed in most areas of the street space is between 1.2 and 1.8 m / s, which is very comfortable in summer. In addition, when the basic airflow in the summer is weak, the unique' sea breeze and land breeze' is blown into the settlement with the wind direction is parallel with the street direction. So that the wind has less resistance during the flow, and the street space can still obtain a comfortable wind speed. In winter, the local wind direction (northwest or northwest) is between 95°and 110°from the main street, and the wind direction is basically

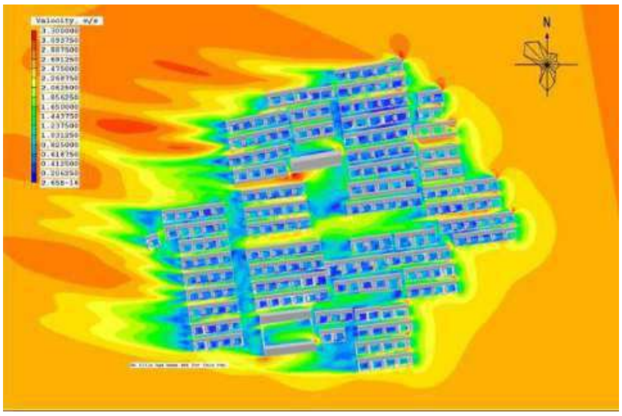

Figure 5 : Summer wind simulation

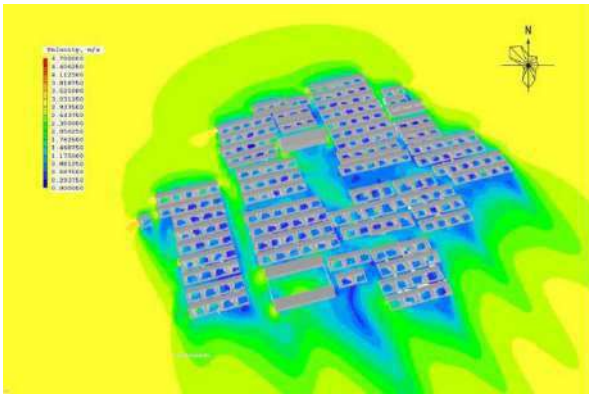

Figure 6 : Winter wind simulation

perpendicular to the street. From the wind simulation result 2 (Figure 6), the wind speed in the street space is significantly smaller than the wind speed outside the settlement. In most areas, the wind speed is between 0.3 and 0.9 m / s, and the human body barely feels the wind speed. It can be seen that the street space can effectively block the cold wind, greatly reduce the wind speed in the street space, and minimize the heat loss caused by the cold air movement.

2.3 Climate stable street pattern

The reasonable orientation and aspect ratio of the seaweed house settlement street effectively improves the thermal comfort of the street space, while the' long -street-short-alley' mode can further stabilize the thermal environment in the street space. Limited by topographical factors such as mountains and coastlines, seaweed house settlements are generally arranged in rows (Figure 3), forming a street pattern of' east-west long streets and north-south short alley' (Figure 7). This kind of street mode can bring more shadows in the summer while storing more heat in the winter. In addition, the number of north-south alley in the seaweed house settlement is small, which can reduce the channels for the northerly winds entering the settlement in winter. The existing north-south alley are also tortuous. After the cold wind enters the alley, the flow is blocked and the wind speed is greatly reduced.

3. Courtyard ecological strategy

Courtyard is the most commonly used place for fishermen. Its temperature, humidity and wind speed directly affect the comfort of living. Seaweed houses are highly ecological and coastal in terms of courtyard layout, building scale, building materials and their construction practices. The ecological strategy of the courtyard of seaweed houses includes:

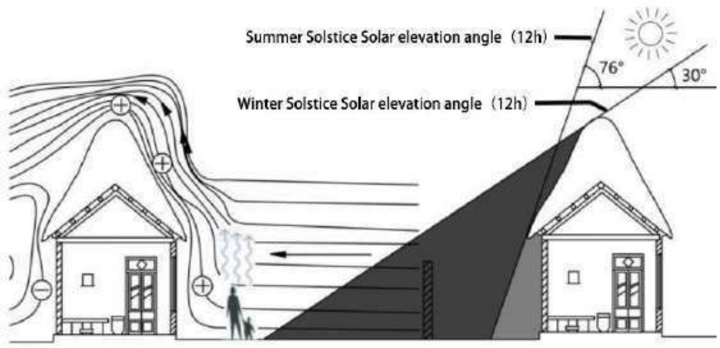

Figure 7： Seaweed house profile

3.1 Reasonable courtyard space

(1) The combination of courtyards: affected by the coastal climate and the defense military, 3 to 5 seaweed houses are general in a row, and the two share the middle wall (locally known as “JieShan”). This type of courtyard link can save land and save building materials and reduce heating energy consumption. It also reflects the good neighbourhood between fishermen.

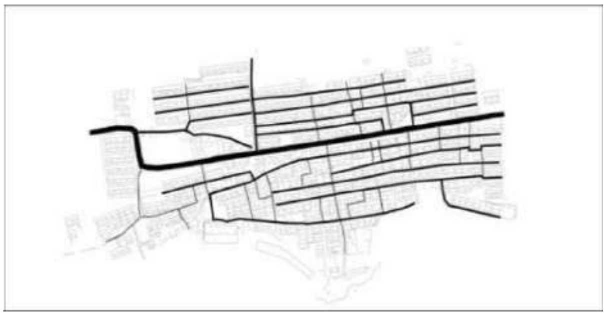

Figure 8 ： street and alley

(2) Reasonable courtyard size: The courtyard of the seaweed house is 5~7m long from and 4~5m wide. In summer, the deciduous trees planted in the courtyard are lush and cover almost the entire courtyard and making the temperature in the courtyard lower than the temperature outside the courtyard. The difference between the internal and external air pressure promotes the air flow, which brings the cool air and promotes the evaporation of water, which can effectively dehumidify and dissipate heat. In the winter, the small courtyard space and the heavy structure make the inner space of the courtyard less affected by the external cold wind, forming a stable and comfortable microclimate.

(3) Reasonable main room scale: The plane of the main room of the seaweed house is rectangular, and the width of main room (9~12m) is beneficial to increase the radiation heat in winter, and the depth of main room (3.6~4.0m). At the same time, the square shape has the smallest coefficient (about 0.6), which can effectively improve the indoor thermal environment.

3.2 Towering roof

The roof of the seaweed house has a large slope, usually between 50°and 60°, which adaptability to local climate well. In view of the climatic characteristics of high winds, high precipitation and sufficient sunshine, the slope roof can make full use of wind resources and solar energy.

3.2.1 Leading the winter cold wind to high altitude

In winter, the wind speed and humidity in the coastal zone are large, and the humid cold wind makes people feel abnormally cold. The roofs of seaweed houses are connected to each other to form a continuous wind-shielding interface, which can effectively lead the winter cold wind to the high altitude, greatly reduce the wind speed inside the settlement, and slow down the heat exchange process through the vertical circulation flow. In the simulation of the winter wind environment in the seaweed house settlement (Figure 9), the wind speed at the courtyard space of the seaweed house settlement and the pedestrian height (1.5m) of the street space is 0.5~0.9m/s, which wind speed in winter. In addition, the saddle-shaped curve

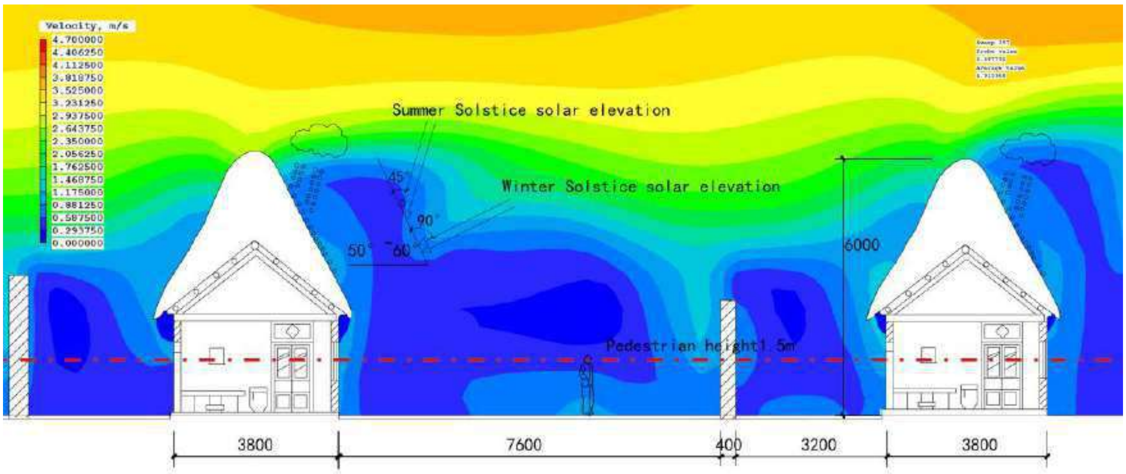

Figure 9：Profile wind simulation

of the ridge of the seaweed house can smoothly guide the airflow, avoiding the “corner wind” effect, causing the wind speed at the ridge to be too large, and blowing the seaweed on the ridge.

3.2.2 Make full use of sun radiation in winter

The roof of the seaweed house helps to absorb winter solar energy and prevent summer exposure, improving the thermal comfort of the indoor environment. As shown in Figure 10, the roof of seaweed house is basically perpendicular to the sun's rays on the winter solstice. The effective area on the sunny side of the roof is the largest. The thick material absorbs the solar radiant heat during the day and effectively blocks heat loss the indoors On the summer solstice, the roof and the the sun's rays at a angle 45°, which reduces the roof's radiation area by 30%, helping to create a cool interior environment .

3.2.3 Accelerate drainage and reduce accumulated snow

In order to minimize the impact of heavy rain and snow in the coastal zone, the slope of the seaweed house has a slope of 50°~60° (Figure10), which can quickly eliminate summer rain and reduce accumulated snow. According to the mechanical calculation, under the same friction coefficient (with a friction coefficient of 0.1), the 60°slope roof is 1.7 times better than the 30°slope roof, and can reduce the snow by 50%. The good drainage performance of the seaweed house roof prevents the seaweed from being damp and greatly prolongs the service.

depth-width ratio	Slope	Windward wind pressure	Leeward wind pressure	Description
≤1:7.5	≤15.0	-0.6	-0.5	The slope is very small, the windward surface reaches the maximum, and the roof is very threatening.
1:6.3	17.5	-0.5		The windward and leeward negative pressure values are the same, and the roof is subjected to a thrust of 0.
1:5.5	20	-0.4		The negative pressure on the leeward side of various slope roofs is -0.5
1:5.0	21.8	-0.3		Fujian coastal residential roof slope
1:4.0	26.6	-0.1		The windward negative pressure is very small
1:3.5	30	0		Windward without wind load
1:3.0	33.7	0.1		The wind pressure on the windward side is small and positive
1:1.0	45	0.4		Positive pressure on the windward side increases with increasing slope
≥1:1.2	≥60	0.8		Slope ≥ 60°, positive pressure on the windward side is equivalent to vertical wall positive pressure

Figure 10： *Roof wind pressure*

3.2.4 Wind disaster reduction

Because the seaweed is light and easily blown by strong winds, the windproof performance of the seaweed roof is very important. The towering roof of the seaweed house can effectively alleviate the impact of strong winds. Table 1 shows the wind load coefficient of the roof under various slopes calculated according to the current 'Load code for the design of building structures'. It can be seen that the flatter the roof, the greater the negative pressure on the windward side, and the greater the negative pressure coefficient of the windward side of the roof. The slope of the seaweed house roof is generally between 50°and 60°, and the windward side of the roof is in the positive pressure zone (Figure 10). Therefore, the seaweed is not easy to be blown by strong winds, and the positive wind pressure on the windward side of the roof can press the seaweed more compact. In addition, the seaweed slowly absorbs the moisture in the air, and the roof becomes compact from fluffy, and the whole body is strengthened, and it is not easy to fall off. Even if the part is blown off, the seaweed is light, and it will not hurt local fishermen.

3.3 Ecological materials and construction

The fluffy seaweed roof and the thick rock wall are typical features of the seaweed house, which is due to the particularity of the building materials and the complexity of the construction process. The main materials of the roof are seaweed and wheat straw, and both materials are taken locally. The straw is smooth and breathable, and the seaweed is firm and resistant to corrosion. The thickness of the seaweed is gradually thickened from the eaves to the ridge, and the thickest part is 1~2m (Figure 11). This special structure maximizes the ecology of the material. The characteristics make the roof have good thermal insulation effect. The gap between the seaweeds also gives the roof a 'breathing function', which provides a cool and breathable condition for the interior space. In addition, the seaweed used for roof contain halogen and glue, so its service life can be as long as 100 years.The seaweed also has the characteristics of insect proof, antisepsis and non-burning. The granite blocks of the wall are all from the mountain around the settlement, the stone masonry is round and be builded in a random way. In order to achieve thermal insulation, the thickness of wall of the building is more than 400mm, and some of the walls are covered with a layer of plaster to prevent moisture. At the same time, the tiny permeability of granite (0.2%~4%) can effectively prevent outdoor moisture and rain from entering the room.

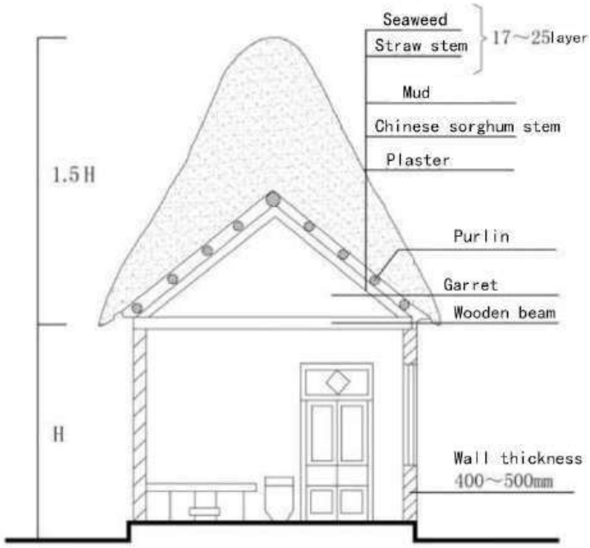

Figure 11： Construction practice

Conclusion:

The seaweed house is an important part of traditional Chinese dwellings which was been created in a specific environment for generations. As a symbolic residential symbol in the Jiaodong area, seaweed houses are gradually disappearing as the fishermen's lifestyle changes. We have the responsibility to protect the remains of the seaweed house and the ancient technology. At the same time, it is necessary to understand the aesthetic value from the construction process of seaweed house, explore the value of traditional ecological residential building technology and materials. We should study the application of traditional building materials in modern architecture, then promote development of traditional architecture.

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Planning for Change: The Forms and Flows of Lisbon Metropolitan Area Food System

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1. Introduction

The aim of this paper is to introduce the goals and some preliminary results of a research Project 'SPLACH – Spatial Planning for Change', financed by European Funds through Portugal 2020 Program, which aims to contribute with new knowledge for a desirable shift of existing urban planning policies, in order to promote a low carbon and social inclusive urban system. SPLACH is about the role of cities, city networks, urban regions, metropolitan regions, and of spatial planning, in addressing structural changes (from crisis and post-crisis issues to climate change issues) and the societal challenges associated to those changes.
In order to contribute to the debate placed by SPLACH, this paper focusses its analysis on the contributions of two specific working packages prepared for SPLACH Project, which deals specifically with the thematic of Urban Planning and Food, namely: i) Transition paths to urban sustainability; and ii) Food Security and Sustainability.

2. Climate Change and the society request for Sustainability

Cooling the planet and improving the environment of our cities emerges as a collective social duty to which urban planners, urban dwellers, but also urban policymakers, should respond equally to counteract the effects of the occurring climate change, as argued within major international policies, ratified by most members of the United Nations, inclunding the Paris Agreement (United Nations, 2015a) and the Sustainable Development Goals (United Nations, 2015b).
Guiding the work of urban planners and policymakers, as well as the choices and daily practices of urban dwellers, in order to practice such Sustainability goals and agreement, emerges therefore as a crucial task. One, that should contribute to understand and intervene over the deep structure of cities, while acknowledging how the urban realm works and functions in terms of its various networks and respective flows (Batty, 2013).
A number of efforts, applied at the municipal level, are deemed to be identified as important contributions to respond to such request, at the same time that do emphasize the social and ecological dimensions of Sustainability, to which 'The New Urban Agenda' (United Nations, 2017) should also respond. For example, the recent Milan Urban Food Policy Pact (MUFPP, 2015) acknowledges the strategic role of cities and municipalities in promoting sustainable food systems, whereas enhancing food security and nutrition for healthy and equitable territories. Moreover, this Food Policy Pact reinforces the idea that is precisely at the municipal level, where urban agriculture and food provision can contribute to centre such debate on the urban planning sphere. Nevertheless, neither the urban forms that have been explored to respond to such problematic appear to have been sufficiently investigated (Lo, 2016; Parham, 2015), nor the processes of living, consuming and producing in cites, in which are included the social and economic flows that sustain the urban food system, appear to have also sufficiently investigated (Neuman, 2005). Therefore, a comprehensive approach to the metabolic function of cities, which could contribute to inform on how to optimize the efficiency of an existing urban fabric (Thomson and Newman, 2018), for example in terms of its food system functioning has not been sufficiently investigated.

In order to contribute to this debate, this paper argues for an integration of food within urban planning to support future planning policies and urban form guidance, that while emphasizing the metabolic functioning of the urban realm, could catalyse a desirable urban sustainability transition of the current urban system. Therefore, this paper aims to discuss the theoretical and methodological framework that has guided SPLACH project to approach the food system problematic, while dissecting the urban forms and the social-economic flows that affect the urban metabolic function of the urban realm. The research that is conducted at this project shall be applied in Lisbon Metropolitan Area (LMA), where most of Portuguese citizens live and work. In order to do so this paper aims to focus on the forms and flows, which seem to have been determinant within LMA food system, while scrutinizing possible typologies and relations, among them, which are deemed to be evaluated from a metabolic perspective. This theoretical and methodological framework aims to guide a possible analysis of the food system of LMA, whereas informing future analysis applicable to other areas.

3. Food and Urban Planning: towards a systemic approach of the socio-ecological urban system

"*Planning can and should constitute a sustainable transformative device for our cities in Europe and elsewhere, and particularly in times when environmental and societal pressures are being assigned. Indeed, current practices and behavioural changes seem far deeper within existing urban fabrics where a profound reorganization of functions and activities are occurring, when compared to urban areas, where past investments in infrastructures and in the built environment seemed to have exceeded the real demand and generated a surplus of the building stock, which in some cases remain partially empty or underused*" (SPLACH Project brief, 2017: 16).

In order to identify possible areas where urban planning could contribute to a sustainable transformation of the current urban system, the SPLACH Project was prepared for financial evaluation of the Program Portugal 2020, co-financed with European and Portuguese funds. This Project, coordinated by the University of Porto, was prepared with the contribution of the main areas of knowledge of three Portuguese research centres respectively, namely: i) CITTA, from the University of Porto; ii) DINÂMIA'CET-IUL, from Lisbon University Institute ISCTE-IUL; and iii) GOVCOPP, from the University of Aveiro. While the first centre is specialized in the areas of urban metabolism and urban planning and transport, the second research centre focus on the socio-economic perspective of the metabolic functioning of cities, Urban Morphology and Sustainability Transitions; and the third centre on issues related to Tourism and Urban Modelling. Furthermore, "*two to three main areas of knowledge were identified for each of these centres, respectively: post carbon cities, transformative policies, spatial planning, socio-technical system, food security, services of general interest, tourism and modelling. Based on these areas of knowledge and on the research strategy of each centre, seven Work Packages (WP) were identified for the SPLACH Project: 1) contemporary spatial dynamics, 2) transition paths, 3) food security and sustainability, 4) urban metabolism, 5) sustainable tourism, 6) planning services of general interest in times of austerity, 7) the potential of transformation of public policies. Finally, a further WP on urban modelling will congregate the contributions from the previous WP"* (SPLACH Project brief, 2017: 16).

The main objective of the SPLACH Project is to produce a comprehensive and coherent body of development control and transformative planning policies, implementation mechanisms, planning models and decision support systems, able to guide Portuguese planning practice, including both the public and the private sectors, at the plan making and the licensing stages - towards a rapid and effective transition to a low carbon and social inclusive urban system. The overall team of SPLACH Project includes Architects, Civil Engineers, Economists, Environmental Engineers, Geographers, Landscape Architects, Sociologists and Urbanists.

The work that is being introduced in this paper, regards in particular the line of thought which has been followed at DINÂMIA'CET-IUL, in order to contribute to the SPLACH Project, throughout the development of two specific but interlinked working packages, namely: 'Transitions Paths to Urban Sustainability' and 'Food security and Sustainability'. Furthermore, the research team that embraces the development of these two specific WP includes a multidisciplinary background, which includes Architects, Economists, Geographers, Sociologists and Urbanists.

3.1 Transitions paths to urban sustainability

"*Transitions paths to urban sustainability is a Work Package that is built upon a theoretical framework where the concept of Socio-Technical Systems (SST) is central. SST are sets of linkages between elements that are necessary to perform the big societal functions such as communication, energy, housing, transport and nutrition. The main goal of this WP is to produce new knowledge that supports the reading of a possible transition of the current function of SST towards sustainability, informing future territorial oriented policies on how to allow such transition process. Research developed at DINÂMIA-CET, over the last years, includes a number of financed projects which have covered this issue, wherein applied at Lisbon Metropolitan Area (for example the MEMO and the PERIURBAN Research Projects*[i]*) - its main case study, while covering different but specific problematics, such as land use, housing distribution, access to water facilities and agriculture uses*" (SPLACH Project brief, 2017: 46).

"The main strategy of the WP 'Transitions Paths to Urban Sustainability' is to draw on the available body of knowledge of the various disciplinary areas present at DINÂMIA'CET SPLACH Project research team, in order to support the reading of future areas of interest for the sustainability transition of the current functioning of the food system, in order to inform future urban policies" (SPLACH Project brief, 2017: 46).

Territory oriented policies, in general, and urban policies, in particular, constitute one of the main dimensions within such reflection for the achievement of urban sustainability. The implementation of a strategy towards a more sustainable city and of urban form (Marat-Mendes, 2002, 2013) and the shift to a new societal paradigm involves policy-driven actions aiming at land uses, territory planning and environmental issues (Marat-Mendes, 2014). *"Therefore, the analysis of SST and of Urban Metabolism includes the identification and the critical assessment of policies concerning Urban Planning, Agriculture, Rural Development and Environment"* (SPLACH Project brief, 2017: 46).

"*Land use and the development of economic activities in metropolitan areas are influenced by the classification of land through urban planning policies, which may present multi-level and multi-scale nature. Agriculture and rural development activities have an important role in the reflection of sustainability, including in the design of metropolitan areas. Therefore, agriculture and rural development policies are at the core of the debate on paradigmatic changes involving those areas. The financial support and the regulation of farm and rural activities supported by these policies have direct and multidimensional impacts on the territory and should be assessed in the debate on sustainability and urban metabolism. In addition, environment and ecological values do determine policies on land use restrictions and territory planning. This is the case of the Habitats Directive, the European Natura Network 2000 and legislation on Agricultural and Ecological Protected Areas integrated in territorial urban planning tools. Environmental policy includes other regulations and mandatory actions like EIA of projects with territorial relevant impacts in multiple dimensions. To sum up, the policy-driven strategy towards sustainability and the design of urban metabolism should also address the identification of policies which present important impacts on land use and territorial development, as here proposed*" (SPLACH Project Program, 2017: 46).

3.2 Food security and Sustainability

The main goal of the Work Package entitled 'Food Security and Sustainability' is to *"design a strategy that integrates concerns of food security with spatial issues towards a*

Post-Carbon City (PCC). This Work Package aims to provide an evaluation of the specific nutrition SST of Lisbon Metropolitan Area, while establishing a possible methodology which can be applied on other urban areas. This Work Package is established on the assumption that the nutrition SST is very relevant to sustainability and as such can contribute to a future agenda for a PCC, as already advocated by a number of political and scientific agendas (e.g., Europe 2020; EU Common Agricultural Policy; and Milan Urban Food Policy Pact). The acknowledgement of this issue is in line with the multidimensional approach to sustainability and the resilience of cities, which should consider the current main societal challenges such as food security, at different scales of approach in simultaneously. A number of complementary approaches to access the nutrition SST, including urban metabolism, food security, and technological and social innovation, accessed in the above identified working package 'Transitions paths to urban sustainability' are therefore determinant to inform the methodological approach that will be here followed. In addition, distinctive methods, tools and sources with interest to the investigation, which contribute to build the main analytical framework of the investigation, will also be identified during the development of this Work Package. Likewise, a number of relevant case studies carried out in other contexts will be used" (SPLACH Project Program, 2017: 48).

This framework should provide views on the impact of production, distribution and access to food at different territorial scales. "*The proposed framework acknowledges the analysis of the food SST of LMA, in a sustainability perspective, while prompting for an identification of the: (i) main obstacles that operate in the dominant system, in practice; (ii) the new and emerging experiences which are taking place in LMA, at present; and (iii) the characterization of the SST landscape of LMA*" (SPLACH Project brief, 2017: 48).

This Work Package draws upon previous research developed at DINÂMIA'CET, which included PERIURBAN, MEMO and TESS[ii] Projects. In particular, the first two have investigated the changes occurred in the territory of LMA in terms of land use, water infrastructures, agriculture, food and other resources, both in a historical and contemporary perspective, while making use of multidisciplinary methodological approaches, which have allowed the direct interaction with the main actors involved in the study area, and of varied methodological contributions from various disciplinary areas, from the social sciences mostly. *"The final output of this Work Package shall be the characterization of the nutrition SST of LMA; the identification of the key factors and agents able to promote change towards sustainability; and the construction of an analytical framework applicable to other contexts*" (SPLACH Project brief, 2017: 48).

4. The Food System. Concepts and main approaches

Following the introduction to the SPLACH project and to the two specific Work Packages, within which the relationship between the Food System and Urban Planning will be examined at SPLACH Project, the present section aims to introduce the preliminary results of the Food System literature review analysis, conducted at DINÂMIA'CET-IUL Research team, in order to identify how is the Food System defined and approached within current scientific literature, in particular dedicated to urban planning issues.

From the identified literature, it is possible to verify that there has been an increasing interest to the thematic of the Food System, from the scientific community, as testified by the available number of publications (articles and books) but also institutional and governmental reports. From this growing body of literature, it is also possible to identify a common ground of covenant in what regards the definition of food system itself. Unanimously described as a system of activities across which food is produced, processed, distributed, cooked, eaten and disposed. Within this description, other elements are also included, such as: i) the activities which are performed within the several steps of the food system; ii) the institutions and the actors which are related to those activities (Pothukuchi and Kaufman, 2000, p.113); iii) as well as the power relations established throughout such activities processes (Wekerle and Classens, 2015, p. 1178).

Consequently, this identified agreed basic definition of the food system seems to have contributed to the construction of an analytical methodological approach of the food system, which has mostly guided a process of desegregation of the food system itself. Thus, allowing the reading of the food system throughout its several elements and layers of contact, among its different scales of resolution (inclunding the individual and the collective, the public and the private, the local and the global, among others). Interestingly, Reisch et al (2013) have employed the term 'integrative paradigm' to define an adequate methodology towards the reading of the food system.

The definition itself and the above identified methodological approach has been able to place a number of problematics among the scientific community, namely: i) the impacts of the agri-businesses and the economies of scale, which have affected the western world and in greater level the emerging countries, throughout their processes of modernization of agriculture industry (Battersby, 2017; Steel, 2013); ii) the problematic of the high fragmentation character of the food industry (Reisch et all, 2013) which have urged a number of calls towards the need for interdisciplinary links between this field of study and urban planning (Brinkley, 2013; Cabannes and Raposo, 2013); iii) the fact that the food system has been left predominantly to the private sector in most western cities (Pothukuchi and Kaufman, 2000); and iv) the transformation that is occurring within the food system due to the absence of a food system planning (Battersby, 2017); among others.

Interestingly, it is precisely at the domains of the several points of contact of the food system (which integrates the social, the economic and political spheres) and on the best way to approach them towards a sustainability transition of the food system, where one finds however less consensus among the scientific community. This situation reflects a contemporary opposite positions towards the specific problematics, which affect society and the environment. For example, in what regards the level of acceptance of the neoliberalism position or the domain of the private market over the cities and its public space, but also the existing social inequalities (Cabannes and Raposo, 2013; Drago, 2018) and the sustainability threats (Cohen and Ilieva, 2015; Fischer-Kowalski and Weisz, 2016). These in turn, contribute to question which institutional structures or solutions of power distribution, do respond better to such urban systems and problematics.

In what regards the food system, its link to society, either in terms of subsistence, access to food, health issues, or its organization within space is paramount to the sustainability of the urban environment (WCDE, 1987; United Nations, 2015b; Mazzocchi and Marrino, 2017). Accordingly, Gandy (2006, 2004) identifies the functioning of any urban system, as determinant to the metabolic function of the urban environments, in all its various dimensions (social, environmental and physical for example). Therefore, understanding the functioning of the food system do contributes to rethink a new conceptual framework, which promotes a new imagine of how different institutions (which results from a social organization) could eventually respond in a closely manner to the society demands, across a variety of scales of space but also governance (Webb et al, 2018).

The relationship of the food system with the spatial dimension of the urban system (urban form) emerges therefore as a critical point. However, this has been mostly disregarded among the available literature, as already argued by a number of researchers (see for example: Cabannes and Raposo, 2013; Pothukuchi and Kaufman, 2000; and Brinkley, 2013).

From the available literature dedicated to the study of the food system and with interest to urban planning one should recall Carolyne Steel's book 'Hungry City – How food shapes our lives' (Steel, 2013) and Susan Paraham's book 'Food and Urbanism' (Parham, 2015), for expanding the discussions on food system within the domains of urban planning, wherein focusing on issues such as urban agriculture and urbanism, which were initiated in the beginning of 2000's with Kameshwari Pothukuchi and Jerome Kaufmam.

The research initiated by Pothukuchi and Kaufman (2000), based on an inquiry to planning agencies and institutions, concluded that most problems associated with the food system were expected to be resolved by the private sector, exposing however that the public planning authorities would be unable to ascertain its role.

It would be later in 2013 that two published works would underline the interest that the food system was gaining from the scientific community. One by Catherine Brinkley (2013) 'Avenues into food planning: a review of scholarly food system research', which would provide a comprehensive literature review, focusing on several aspects which has been approached by studies about the food system. Furthermore, Brinkley attention was mostly placed on recaps previous holistic definitions of the food system. Yet, it identified two specific areas, which were being missed in the food system literature: cultural capital and waste-disposal.
The second work regards the publication of the journal 'International Planning Studies', which in 2013 would dedicate an entire issue to the thematic the food system planning. Edited by Kevin Morgan (2013), issue 1 of volume 18 of this journal comprised an editorial text and eight papers dedicated to the rise of the food system in urban planning, while integrating both theoretical discussions but also the analysis of specific case studies from varied geographical contexts and problematics.
Interestingly, it was at the economics domain that the urban form, understood as the configuration of fixed metropolitan elements, which comprises several important features of cities, including density, compactness and land-use (Lo, 2016), emerges as an important issue to be considered within the analysis of the food system. Specifically, in what regards the increasing importance to the food system with a required analysis of sustainability transitions, which is in turn highly dependent on individual and community patterns of behaviour, mostly of households and communities (Lo, 2016). Understanding the behavioural dimensions of both sustainability (Lo, 2016) and the food system (Timmer, 2012), emerges also as an unexplored area particularly with respect to the food system. This includes dietary problems which despite their recurrent problematization in health scientific community but also urban planning (see for example Drewnowski et all, 2016 and Jiao et all, 2016), are not widely discussed in food system papers. Steel (2013) is again a very important exception, as her book explores consumption patterns and dietary behaviours in her discussion of the food system.
Furthermore, not only urban planning appears to have disregarded the analysis of the food system, despite the growing literature on this thematic, as the several layers of the food system seem also to have received different levels of attention from the scientific community. For example, preference seems to have been placed on the food production level, when compared for example with consumption, distribution or even preparation phases. In turn, the urban planning responses to these specific problematics do find also different echo's, whereas the predominant one seems to be on the urban agriculture, at the production stage, linked to a particular fascination for the creation of a 'productive multifunctional landscape' (Viljoen & Bohn, 2012). However, this is a situation that places into question the social role of a future urban agenda, and of the planner's professions, as the agricultural labour that could shape such landscape has largely decreased since the 1970's, to the point of almost despairing within the western world (Fisher-Kowalski, Hass, 2014).
Although urban agriculture is also being studied by itself as a social and even political movement, there are many reasons why it is being so stressed within the food system literature. One important aspect is that the production phase of the food system is where most environmental implications are located, including land-use, soil degradation, water consumption and pollution, eutrophication, biodiversity loss, and introduction of hazardous chemicals (Reisch et all, 2013). On the other hand, industrial agriculture itself is a problem in terms of metabolism, as it is mostly dependent on non-renewable energy sources, with deep implication in Net Primary Production – energy fixed by autotrophic organisms – which is at the basis of heterotrophic food chains and accumulation of carbon stocks in soil (Erb et all, 2016).
As most planning activities are related to urban soil, and specifically into the organizing and development of built areas, the reconceptualizing of urban land and urban landscape to include productive areas (Viljoen and Bohn, 2012) merges as a critical debate. An understanding of the socio-metabolic implications of this problem is important, as different types of land-use will translate into different advantages and potential sustainability pitfalls.

Land-use intensity, rather than land-cover seems to be a more productive option, although it entails problems on its own, including soil degradation, groundwater and air pollution and biodiversity loss (Fischer-Kowalski and Weisz, 2016; Erb et al, 2016).
People living in cities must recognize themselves as selective agents in the determination of what species can and cannot live in cities, including the possibility of reducing the number and variety of native species of a given territory (Alberti: 2015,115). Thus, this place into question the participative level that urban citizens should take in future urban agendas and the social role of planners themselves in such a process of sustainability transition.

5. Searching for Forms and Flows of the Food System. Towards a social-ecological reading of its metabolic behavior: LMA case study

As in many other European cities, LMA has witnesses in particular after the financial crisis of 2008 a number of new situations, either in planning practices and policies (Mourão and Marat-Mendes, 2016), but also in its food system, in terms of urban fabric but also of new social and economic practices. However, what are the impacts of these changes on the metabolic function of the city? What lessons can we retrieve from these to regenerate the urban realm in a Sustainable manner? Finally, further work of Project SPLACH aims to contribute to clarify to some of these questions, and therefore offer a more territorialized and spatialized clues about the metabolic function of cities.

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Cascading Threats of Climate Change on the Food System in Nigeria: An Overview

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> "When risk cascades through a complex system, the danger is not of incremental damage but of runaway collapse or an abrupt transition to a new, suboptimal status quo" (WEF, 2018:6).

Abstract

The cascading threats of climate change on food production, procurement and distribution and the resulting vulnerability and reduction of people's access to food (physical accessibility, quality of food available and purchasing power) have become issues of compelling attention in contemporary times. Increasing temperatures, declining and more unpredictable rainfall, more frequent extreme weather and higher severity of pest and disease are among the more drastic changes that would impact food production (Parry et al, 2007; Kotschi, 2007; Morton, 2007; Brown and Funk, 2008; Lobell et al, 2008). The paper utilizes a qualitative, informal approach and participant observation in examining the cascading threats of climate change on the food system in Nigeria. Content analysis was used in analysing secondary data captured through various books, academic journals, Internet reports and newspaper clippings. The paper adopts the vulnerability-hazard-risk framework as a conceptual approach. Integration of the food system and food planning within the Green and Brown agenda through participatory governance, collaboration and authentic dialogue provides an eco-efficient approach to minimising the ecological footprint and foodprint. A secure ecological foundation guarantees food planning within a cascading complex and interconnected threats of climate change.

Introduction

Climate change is defined as "a sustained shift in the average value of climatic elements (temperature, sunshine, precipitation, wind etc.) either singly or in combination, the shift must be maintained for sufficient time to be measurable by Climate Normals, which are calculated over 30 year periods by the World Meteorological Organization and other bodies" (Smith, 2013:408). It is an outcome of human-induced driving forces such as the combustion of fossil fuels and land use changes, but with wide-ranging consequences for the planet and for human settlements all over the world (UN-Habitat, 2011). Climate change is caused by natural processes (biogeographical) and human activities (anthropogenic) (IPCC, 2007). Climate change impact on land uses is one of many complex and interconnected challenges that Planners deal with in the built environment. Paradoxically, failure of urban planning, failure of regional or global governance and increasing urbanization are among the interconnected risks of climate change (WEF, 2018).

World Economic Forum 2018 report indicates the most pressing threats that are perceived as having the biggest impact in the next ten years are extreme weather events and natural disasters, failure of climate change mitigation and adaptation, water crises, biodiversity loss, and air and soil pollution (WEF, 2018). For example, the Intergovernmental Panel on Climate Change (IPCC) report predicts the probability of more heat waves, heavy rainfall, droughts and other extreme weather throughout the 21st century (Parry et al, 2007).

The food system constitutes a critical and sensitive part of climate change. The connection between climate change and the food on your plate, our diet and global warming (Lappe, 2009) is, therefore, very profound. Climate change threatens biodiversity and ecosystem services across the planet (Millennium Ecosystem Assessment, 2005) and is a threat to the ecological foundation of agriculture and the food system. Climate change threatens the livelihoods, food availability and health of the population (Bassey, 2013:101). Destruction of forests for farming, mining, and oil and gas production, not to mention infrastructure development, remains the main driver of biodiversity loss" (Lancet, 2018:e51).

Climate change presents the food system in Nigeria with challenges for physical planners especially, land use and infrastructure planning. Planners are faced with the task of planning, shaping and designing liveable, equitable and sustainable communities as well as ecologically secure food system for future generations. As the population of Nigeria grows (about 195 million) and agriculture declines in importance, national attention to food production and food prices become compelling issues of attention.

The paper is structured in four parts. It gives a background to climate change as a threat to the food system, discusses briefly the food system in Nigeria, conceptualizes climate change and food security and suggests food planning as an eco-efficient approach to securing the ecological foundation in Nigeria's food system.

Cascading Threats

Mark et al. (2008) highlighted some of the direct impacts of climate change on agricultural system as: (a) seasonal changes in rainfall and temperature, which could impact agro-climatic conditions, altering growing seasons, planting and harvesting calendars, water availability, pest, weed and disease populations; (b) alteration in evapo-transpiration, photosynthesis and biomass production; and (c) alteration in land suitability for agricultural production. Some of the induced changes are expected to be abrupt, while others involve gradual shifts in temperature, vegetation cover and species distributions.

Climate change is the second type of systemic shock threatening cities with prospective unparalleled short to long-term impacts. Climate change comprises two complementary elements namely (a) the increasing frequency and severity of extreme weather events with short durations (e.g., hurricanes, storm surges or heat waves); and (b) slow-onset changes that are semi-permanent or permanent (e.g., sea level rise, falling groundwater tables or desertification) (UN-Habitat, 2010**)**. These two complementary elements of climate change bring about unprecedented levels of food insecurity especially among the poor and vulnerable groups who are always at the receiving end of extreme weather events because of their exposure. Climate change due to anthropogenic global warming (AGW) is commonly perceived as the greatest contemporary environmental threat facing the world. Urbanization and climate change are co-evolving in such a way that populations often in densely packed urban areas will be placed at much higher risk from climate change as well from other profound societal and environmental changes (UN-Habitat, 2011:2).

When the food infrastructure (land, soil, vegetation, water) is threatened by climate change, food security (availability, access, utilization and stability) is also threatened. Climate change according to WFP (2018:2) affects:

- “Food availability: Changes in climatic conditions have already affected the production of some staple crops, and future climate change threatens to exacerbate this. Higher temperatures will have an impact on yields while changes in rainfall could affect both crop quality and quantity.
- Food access: Climate change could increase the prices of major crops in some regions. For the most vulnerable people, lower agricultural output means lower incomes. Under these conditions, the poorest people — who already use most of their income on food — sacrifice additional income and other assets to meet their nutritional requirements, or resort to poor coping strategies.

- Food utilization: Climate-related risks affect calorie intake, particularly in areas where chronic food insecurity is already a significant problem. Changing climatic conditions could also create a vicious cycle of disease and hunger. Nutrition is likely to be affected by climate change through related impacts on food security, dietary diversity, care practices and health.
- Food stability: The climatic variability produced by more frequent and intense weather events can upset the stability of individuals' and government food security strategies, creating fluctuations in food availability, access and utilization".

Cascading Effects

Climate change exacerbates the risks of hunger and undernutrition through:

- Extreme weather events
  Climate change increases the frequency and intensity of some disasters such as droughts, floods and storms. This has an adverse impact on livelihoods and food security. Climate-related disasters have the potential to destroy crops, critical infrastructure, and key community assets, therefore deteriorating livelihoods and exacerbating poverty.
- Long-term and gradual climate risks
  Sea-level will rise as a result of climate change, affecting livelihoods in coastal areas and river deltas. Accelerated glacial melt will also affect the quantity and reliability of water available and change patterns of flooding and drought (WFP, 2018:2).

Vulnerability, Hazard and Risk Framework

"Food systems encompass all the people, institutions and processes by which agricultural products are produced, processed and brought to consumers. They also include the public officials, civil society organizations, researchers and development practitioners who design the policies, regulations, programmes and projects that shape food and agriculture" (FAO, 2013:x). The food system comprises the 5A's of food security namely; accessibility (effective distribution), availability (sufficient supply), acceptability (culturally acceptable/nutritionally adequate), appropriateness (ecologically sustainable) and agency (enables action).

Vulnerability to climate change manifests in three ways: people/population vulnerability, resource/infrastructure vulnerability and spatial/locational vulnerability. The co-evolving partners (urbanization and climate change) place a large proportion of the population, especially the poor, destitute and inadequately housed people, to much higher exposure and risk in urban areas. As Rosenzweig et al (2011: xvi) observes:

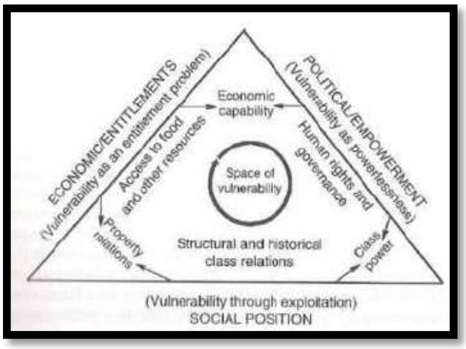
> "climate change exerts added stress on urban areas through increased numbers of heat waves threatening the health of the elderly, the infirm, and the very young; more frequent and intense droughts and inland floods compromising water supplies; and for coastal cities, enhanced sea level rise and storm surges affecting inhabitants and essential infrastructure, property, and ecosystems. At the same time, cities are responsible for no less than 40% of global greenhouse gas emissions, and given current demographic trends, this level will likely only increase over time".

The vulnerability, hazard and risk framework provides a conceptual basis to situate the vulnerability of the food system to climate change and its subsequent impact on agriculture and food production. This framework seemingly could be applied to agriculture and food production both in urban and rural areas.

Vulnerability is defined as the characteristics and circumstances of a community system or asset that make it susceptible to the damaging effect of a hazard (UN/ISDR 2009). Vulnerability is a dynamic concept rather than a constant state; it is constantly in flux due to changing interactions between geophysical and social processes through time and space (Smith, 2013).

Watts and Bohle (1993), described vulnerability as an aggregate measure of human welfare that integrates environmental, social, economic and political exposure to a range of potential harmful perturbations Vulnerability is a multilayered and multidimensional social space defined by the determinate, political, economic and institutional capabilities of people in specific places at specific times. Vulnerability arises from a complex web of economic (vulnerability as an entitlement problem), political (vulnerability as powerlessness) and social conditions (vulnerability through exploitation) (Figure 1) which vary over time and space.

Figure 1: Dimensions of Vulnerability



Source: Adapted from Watts and Bohle, 1993.

Vulnerability can be seen in terms of exposure, capacity and potentiality (Watts and Bohle,1993). Or in terms of exposure and defencelessness (Chambers 1995:175,189) comprising of two sides: “the external side of exposure to shocks, stress and risk; and the internal side of defencelessness, meaning a lack of means to cope without damaging loss. Loss can take many forms from becoming or being physically weaker, economically impoverished, socially dependent, humiliated or psychologically harmed”. Or in terms of exposure to risk and ability to cope (World Food Program 2002). Vulnerability context refers to the seasonality, trends, and shocks that affect people’s livelihoods and it is the result of many factors some of which relate to policies and institutions and a lack of assets, rather than particular trends, shocks or aspects of seasonality per se (Guidance Sheets, 1999, 2000).

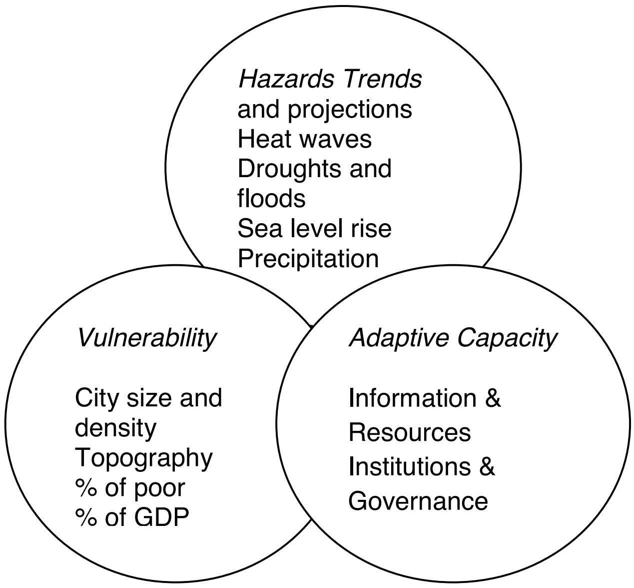
Thus, vulnerability can be summed up as the predisposition or susceptibility to any hazard that could cause harm or loss to human and/or physical and natural resources. In regard to the food system in Nigeria the complex interrelated and cascading threats and effects of Lake Chad Basin shrinking, Tomato Ebola, Boko Haram insurgency (conflict) and climate refugees among others, continue to impact on people’s livelihoods and their vulnerability.

In any climate change event (land degradation, pollution, flood, drought or desertification) people become vulnerable and food insecure. As a result there is the need to access food and this need hinges on entitlement. The various institutions machinery set up to ease the impact by providing resources sometimes exert their power over the powerlessness of the situation and thereby exploiting the weak and poor who lack economic capability during this period. Ultimately, this increases the space of vulnerability in terms of people, property, resources and infrastructures. Vulnerability seeks to capture the underlying causal processes that led to the actual status and which will probably influence future conditions (Lautze et al, 2003). Vulnerability is dynamic and describes how people move in and out of poverty and food insecurity (Frankenberger 2003; Brown and Gentilini, 2007).

The UCCRN climate change vulnerability and risk assessment framework (Figure 2) is composed of three sets of indicators:

- Climate hazards facing the city, such as more frequent and longer duration heat waves, greater incidence of heavy downpours, and increased and expanded coastal or riverine flooding;
- Vulnerabilities due to a city's social, economic, or physical attributes such as its population size and density, topography, the percentage of its population in poverty, and the percentage of national GDP that it generates;
- Adaptive capacity aspects, factors that relate to the ability of a city to act, such as availability of climate change information, resources to apply to mitigation and adaptation efforts, and the presence of effective institutions, governance, and change agents

Figure 2: Urban Climate Change Vulnerability and Risk Assessment Framework.

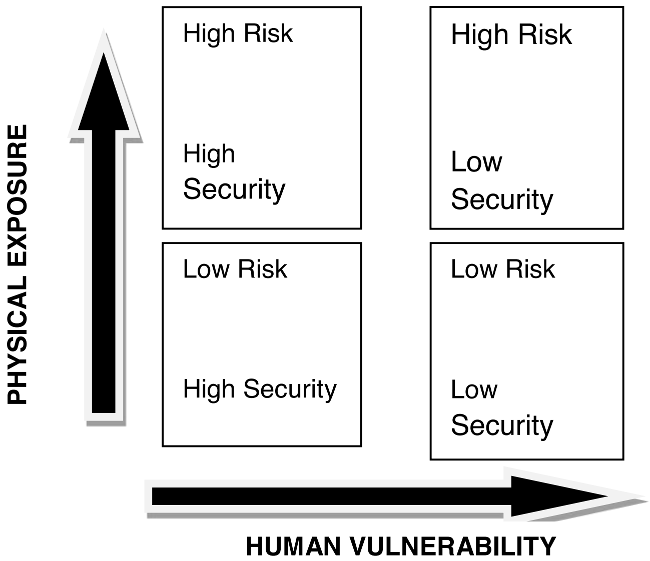


Source: Mehrotra et al. (2009).

Smith (2013) explains risk as: RISK= Hazard Probability x Elements at Risk x Vulnerability. "Hazard is a potential threat to humans and their welfare arising from a dangerous phenomenon or substance that may cause loss of life, injury, property damage and other community losses or damage while Risk becomes the combination of the probability of a hazardous event and its negative consequences" (Smith, 2013:11).

Smith (2013:9) affirms that "human sensitivity to environmental hazards (natural or technological) is determined by the physical exposure of people and their assets to potentially damaging events and by the degree of human vulnerability (or resilience) to such damaging events. Exposure and vulnerability are hazard specific in any one location, such as a river floodplain, but broader relationships can be displayed in a simple matrix (Figure 3). As physical exposure increases, human vulnerability also increases. Nigeria, with high exposures to risk especially in the coastal communities, find it difficult to fund hazard protection and to reduce exposure.

Figure 3: A Matrix Showing Possible Combinations of Physical Exposure to Hazard and Human Vulnerability in Relation to Risk and Security



Source: Smith (2013:9)

The food system in Nigeria is vulnerable to internal and external shocks presented by climate change. Natural and human vulnerability to the impacts of climate change are very high. Adaptive measures through food planning could be put in place to secure both the natural systems and human environment. Reducing the exposure to risk enhances the ability of the population, particularly, the vulnerable groups to cope. Vulnerability and exposure to risk could be mitigated through effective land use planning and food planning that facilitates accessibility (effective distribution, availability (sufficient supply), and appropriateness (ecological sustainability).

People/Population Vulnerability

The population groups most vulnerable to climate change and food insecurity include the low-income, poor, marginalised or indigent people in both developed and developing countries. Within this group are men, women, children (households, individuals), the elderly, homeless or inadequately housed, lone parents, disabled (physically challenged, mentally retarded), the poor living in food desert areas or do not have access (physical or economic) to food. These vulnerable groups do not have access to basic infrastructures and lack assets and do not have shocks to climate change impact. Lack exposes people's vulnerability. Lack, whether physical, financial, health, or otherwise, is profound among low-income, poor and no-income groups. The poor's resources and livelihoods become vulnerable to climate change impact particularly when there is flood, drought or other disaster occurrences. They do not have the shocks or safety nets to absorb the impact of climate change. These vulnerable groups skip meals, go on compulsory fasting due to erratic nature of access to food, unemployment and are always at the receiving end of climate change impact which subsequently makes them food insecure.

Correspondingly, the vulnerable groups' spatial location predisposes them to direct impact of climate change devastation. Evidently in most cities in Asia, Latin America and Africa most of the vulnerable groups are located in slums, squatter and informal/illegal settlements, marginal lands, hillsides/slopes, swampland with no infrastructures and facilities. The living conditions expose them to the vagaries of climate change and food insecurity. With poor assets, unstable livelihoods, and no entitlements, the vulnerable groups experience the complete onslaught of climate change and food insecurity. Low-income households often lack the resources to mitigate damages after they occur-for instance, through healthcare, structural repair, communication, food and water (Adger, 1999, 2000). In the absence of adequate recovery assistance, the poor often sacrifice nutrition, children's education or any remaining assets to meet their basic needs thereby further limiting their chance of recovery and escape from poverty (UNDP, 2007). When the poor's vulnerability increases, livelihoods become less securely sustainable; safety nets are weakened, and there is little or no family support.

UN-Habitat (2011) notes that poorer groups are disproportionately at risk for a variety of reasons such as:

- Greater exposure to hazards (Ruth and Ibarraran, 2009);
- Lack of risk reducing housing and infrastructure (poor quality housing, lack of drainage systems);
- Less adaptive capacity (lack of income or assets that allow to move to less dangerous sites or more quality housing);
- Less state provision for assistance in the event of a disaster (e.g. needed emergency responses and support for rebuilding or repairing homes and livelihoods; indeed, state action may increase exposure to hazards by limiting access to safe sites for housing) (Syukrizal et al, 2009);
- Less legal and financial protection (lack of legal tenure for housing sites; lac of insurance and disaster-proof assets) (Bartlett et al, 2009; Hardoy and Pandiella, 2009).

However, the vulnerability, risk and exposure of rural areas and its inhabitants to climate change and food security is different. Rural areas constitute the food production engine because of the vast land available for agriculture and food production. The components of a food system, i.e. production, processing, distribution, consumption and waste management are severely disrupted when there is drought, flooding, heat wave or rise in sea levels.

Climate change effects place additional stress on the already stressed agricultural land and the vulnerable groups, particularly poor farmers, become worse off. The most profound and direct impacts of climate change over the next few decades will be on agriculture and food systems (Brown and Funk, 2008). Climate change will adversely affect food security as shown by all quantitative assessments (Schmidhuber and Tubiello, 2007). Climate change threatens this engine base and the livelihoods of many who are dependent on land for survival and sustenance are compromised when there is soil erosion, landslide, and/or environmental degradation.

Resource/Infrastructure Vulnerability and Food Production

Olaniyi et al. (2014) opined that the dearth of statistical data and non-collection environmental data in a systematic manner make it difficult to estimate in concrete terms the overall effect of climate change on agriculture and food supply, flooding and erosion, health risks diseases spread, water resources, wildlife, level of CO2 emission and trends in temperature increase, and their effects on the social and economic systems of the country. In Nigeria, Odjugo (2008) shows that climate change has led to a shift in crops cultivated in the northern region as well as reduction of arable lands.

In Nigeria with regards to food availability, utilization, access and utilization, climate change affects food production, procurement, processing, distribution, consumption and waste management/disposal. A disruption of any of this leads to a cascading disruption of the entire food system. The cascading effects of climate change on food security include: Disruption in food production: irregular cycles of production; disrupted from the regular pattern of planting, harvesting; threat to national food security (local production is impacted, reliance on imports); global food security; Erratic food supply; Epileptic food access and availability; Increase in food prices; Artificial food scarcity/shortage; Market failure; Food-borne diseases from bacterial growth; Poor food quality; Declining incomes; Nutritional inadequacy and deficiency; Declining health/wellbeing and Increase in hunger and malnutrition.

The negative impact of climate change erodes the assets base of many countries and dislocates the food system as well as the human, natural, physical, financial and political capital of many. The components of a food system, i.e. production, processing, distribution, consumption and waste management are severely disrupted when there is drought, flooding, heat wave or rise in sea levels. The connection between soil erosion and food production, or flooding and food availability and access, or extreme heat, inadequate soil moisture and crop yield, or the destruction of micro-organisms which helps improve soil fertility and burning are part of the intricate web of food production.

Agriculture also provided gainful employment and a satisfactory livelihood to over 90 percent of the Nigerian population (NDHS, 2009). Agriculture remains a major driver of economic growth in Nigeria. It is composed of four subsectors: arable crops (including food crops), forestry (including tree crops), livestock (including poultry) and fishery. Agriculture contributed 41.5 per cent to GDP in 2008. The sector has continued its dominance in the economy, in terms of its

size and contribution to the GDP. The policy thrust during the first National Implementation Plan (NIP) (2010-2013) was to enhance total factor productivity in the agricultural sector through the application and diffusion of knowledge and improvement in the technology base.
However, the agricultural sector remains weak despite its contribution to the GDP. The inefficient production system is characterized by poor input; weak inter-sectoral linkages; ageing operators and an informal production and marketing structure and the agricultural sector remains strategic for national food security, employment generation, wealth creation and poverty reduction as over 65 per cent of the labour force is engaged in the sector (FRN, 2010).

Spatial/Locational Vulnerability

- *Desertification*

Climate change has started impacting on desertification (Odjugo and Ikhuoria, 2003) and it is impacting negatively on plant species composition in Northeastern Nigeria (Ayuba et al., 2007). Desert encroachment with its associated sand dunes is depriving farmers of their agricultural farmlands and grazing rangelands. It has also led to uncertainties in yield predictions, implying that crop productivity could either increase or decrease in a changing climate. Other potential impacts linked to agriculture include erosion that could be exacerbated by expected increased intensity of rainfall and the crop growth period that is expected to be reduced in some areas (Campbell et al., 2014). Odjugo and Ikhuoria (2003) observe that Nigeria north of 12°N is under severe threat of desert encroachment and sand dunes are now common features of desertification in states like Yobe, Borno, Sokoto, Jigawa and Katsina. The migrating sand dunes have buried large expanse of arable lands, thus reducing viable agricultural lands and crops' production. This has prompted massive emigration and resettlement of people to areas less threatened by desertification. Such emigration gives rise to social effects like loss of dignity and social values.

- *Rising Sea level*

Coastal settlements like Bonny, Forcados, Lagos, Port Harcourt, Warri and Calabar among others that are less than 10 m above the sea-level are now seriously threatened by a metre rise of sea-level. The sea incursion due to sea-level rise means salt-water intrusion into the fresh water, invasion and destruction of mangrove ecosystems, coastal wetlands and coastal beaches (Odjigo, 2010). Sea incursion is reducing the arable land of the coastal plains. The coastal inundation and erosion with their associated population displacement are currently major environmental problems in Nembe, Eket and other coastal settlements in Bayelsa, Delta, Cross River, Rivers, and Lagos States of Nigeria. It is estimated that a metre rise in sea level will displace about 14 million people from the coastal areas of Nigeria (Abu, 2007).

- *Shrinking Lake Chad*

The regional impact of Lake Chad shrinking, flooding and drought have significant impact on the food system and food security in Nigeria and increasing numbers of climate refugees.

Lake Chad provides water and sustenance to around 30 million people in four neighbouring countries. The crisis afflicting the strife-torn Lake Chad Basin is rooted in decades of neglect, lack of rural development and the impact of climate change. Some 7 million people risk suffering from severe hunger in the Lake Chad Basin, which incorporates parts of Cameroon, Chad, Niger and northeastern Nigeria.

In the latter, some 50,000 people are facing famine. Conflicts, environmental degradation and climate change including repeated droughts, are exacerbating the situation. Lake Chad has lost some 90 percent of its water mass with devastating consequences on the food security and livelihoods of people depending on fishing and irrigation-based agricultural activities. (FAO UN, 2017). The Chad Basin is one of the irrigation food baskets in northern Nigeria and it serves the whole country. The federal Government's efforts at augmenting food production at the Chad Basin have also come under serious threat causing food instability from the activities of Boko Haram insurgents.

Food Stability

Food stability in Nigeria is also threatened by Boko Haram insurgency, herdsman influx, the shrinking of the Lake Chad Basin, Tomato Ebola and the destructive impact of the extractive industry sometimes causing climate induced flooding, desertification and erosion.

Boko Haram Insurgency

The Boko Haram insurgence, the Fulani herdsmen intrusion have contributed to the fragility of the food system and increased the number of food poor and food insecure people. Boko Haram insurgency is a threat to food security in Nigeria. Citizens cannot go to the market or access food whenever and wherever they want, and farming activities are disrupted. The North Eastern part of Nigeria has been ravaged by Boko Haram insurgency displacing over 2 million people, causing hunger and poor food diets for several millions including children, women and nursing mothers; and killing over 17000 people since 2009. Several hectares of land prepared for rice cultivation and other grains have been abandoned in Borno because of insurgency and the multibillion Naira irrigation project is under threat (Soriwei and Okechukwu, 2013). Vast expanse of arable land has been destroyed and for two season farmers have been unable to go the fields to plant for fear of being attacked (Soriwei and Okechukwu, 2013).

Conflict between Boko Haram and the Nigerian Armed Forces has escalated since 2012 and is concentrated in the northeast and around Lake Chad in Borno State (Figure 6). The impacts of conflict on livelihoods, market functioning, and humanitarian response have severely limited access to food for both resident populations and displaced households. Acute food insecurity is widespread in northeast Nigeria, with the March 2016 Cadre Harmonisé estimating that more than 3 million people are in crisis (CH/IPC Phase 3) or worse and in need of humanitarian assistance. There is also visible malnutrition among adults and children, an extreme scarcity of food and water, very limited health facilities and a lack of functioning markets.

The impact is also felt in the south west. The south western region relies on the north for food grains. Olufemi and Ojo (2015) notes in the South west of Nigeria the impact of the insurgency is being felt in Lagos and Oyo States. Prices of foodstuffs like yam, beans and onions have skyrocketed. The open market became a space of insurgent citizenship where pandemonium breaks out between ethnic traders. In May and June 2013 about 14 Yoruba traders from Bodija market in Ibadan (Oyo State) were killed in Borno State by Boko Haram and this led to clashes between Hausa and Yoruba traders at the market. Food produce worth millions of Naira were destroyed.

- *Herdsman Influx*

Aside from the seemingly political undertone, the influx of herdsmen (Figure 4) into urban communities is partly a result of decreased fodder, famine, drought and desertification caused by both climate change and anthropogenic factors. Many farms and farmers have been driven out, displaced or killed by the herdsmen who take over these farms to graze their cattle.

Figure 4: Herdsmen in the City

Source: This Day Live 2018

In 2016 a Grazing Commission Bill was set up to propose a National Grazing Bill in the light of the Herdsmen incursion. The Bill aims at creating specific grazing areas as well as reducing attacks on states and communities by suspected herdsmen. Specifically, the National Grazing Reserve Bill seeks to institutionalize pastoral farming seeks to establish a commission which will take land in any part of Nigeria for use as grazing reserve. 75% of the farming population in Nigeria are women and there are about 50000 ha grazing reserve. There has been opposition to this proposed Bill due to its impact on the Land Use Act, grazing and ranching activities. Nigeria has about 84 million hectares of fertile land and agriculture accounts for two thirds of Nigeria's employment.

- *Tomato Ebola*

Tomato Ebola outbreak in 2016 led to scarcity of tomatoes. Tomatoes is used in almost every local dish/delicacy particularly stew and jollof rice. Its scarcity meant a lot deprivation for households. The moth 'Tuta absoluta' destroyed 80% of tomato farms in Kaduna State (Kaduna is the Tomato capital), and more than 90% of 17,000 hectares (42,000 acres) of tomato fields outside the northern city of Kano have been destroyed by the insect . More than 200 tomato farmers in the region have already suffered losses of more than 1bn naira ($5.02m) from the disease in Northern Nigeria (Agence France-Presse, 2016). This led the State to declare emergency, tomato processing factories shutting down and astronomical increase of tomatoes and scarcity of it as well. *Tuta absoluta*, which originated in South America and spread to Europe and Africa, quickly develops resistance to pesticides, making it difficult to contain. The brown moth lays eggs on tomato plants and develops into a hungry caterpillar that feeds on the leaves, stems and fruit.

- *Extractive industry*

Extractive activities make leads to the fragility of the ecosystems. Local droughts, relentless pollution, rise in temperatures, it is very clear that the continent is being cooked on carbon fires (Bassey, 2013:101). The exploration of oil in the Niger-Delta area has caused irreversible degeneration of the biodiversity and ecosystems, soil depletion and contamination as well as soil erosion. This is devastating for food production activities in the region and it has a cascading effect on the rest of the country. For example, the National Oil Spill Detection and Response Agency (NOSDRA) announced 2122 oil spill incidents were recorded between 2006 and 2009 (Bassey, 2013). The Niger-Delta region of Nigeria is one of the most polluted places on earth due to physical evidence of degradation, at least 10 communities in Ogoniland have contaminated drinking water with high levels of hydrocarbons, with 8cm layer of refined oil floating on the groundwater which serves wells and a depth of 5m hydrocarbon pollution in the soils (UNEP, 2011).

Food Planning: Preventing Runaway Collapse

The Federal Government of Nigeria established the National Fadama Development Project which is in its third phase and the presidential initiatives on rice, cassava, maize, vegetable oil, tree crops, tropical fruits, livestock and fisheries; and continues to maintain the National Strategic Food Reserve to meet food emergencies and for the stabilisation of income to enhance access of Nigerians to adequate food. There should be an emphasis on sustained policy and strategic food planning to ensure the achievement of the Sustainable Development Goal two to “End hunger, achieve food security and improved nutrition and promote sustainable agriculture” and the section 2.4 indicator to ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality” by 2030. “Security of our food supply will diminish unless we realize the central importance of the ecological foundation of the food system” (Achim Steiner, United Nations Under-Secretary-General, and Executive Director United Nations Environment Programme, UNEP, undated, p.vi). Securing the food infrastructure through food planning embedded in an eco-efficient approach will avert or prevent the runaway collapse or an abrupt transition to a new suboptimal status quo that will drive several millions to food poverty and hunger.

Food Planning

Food planning, the planning and spatial distribution of edible spaces to enhance accessibility, availability, ecological sustainability and reduction of foodprint in a way that fosters health and well-being, is the overarching strategy that could be adopted to secure the ecological foundation of the food system. Food planning would promote efficient and effective use of land, land use regulation and control; promote good environmental management practices to reduce land degradation, and enforcing land use laws among various land users. Physical planning could be effective in guiding food infrastructure, that is, what, where, when and how land is used for food production, procurement, processing, distribution and waste. This could be achieved by land use and environmental regulations to determine the spatial location of farms and edible food spaces without compromising future needs.

Food Planning could be achieved in Nigeria and other regions within the global context by:

- Recognising and linking the food system to other systems and subsystems like health, education, culture, transportation, housing, environment, economy and the spirit (faith).food planning with effectively foster this linkage(s) by providing adequate plans, spatial mapping of the food system and suitability or not of land use for agriculture and food production.
- Reducing Ecological footprint: Integration of the Green and Brown agendas. The Green and Brown Agenda emphasises reducing the ecological footprint and ensuring that the ecosystems are not degraded by climate change or human endeavours. The eight trends of the Green and Brown agendas (UN-Habitat, 2009) which focuses on: developing renewable energy, striving for carbon-neutral cities, developing distributed power and water systems, increasing photosynthetic spaces as part of green infrastructure, improving eco-efficiency, increasing a sense of place, developing sustainable transport and developing slum free communities have significant relationship with food security and planning values. Both Agendas emphasise maintaining ecological health and sustaining the bioregional ecosystems on the long-term for future generations. Physical planning promotes the same core values of environmental management and sustainability in an equitable and efficient way. Embedding physical planning within the green and brown agendas helps to secure an ecological foundation for Nigeria's food system.

- Promoting eco-efficient communities: an integration of the natural, human and planning values would provide a secure foundation for an eco-efficient food system in Nigeria. Also by reducing, recycling and reusing food waste, communities can begin to be more eco-efficient. Adapting the cradle to cradle concept (developed by McDonaugh and Braungart, 2002) in Nigeria where resources and wastes can be shared like an ecosystem is a germane to an eco-efficient food system. This can be achieved through:
    - Food Infrastructure: Promotion of Green food infrastructure and Green Planning (eco-friendly planning), renewable energy, local food and fibre, and biofuels. There has been a positive trend in planning in the direction of an expanded notion of urban infrastructure that includes the idea of 'green infrastructure' based on photosynthetic processes. Green infrastructure refers to the many green and ecological features and systems, from wetlands, to urban forests, which provide a host of benefits to cities and urban residents-clean water, storm water collection and management, climate moderation and cleansing of urban air among others. Growing energy and providing food and materials locally is becoming part of urban infrastructure development. The use of photosynthetic processes in cities reduces their ecological impact by replacing fossil fuels and can bring substantial ecological benefits through emphasis on natural systems (UN-Habitat, 2009:119).

    - Food Governance: Encouraging Participatory food governance and collaboration. Planners should take the leadership role in fostering authentic dialogue, collaboration and interdependence within and among various role-players (Agriculturists, Local Governments, Research Institutes, Universities and other relevant institutions and professionals), stakeholders (private sector, small scale business owners, informal sector), and the civic society, Community Based and Faith-based organizations. Public-Private governance which encourages voluntary, private and mobilization could be a step in the right direction to securing the ecological base of the food system in Nigeria.
    - Food sovereignty is the principle that people have the right to define their own food and agriculture system (Food and Water Watch, 2009:42). Food sovereignty is the people's right to define their own policies and strategies for sustainable production, distribution and consumption of food that guarantee the right to food for the entire population (World Forum on Food Sovereignty, 2001). Food

Sovereignty is the people's right to voice their opinion on food issues and decisions, from farm to table (production to consumption) (Olufemi, 2013).

Conclusion

The importance of the ecological foundation of the food system for the local, national and global economy requires adequate and sustainable protection, otherwise, it will continue to diminish right in front of our eyes and the food security of generations to come will be threatened. Building a sustainable food system in Nigeria and elsewhere is a means to secure the ecological foundation of food security (UNEP, undated). Sustainable food systems, as part of a new Green Economy, provides an alternative to current food systems and can help secure the ecological foundation of agriculture and fisheries. Sustainable food systems enable the production of sufficient, nutritious food, while conserving the resources that the food system depends on and lowering its environmental impacts (UN-Habitat, 2009). Food planning secures current and future land use, food supply capacity and production,

Planning to secure the ecological foundation of the food system must focus on land use, land use regulation, reduce sprawl and encroachment of the agricultural lands, environmental management, governance, promoting green infrastructure and green planning (more trees, vegetation and greenery), and campaign to reduce ecological footprint and foodprint. These can be achieved by good and participatory governance (not representative governance) and effective leadership, appropriate financing to minimise waste and corruption, discipline on the part of all citizens (green mindset and integral ecology), political will, education and awareness, sustainable participation, collaboration and authentic dialogue at every level from household to highest level of government and effectively engaging cooperatives and associational life groups such as youth, town unions etc., through mutual cooperation and authentic dialogue.

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Shymkent City

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ABSTRACT:

Shymkent is the fastest growing city of Kazakhstan, that has large amount of urban issues to be solved.
Shymkent City was envisioned as the key urban driver of the most young-populated megalopolis of Shymkent. This new neighborhood is going to represent new comfortable urban environment, that should became the specimen for urban transformations of Shymkent in the future.
The whole concept of Shymkent City built on eleven qualitative criteria of urban environment: human scale, regulation of building height, differentiated transportation, comfort public spaces, mix use, open city structure, compact city, diverse architecture, city anchors, BIM standards and green building. Key developed strategies of Shymkent city envelop quarters, landscape, transport, public spaces, creative indutries, education and business, smart city and stakeholders.
Key urban issues of Shymkent are transportation, education and arid climate. All these issues worked out in Shymkent City. Bioclimatic architecture encircled basic solutions for arid South Kazakhstan climate. Education facilities and business incubators resolved the challenge of large generation of schoolchildren and self-employed young entrepreneurs. Tram and Bus Rapid Transit made circlulation through the city fast and comfortable.
Urbanization traditions of Middle Asia has not been left aside. Urban structure of Shymkent City based on the grid of quarters, those resemble traditional "makhallya" - perimeter-build-up courtyards, that compose the whole pattern of the city.
Design of Shumkent was performed by mixed team of Ukrainian and Kazakh professionals in the beginning of 2018. Later it was adopted by local authorities and started implemented. Albeit some challenges, we consider Shymkent as a key finance and cultural city of Middle Asia in closest future. And Shymkent City is going to became the kick off for this urban transition.

Past knowledge and new strategies: Are Iranian cities ready for climate change?

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ABSTRACT:

Iran is known to have sheltered the first cities of the world, using several technics of construction to adapt as well as possible to the hot and semi-arid climate which is covering the vast majority of its territory. The *Qanats*, a three thousand-year-old irrigation system were used for drinking water supply as well as irrigation of agricultural lands or lush and shady gardens. The underground drainage system takes source on the foothills aquifer of the numerous mountain of Iran. The *Bad-gir*, (wind tower), is a system creating cycles of fresh air inside the houses, playing with the pressure balance and the humidity rate. In Yazd, some of wind towers were even connected to the Qanats to increase the freshness effect when the air is in contact with the water.

The management of air, water and sun/shadow and technics such as *Qanats* or *Bad-gir* have however gradually disappeared, replaced by more modern technics but certainly less ecological or economic.

It seems interesting to confront the neglect of those localized technical tools to a more global reflection on the urban issues of climate change, particularly through the question of urban heat islands.

In Tehran, the urban dynamic is currently more spreading than the rehabilitation of old neighborhoods. The north of the city is denser and new cities appear while the old buildings fall into ruin. Human activities (the presence of the Grand Bazaar) and the hyper-motorization of society (private cars, cheap oil ...) contribute to change the form of the city. In addition to these issues, many *Qanats* have been closed (construction of the Metro, foundation of high-rise buildings) and, in the 1970s, most of the mountain streams that used to pass through the heart of the city were deviated from the city, for security reasons related to flash-floods. All those phenomena giving rise to a real “drying out” of the old city center

As part of the city's river renovation program, the municipality's services are currently conducting a series of technical studies on all the city's rivers with 5 main goals: Security, Ecological environment, Relation with citizen, Water quality and quantity, Urban renovation.

There is no doubt about the relevance of the water return in the city through the questions of urban renovations, notably to remedy the question of the islands of heat: refreshment, creation of landscape and shaded environment, and for inhabitants, back to the pleasure of contact with water.

The return of water to the city is proposed through the river renovation program, which certainly deserves to be conducted as part of a broader reflection, a vision that takes into account the urban dynamics at the metropolitan scale. How to integrate the city within its geographical Hinterland and how to take into account the large landscapes as green or Blue corridors?

Otherwise, it appears that a number of technical solutions are known: Retention of rainwater, Water Sensitive urban design... If so, how to promote and implement them? How to consider the urgency of the climate issue on urban planning documents?

It appears that the climate subject is beyond us, by its temporality and by its universality. But it also appears that many solutions exist before our eyes. Could Iran, through its ancient technics of air, water and sun/shadow management, become a hotbed of knowledge and practice for cities and constructions adapted to the arid climate?

Substitute industries and economic change as a chance for cities to become more sustainable

A Case Study examination of the City of Völklingen, Germany

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Introduction

Globalization causes an ongoing process of structural economic transformations on local and regional level and the relocation of industry changes the economic basis of a lot of cities worldwide. Many of these cities also have to face long-term economic and demographic challenges. The impact on cities and citizens pose big challenges on today's urban planning (Pallagst 2008). Cities struggle to reinvent themselves based on new economic principles (e.g. sustainability) and new substitute industries. Substitute industries are defined as a primary replacement of jobs as well as a strategy for the general revitalization or restructuring of the local economy. The term "substitute industries" does not give any concrete pointers to a specific industry or sector (Pallagst 2017).

However, in many cities around the world, the share of the three economic sectors changed in the last decades, from the secondary to the tertiary sector leaving many old industrial and commercial brownfield sites in urban cores. Furthermore, many citizens have lost their jobs and could not easily be re-employed in the tertiary sector due to different qualifications needed In the meantime, globalization causes not only economic but also environmental problems by rising cargo trade and relocation of economic branches overseas due to lower production costs (Ellrich, Neuhaus 2012). This creates increased CO_2 emissions, particularly because of longer transport distances. In times of climate change and an alteration to a more sustainable-based economy, this matter is in need to be rethought and analysed. Long-term demographic changes (e.g. aging society & migration) in combination with economic changes result in a social aspect that also needs to be included when aiming at sustainable future development (Pufé 2014). Urban planning can play its chare to contribute to a more sustainable urban environment and develop approaches and tools towards more sustainable solutions. Urban planning can provide necessary frameworks and test fields by cooperating with the city in promotion of economic development. New substitute industries, such as commercial urban farming, can be attracted to provide sustainable new future-oriented jobs.

The case study of the City of Völklingen was selected to be on display in this paper based on its path of economic transition: From a mining and manufacturing town to other somewhat more innovative economic branches of the green economy and specifically urban farming. The research presented here is amalgamating select results of the authors master thesis as well as the Technische Universität Kaiserslautern's GIAGEM (Green Innovation Areas in Revitalizing German and Mexican Cities) project, funded by the German Federal Ministry for Education and Science (BMBF). The project as well as the thesis-applied case study research as a methodological approach, involving literature analysis, data analysis, and semi-structured interviews with stakeholders from the case study city. Preliminary research results were then validated in the frame of two workshops in the year 2017 and 2018 with experts from the respective cities.

1. The cause and effects of economic change and shrinkage in cities

The causes that can lead to an economic change and shrinkage of a city include various aspects. Characteristics are the following indicators as causes of urban shrinkage and economic change:

- Downwards spiral through global economic and social shifts
- Deindustrialisation of traditional locations in western economies
- The decline of a city-defining economic sector or several areas
- Outflow of the population of inner cities (suburbanization and long-distance migration)
- A special concern in monostructured spaces (Henckel 2003, Liebmann and Kühn 2010).

There are also other reasons for the already described, mostly economic phenomena (that are derived from different political and economic systems in west and east Germany), as well as the spatial relocation of entire industries and the associated job losses: The general difference is on display within Germany between the old mining and industrial regions in West Germany and the deindustrialized regions in the eastern part of the country. In the East, structural change was prevented due to the political system until reunification. As a result, the process of structural change and the associated urban shrinkage came suddenly and to unpredictable severity. In the West, however, it was and is a slow process (Ellrich and Neuhaus 2012, Glock 2007, p.1).

The natural population development in Germany is negative in terms of the natural birth rate since 1972. In addition, there is a shift in the average age and rising life expectancy. This so-called aging of the population is the result of the outmigration of mostly young, qualified and employment-oriented citizens from eastern Germany to western Germany as well as from old industrial centres (effected by economic structural changes) to cities with more modern oriented economies and employment opportunities. Furthermore, the migration from rural to urban areas for the same reason can influence population developments.
Thus, it can be concluded that the demography changes by its negative birth rates and due to population migration in the absence of prospects on the labour market and lack of education opportunities (Spiegel Online 2007, Deutsche Akademie für Städtebau und Landesplanung 2002, p.7ff).
At the moment, Germany is experiencing positive population growth on average. This is mainly based on immigration from economically weak European countries and on refugee movements from the crisis areas of the Middle East and Africa since the summer of 2015 (Breuer 2017).

A result of economic decline in the old mining and steel industries is a weakened local and regional economic base. The declining economic situation is characterized by a lower supply of jobs for the citizens, which in turn can lead to an increased outmigration of young and well-educated people as well as to a drastic labor shortage in the long term (Institute for Regional and Urban Development Research and Construction of the State of North Rhine-Westphalia (ILS NRW) 2003, S.A4).

The spatial consequences of structural change include among other things are inner-city vacancies and the urban sprawl or suburbanization of the urban peripheries (so called doughnut effect). Higher-income families looking for a single-family home in the countryside mainly practice this. Other effects can be the “perforated city”. It indicates visible unstructured shrinking within the city, resulting in urban brownfields or abandoned buildings everywhere in the city (Glock 2007).
With the loss of jobs, a spiral of self-accelerating decline can begin, resulting in sometimes existential-threatening consequences (for the municipalities). The question arises: Can the

shrinkage of a city be absorbed, mitigated or prevented if enough alternative, new jobs are being created?

The answer could be the formation and location of new clusters. Many municipalities or regions have their own cluster concepts for this purpose and try to locate and promote them in a targeted manner. In doing so, the focus is primarily on the new economy, e.g. information and communication technology companies or the green economy. But developments in the logistics industry also play a major role. An area dominating here is, for example, the increase of logistics centers, both in their number and in the claimed area (Henckel 2003, Haas 2017a). The most well-known types of **substitute industries** in Germany are industries or services that are credited with a certain innovative or economic power. The following typologies are the most common examples: **Culture and cultural industries** are becoming increasingly important for German urban development policy. It plays a special role in the "renaissance of the cities", since people live, produce and consume culture throughout every day. Thus, culture is constantly changing, it cannot be assumed that the same kind of project or initiative will work everywhere (Dengler 2010, Florida 2003). The substitute industy of **education and medicine** have always been important aspects for citizens. In the future, with increasing global competition for education and research resources, with the aging of society, and with medical advances, this importance will increase even further (Schober 2014, p.9; Peuling 2017). The production of goods and services around **High-tech and IT** will continue to be unabated in the coming decades. The developments are happening across all sectors of the economy and are characterized by a great dynamism of innovation. Therefore, the promotion and settlement of companies and institutes of this economic branch is considered to be particularly future-proof and is very popular with municipalities (Bundesministerium für Bildung und Forschung 2017). **Festivalization** is a new informal urban development instrument that emerged in the 1990s. The term refers to public events that have an influence on the city (planning). These include, for example, major sporting events such as Olympic Games or football championships, as well as other cultural events such as city festivals or performance shows like world exhibitions or fairs (Häußermann and Siebel 1993, p.7 ff.).

This development also includes the development of tertiary institutions (including service, research and education centers) within the city centers. These are called new forms of urbanization. Other aspects include the rediscovery of old means of transport such as the rail-bound infrastructure. But airports are also increasingly seen as an important means of more urban and regional development. Here, the influence of the logistics industry and the increased mobility behavior become visible. They count as a positive location factor and are regarded as the key to economic (re-) ascension (Henckel 2003).

Creating and locating new and alternative jobs for workers who have lost their jobs as a result of structural change is a tedious and complex task (Peuling 2017). The key to success seems to be the creation of a replacement or substitute industry for the municipality and its employees. The effects and consequences of city shrinkage particularly effect urban planning and municipal areas. At the same time, the question always arises as to whether it is possible to counteract these developments by means of a city-planning instrument, for example with the establishment of new companies and the associated new jobs. Urban planning needs to provide a new framework for the affected cities to make this reinvention possible.

2. Substitute industries and the tool's revitalizing role

Substitute industries can be economically, ecologically and socially profitable for a city if the choice on „the right“ industry and solution for the city is made. Also, the question arises “Can substitute industries generate or at least stabilize growth in a shrinking city, stop the population shrinkage and restore jobs?". The following chapter further defines and explains the instrument of the substitute industry, as well as needed vocabulary to understand the nature of the tool.

Revitalisation

Prior to the establishment or implementation of a replacement/ substitute industry strategy is the principle of revitalization. Revitalization (in the spatial sense) means that a city has basically set itself the goal of reviving a neighborhood, a district or the whole city. This includes both the repair of public infrastructure, the adaptation of public services to the population and a willingness to intervene in local economic development. The public sector can partially control this or set impulses in a direction of development. For example, it is possible to ban certain industries or trades (Peuling 2017).

However, it is more important to incentivize and promote specific industries where the city already has a certain base. Incentives can i.a. in the offered location, in the networking with science and research, in the connection to universities, colleges, in the technical infrastructure, in the possibility for clustering or even in financial nature. The financial incentives are divided into the activities of the municipality, in a deduction of trade tax or in the assumption of development costs and in an external share of public funds, such as corresponding subsidy programs of state, federal or European Union (Peuling 2017). Depending on the starting position of the city concerned, an individual case-by-case solution is necessary. There is not one strategy for a revitalizing measure (Pallagst 2017).

Substitute industries

In order to understand the concept of the substitute industry in the context of this work, it is necessary to explain and classify this tool.
Many shrinking cities have lost a major employer, or a whole branch of industry. They try to (re-)create jobs by means of targeted settlement of new companies in various branches of industries. In this case, the correct name in the sense of meaning would be the term "new settlement of alternative economic branches" (Pallagst 2017, Kunzmann 2009).

The term "substitute industries" is used to describe the primary replacement of jobs as well as the strategies for the general revitalization of the local economy. The term "substitute industries" does not give any concrete pointers to a particular industry or sector. There is no "right strategy" in dealing with shrinking cities and the location of one or more replacement industries from one industry or sector. Each city and region has other unique focuses in their (economic) history and therefore needs individual consideration. Nevertheless, some economic sectors are ahead of others when it comes to settling a particular replacement industry: Preferred industries include the tourism, logistics, cultural & creative, education & medical, high tech & IT and green technologies and infrastructures industries (Pallagst 2017, Pallagst et al 2017b, Pallagst et al 2018).

Green infrastructure

The green infrastructure (also called blue-green infrastructure) represents a strategically planned, urban network, which is composed of natural and semi-natural areas. These form a networked ecosystem that performs various functions for the community. For example Air pollution control, natural water management and the habitat for humans and animals. These areas are characterized on different levels of scale of different natural spatial configuration and equipment (European Commission 2013, American Planning Association 2007).

Often, revitalization projects focus on the use of inner-city fallow land, especially on the use of vacant, individual plots of land. These formerly commercial real estate or land areas provide a place where commercial and social projects such as urban or community gardening and urban farming can be implemented (Pallagst et al 2017b, United States Environmental Protection Agency (EPA) 2014).

The use of fallow or abandoned urban spaces offers the potential for a sustainable transformation of formerly polluted sites, as well as job creation in new emerging or revitalized areas, thereby sustainably changing and shaping the identity of places (Pallagst et al 2017b, United States Environmental Protection Agency (EPA) 2014).

The connection to high-tech or traffic projects is close. Green infrastructure can also be linked to new regenerative energy and new mobility concepts (Pallagst et al 2017b).

Urban Farming

One of these links of green infrastructure and the bioeconomy, as the more environmentally friendly oriented branch of industries, is urban farming. Urban farming combines the aspects of green infrastructure with a social context in terms of the creation of jobs as well as new farming produce as new resources. It has many positive effects, such as the reduction of the ecological footprint or the food security of urban residents. In recent years it became more popular and can be seen as an opportunity to revitalize densely populated cities, also due to the growing need of city residents to engage themselves in horticulture and to participate in civic projects (Pallagst et al 2017b, Peuling 2017).

By definition urban farming or urban agriculture is the use of land by individuals or groups in urban and urban like areas or their peripheries for the cultivation of food, for whose agricultural land consciously urban spaces are sought and used. The cultivation usually is closely connected with ecological and economic cycles as well as with the social life of the city (Stierand 2016). Urban farming is possible on small and large scales. Smaller scales are often referred to urban gardening. In this case, all forms of food production in settlement areas are included, such as inner-city farms or peri-urban gardens and solidarity-based as well as social agricultural projects (Haide 2014, p. 5).

Furthermore, there is a broad variety of urban farms, not solely the production of agricultural produce. There are many different forms of urban farming: **Leisure Farms** aim to combine the range of recreational activities associated with agricultural activities within or near the city. The farms offer ranges from practical experience with animals and crops, dining and agritourism or the equestrian sports. At **Therapeutic Farms**, the garden, forest, landscape, animals and plants are used for recreational or work-related activities. Target groups are in particular psychiatric patients, mentally stressed persons or people with learning disabilities. In the Netherlands, therapeutic farms, with a strong national organization are a successful concept in peri-urban areas. **Social farms** are designed to promote the integration of disadvantaged and marginalized people, for example by offering them jobs. Networks of social farms have already been developed at national or regional level in Germany, Italy, France, the Netherlands, Belgium and Norway. **Educational Farms** are often affiliated with Leisure Farms and may have a recreational component, but the educational function is dominant. These Farms usually offer recreational or educational activities to learners of all ages in urban areas of Central Europe (for example in Geneva, Toulouse or Stuttgart) (Lohrberg et al 2016).

From a historical view urban farms are not an invention of the 20th century. A very early form of urban farming is being practiced since the 14th century in the Mexican capital, Mexico City created by the Aztecs: The Chinampas Gardens, with sustainable and organic food production 20km outside central downtown (Sieg 2018). In the US there are efforts to establish the term Agrarian Urbanism or Agricultural Urbanism in urban planning to highlight the growing importance of food security. The Prinzessinnengaerten project in Berlin describes itself as an Urban Agricultural Project with the goal (Haide 2014).

However, since large-scale **urban farming**, run by company's rather than individuals or small groups, is more relevant to this case study than it is on a small scale because of its job creating nature. A good example of large scale urban farming is the town of Völklingen in the land locked German State of Saarland: Here, a **sea fish farm** was built within the city on an area formerly used as a coking plant. New future-oriented jobs were created in an old industrial location in a new branch of economy for the city (FRESH Corporation AG 2018).

Critics try to put the importance of urban agriculture into perspective, because they do not allow self-sufficiency of the cities yet. As the technology of urban farming, on large-scale food production is still being developed, it is expected to become more efficient and productive in the future. Today it is important to recognize benefits in the overall urban perspective. Urban agriculture produces many other goods in addition to agricultural produce: education, social cohesion, effective use of space and design, as well as the quality of life of its citizens. Urban Farming thus has a diverse potential for the city and its society (Stierand 2016).

3. The case of the City of Völklingen

The city of Völklingen, located in the German State of Saarland, showcases how green infrastructure is leveraged as a substitute industry in a former mining town. As Völklingen - in the early 2000s - came to a point when there was no significant job-creating industry left, the city decided to actively try to attract new industries and initiate revitalising projects. This practical example is characterized by its innovative approach of creating new, future-oriented jobs at the old industrial and mining areas. Therefore, the City of Völklingen has promoted a new industry for fish farming in the town (results of the GIAGEM Workshop in 2017).

Historical Background

However, the years of decline because of the monostructured economy has become a major problem for the city since the 1980s, as more and more factories (huts, mines, etc.) have had to close down due to increasing globalization. In 1973, 20,260 workers worked in the mining industry, representing 64% of jobs in Völklingen (with a population of 48.000 citizens). In 2016 the city's economy offered around 12.500 jobs in total with a unemployment rate of 11,1% (German median 6,1% for 2016) (Stadt Völklingen 2016, FIRU 2007, p. 42).

The geographical situation of the steep Saar Valley (at the German border) and the lack of awareness of alternative economic activities have resulted in this overall disastrous economic situation of the city. The municipal administration in Völklingen began to take care of the restructuring of the economy only around the turn of the millennium, beginning with the recognition of the Völklinger Hütte as a UNESCO world industrial heritage in 1994 (Stadt Völklingen 2017a).

As the city's financial dept restricts significant investment the city's public services company 'Stadtwerke', which is in charge of supplying the inhabitants of the city with the usual basic services such as water and sewage, electricity, gas, refuse collection, took on the role of looking for alternative, innovative and sustainable business plans. New forms of income should be generated with the aim of safeguarding the future viability of municipal utilities and at the same time improving the city's economic situation as well as create new jobs (results of the GIAGEM Workshop in 2017).

The Sea Fish Farm

As the new and innovative branch to be implemented in the city of Völklingen, Stadtwerke identified marine aquaculture, which is part of the emerging branch of bio-economy as well as urban farming. Aquaculture offers an alternative to both overfishing and the negative impacts of coastal marine fish farming. All in all, it helps reducing the ecological footprint of the production of fish. The site of the former coking plant Fürstenhausen was chosen to host Stadtwerke's aquaculture project. After the decontamination on site was completed, Stadtwerke built a pilot plant for marine fish farming. Part of the joint vision by Stadtwerke and the city of Völklingen was to generate future-oriented jobs in a new branch of economy with the first commercial land locked sea fish farming facility of its kind. The project is part of the global trend towards urban farming, as the fish farm can be built virtually independently of the sea or other bodies of water in almost all (urban)locations (Saarländischer Rundfunk Online (SR) 2018; GIAGEM Workshop 2017; Höll 2017).

With its innovative use, the sea fish farm can be seen as a best practice for a commercial urban farming project. Its nature is a new kind of land use type with the purpose of revitalizing vacant or abandoned spaces. It is of experimental and innovative character. The fish farm addresses a number of public, private and civil society actors as well as bringing a change to the city in social and economic terms as well as offering a new vision for the city's future (development). They nature of urban farming projects in general is an aim in particular at connecting the communities' and the entrepreneurs' interests by means of long range land use planning and sustainable land use allocations. In doing so they support two aspects: sustainable and land conscious urban planning and implementing bioeconomic (or other entrepreneurial) uses in urban revitalization processes (Pallagst et al 2017b).

Today, the area around the project has undergone a tremendous redevelopment process initiated by the city government. However, plant construction and the cultivation of saltwater fish far from the sea proved to be complex (Saarländischer Rundfunk Online (SR) 2018; results of the GIAGEM Workshop in 2017; Höll 2017).

The beginning as a public project (2007-2015) was characterized by problems and the project could not be implemented as originally planned. This is partly due to the nature of the project since this was a pilot project without existing blueprints. Thus, there was no empirical data for orientation help in planning, implementation as well as the strategy. On the other hand, it must be stated that employ important job-positions with public utility employees or politicians did not provide the necessary expertise to successfully implement this type of project (Fresh Völklingen GmbH 2018, Zeller 2017).
Since the Sea Fish Farming project was a pilot project with no precedents, the costs could not be accurately calculated as there were unpredictable funding gaps and additional costs. The plant did cost around € 25 million (including commissioning costs of around € 3 million), from an estimated construction costs of € 12 million (Fresh Völklingen GmbH 2018, Zeller 2017).

This initial process was characterized by a highly contested mix of over-ambitious goals and mismanagement. Despite its innovative approach, the project is still stigmatised by the bad image of its first years of implementation.

Due to this process, the fish farm was sold to a private investor in 2015 and is called Fresh Völklingen GmbH now. Nevertheless, as the project stands now, the sea fish farm was able to reach its primary goal of the development phase- namely create future oriented jobs for high and low skilled workers, generate revenue for the city and introduce a new industry to the City of Völklingen as well as providing a vision of the future development of the City in commercial urban farming.

Basic data of the project

To better understand the marine fish farming facility, the most important characteristics and data are listed below:

- Project, the first of its kind, no comparable facility or standards worldwide.
- The area size of the Fresh Völklingen GmbH is 10,000 m², the production area is 6,400 m².
- The large saltwater pools have a capacity of 1,800m³ of water. There is a fresh water requirement of about 1% per day. This compensates for water loss through evaporation and fumigation.
- The breeding facility consists of four large pools and a 100% mechanical-biological water treatment plant that adds no chemical additives. Therefore, the saltwater pools

create a closed circuit, in which the water is purified in a biological way, free of artificial additives.
- Runs on 100% renewable energy and heat generation.
- In its current structure, the plant can produce between 500-700 tons of fish annually (depending on the species)
- Achievement of EBIT at the beginning of 2018
(neomar 2017, Fresh Völklingen GmbH 2018, GIAGEM Workshop 2017).

A **theoretical second plant** with a production volume of 1000 ton of fish per year (i.e. about 1/3 larger than the existing one) costs according to in-house calculations of Fresh Völklingen an estimated € 15-18 million (plus commissioning costs). The construction phase should take 2-3 years. The amortization is expected to be reached in 8-12 years (Zeller 2017).

A **production cycle** lasts for different lengths of time, depending on the type of fish, and covers the entire period. From the arrival of the juvenile fish in the quarantine station to the breeding and harvesting of the adult fish.
- Dorade & sea bass: 380 - 400 days to 400 - 600 grams
- Kingfish: 350 - 420 days for a strength of 3 kg - 5 kg
(Zeller 2017).

One declared aim of the "Fish Farm Project" of Stadtwerke Völklingen at the beginning was to restore some of these **jobs**. But not only the question of the number of jobs, but also of the qualification requirements of the employees arises, since the former industry of the city-coking plants and mining jobs usually required low-threshold qualifications (Peuling 2017). Fresh Völklingen GmbH occupies about 3% of the former Fürstenhausen site (37.5 ha) where about 500 employees were permanently employed in the former coking plant (Zeller 2017). In the Sea Fish Farm are about **20 workers** permanently employed. The proportion of highly qualified employees is noticeable. Although there are also employees with vocational training or as untrained employers in the production, most of the employees have completed and specialized university degrees. With regard to the question of new jobs for former workers of the steel and mining sector, there is much to suggest that only after significant retraining the opportunity to find a new job at the sea fish farm is possible.

A conducted **SWOT- analysis** finds the project to meet goals as well as showcases weak spots, chances and opportunities.

Strengths	Weaknesses
- **Ecological, local production** of fish, short distances = lower CO_2 balance than imported fish - **Brownfield regeneration** on former coking plant area - **Good traffic connections** to the region and within Europe = easy accessibility of the markets - **Technology works**, the world's first inland saltwater aquaculture - **Constant advancement of the system**, high degree of innovation of the private owner company	- **No competent governance** / governance / project development (as a public project) - **Public entity restricted / less flexible as a private investor** - **long building delays**, because prototype - **Stadtwerke Völklingen have almost gone bankrupt** (about 20 - 22 million € loss) - **High initial investment** of approx. € 15-18 million for further plant

- **Private sector operates plant economically** (EBIT beginning of 2018) - Site requirements relatively low, **can be built almost anywhere** in the world - Very **good employment ratio** per hectare compared to the former coking plant - **Powered by 100% renewable energy** - Fish farm has **space to expand** - **Jobs hardly threatened by automation** - Fundamental part of the growing **urban farming market** - **Represents the future of food production** as world demand for fish and overfishing increase	- **High academic quota** among employees, therefore hardly any job replacement for local unemployed - **Only created 20 new jobs** - Small business, relatively few jobs - **Bad image** due to the initial phase - **Specialized product**, not mass-produced at a high price
Opportunities	**Threats and challenges**
- **City and region actively involved in business development** - **Potential for skilled workers is available** (through further training of jobseekers) - **Worldwide interest** for research and economic reasons & requests for planning and construction of the fish farm system - **Increasing global interest in sustainable & high quality food**	- **Depending on globalization**, relocation may be possible for more profitable assets in the future - **No financial support from the municipality** and its own operations due to the budgetary situation - **Location not in a metropolitan area** = smaller local market

From the analysis, some conclusions can be drawn: The plant fulfills the primary objective of the Stadtwerke. It produces fish as a new resource and has created new local jobs. The innovative technology is constantly evolving and working. Since the Stadtwerke has sold the fish farm to a private investor, the plant can also be operated economically. Furthermore, this pilot plant has the potential to serve as a blueprint worldwide due to the low site requirements.

4. Key lessons learned and recommendations

Regardless of the suboptimal project history in terms of bad execution by the Stadtwerke, the project itself can be seen as a success. This is based on the functioning technology of the prototype, on the now economical operation and the sales success of the fish. Furthermore, the facility itself is relatively modest in terms of location and can theoretically be built in most

cities and regions around the world. This convincing advantage paired with the learned lessons of the development phase and the acquired know-how could turn the sale and plant engineering into a sought-after export good of the City.
The production of food cannot be centralized in geographical terms and is best organized locally, also in terms of climate and environmental protection. In times of increasing food sensitization and the ongoing trend in urban farming solutions, this is a forward-thinking design and method. It should be noted, however, that market saturation can also occur in the food industry if demand is over met.
The weaknesses of the fish farm mainly include the history of construction and management of the project. Both major management mistakes were made and the extent of the construction of pilot plants of this size consistently underestimated. This was partly due to unqualified managers, who did not have the necessary expertise in the project planning of such a system and on the other hand, massive financial miscalculations. The question also arises as to whether public-sector companies, such as the Stadtwerke should take on such a project.
Above all, the favourable conditions of the zeitgeist for sustainable and resource-saving technologies should be considered an opportunity for fish farming. The international interest in urban farming, which includes fish farming, is not diminishing and there are many requests for the construction of such facilities in other countries. The sale of the patent or the further production of fish farming systems could further increase value creation in Völklingen as well as have positive effects in the labour market and increase business tax revenues in the city.
A set of recommendations for the Cities in similar difficult structural economic situations can include:

- Investment in the education of jobseekers
- Consolidation of public finances
- Establishment of a (private and public) funding and subsidies coordination office
- Improve public relations and communication
- Strengthen regional cooperation and networks
- Advance brownfield conversion - use potentials
- Expand local (economic) strengths further

On a project level it is to say that:

- Ensure basic and good governance
- Build on existing strengths
- Use projects as an image carrier for the city or region
- Use of the marine fish farming project as a model and learning curve for future developments

One lesson learned is that with future projects of this kind Völklingen will responsible of the relevant actors, interested investors and public companies work cooperatively on further development of this project. Follow up investments such as the construction of a Shushi producing plant in the vicinity as well as other closely related up- and downstream companies are on the horizon. The regeneration of Völklingens economy could have just started to kick off.

5. Conclusion

Classical urban planning reaches its limits when dealing with shrinking cities. There is no universal solution or general recipe for dealing with shrinking cities. These new challenges can only be met in new ways. However, these paths differ from city to city, as the starting conditions in each municipality are also dependent on the individual case and not every city can be developed with the same strategy.

When dealing with shrinking cities, an experimental path is usually chosen, new forms of urban planning and development are tried out, and action concepts are tested for which there are still no blueprints. The way forward is to reach sustainability for future developments. This requires a change of mentality of the city administration. In addition to (new) instrumental challenges, a high degree of openness and communication as well as long-term aspects are perceived as important.

The case study municipality has decided to actively shape the socio-economic structural change. This implies that - as shown - positive as well as negative results can be achieved. The positive effects here are primarily the achieved primary goals of the projects. On the one hand, future-oriented jobs should be created and on the other hand, the urban economy generally strengthened to reach sustainable developments. Additionally, existing strengths should be further developed and promoted. It can be learned from the historical developments that monostructured economies cause difficult situations in communities when this economic sector is in crisis.

The substitute industry as a sustainability strategy to create revitalisation trajectory's in these communities. As a result, jobs have been created on old, existing areas. But at this point, there is a need to look at the size of the Völklingen case study. Only about 20 jobs have been created in a company. This is not (yet) a substantial success that can turn the city's economy noticeably around. The analysis of the case study shows that the replacement industry has been set up with the aim of "recovering jobs". However, these jobs cannot or hardly be filled by the workers who previously worked in the city's industrial sector.

The aspect of sustainability in terms of nature conservation, nature resource savings, CO_2 emissions, to just name a few indicators, is also an important aspect of substitute industries. Especially regarding the urban farming case study of the sea fish farm. As the world's first inland saltwater fish farm it is seen as an important tool against overfishing of the oceans as well as coastal aquaculture, known for controversial methods and rich in consequences (e.g. use of antibiotics in the open sea). The sea fish farm bypasses the current discussion on the (health) threads of plastic waste in the oceans due to being an enclosed system without waste contamination or the need to use antibiotics. The sea fish farm contributes to the growing global demand for healthy fish and environmental protection. In addition, the low CO_2 consumption is to be highlighted in the local, organic production of marine fish in comparison with imported goods.

The time aspect, more precisely the time delay, is rarely taken into account in the substitute industry instrument. Many years or decades can pass between the demise of an industry and the creation of a new employment opportunity. Furthermore, the quality of jobs is shifting, so that new jobs often require a much higher level of education than previous ones.

The recommendations for action that emerged from the analysis aim at cities and project managers to adapt their strategies and continue to play an active role in structural change and to set in motion sustainable developments despite certain setbacks. For the future, the main focus in these communities should be on learning from the mistakes of past projects and incorporating these insights into future initiatives. The transferability of the recommendations is not always given, although partial results can also be transferred or learned from.

In this context, it should be noted that the question "Can substitute industries generate or at least stabilize growth sustainable in a shrinking city, stop the population shrinkage and restore jobs?" could not be fully clarified in this work. In the case study the answer to this question is negative, due to different scales of crisis and the project size.

However, it is clear that the creation of new jobs can compensate for the loss from the mining or the manufacturing industry, but this depends on the type and size of the new initiatives. Although new jobs are often not created in the same number and usually only in changed demand in education quality. The sea fish farm created an equal amount of academic and non-academic jobs. Most of the times substitute industries are focusing on academic jobs, which is not helping the local job market in city's affected by structural changes. The fish farm can be seen as a best practice example in this concern.

However, city planning and development has always been subject to constant change and is constantly confronted with new challenges. As a result, there are always new challenges and repercussions that must be considered when recruiting and locating replacement industries, and whose consequences on the urban environment are still often unknown. Here the result is usually completely open. There is no guarantee of success. An example of the unknown effects is the digital revolution, in which the potential positive and negative effects on cities are still difficult to predict.

Based on the experiences of the city examples presented briefly, it can be concluded that there is no clear answer to dealing with alternative industries. These are neither to be understood as a "panacea" nor as a "symbol of false hope". After all, it is a step in the right direction to anticipate a sincere analysis of the location and the city for the revitalization initiative, since not every municipality has the same prerequisites and potential and consequently cannot rely on the same strategy.

In conclusion, it should be noted that all measures to a certain extent can at least slow down the shrinkage processes. Existing resources can be used to rebalance cities between shrinkage and growth. Even if it is not possible to counteract all the external factors it is nevertheless important to constantly set new innovative and goal-oriented impulses in order to actively shape the future in a more sustainable way.

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LUMAT project – integrated environmental management of land resources as contribution to enhancement of urban areas resilience to climate change

abstract

LUMAT project (Implementation of Sustainable Land Use in Integrated Environmental Management of Functional Urban Areas) financed by INTERREG Programme CENTRAL EUROPE – is concerning enhancement of integrated environmental management of land resources in functional urban areas by using ecosystem services approach. Cases of the LUMAT project functional urban areas in 7 countries present solutions of integrated environmental management which can be considered as activities contributing to enhancement of urban resilience to climate change. The project has applied the methodology of ecosystem services analysis and assessment. This approach includes services connected with climate change resilience which is an important element of adaptation of urban areas to climate change.

Action plans presenting examples of solutions contributing to enhancement of integrated environmental management in FUAs include activities for development and strengthening green and blue infrastructure. This group of activities constitute an important factor in climate change adaptation plans for urban areas. In the idea of LUMAT there are actions which are to bring environmental but also social and economic benefits.

One of the action plans concern green and blue infrastructure development in the functional urban area of three cities in Silesian Metropolis in Poland. These cities as other in this metropolis present a densely populated post-industrial area with numerous brownfields and post-industrial sites. The new strategy of development of the cities provides for new goals and priorities in social and economic sphere. At the same time the local authorities are aware of the need for ecological balance of urban areas.

The LUMAT project has offered a possibility for improving this balance by creating a network of green sites including abandoned areas (brownfields, post-industrial sites) but also the existing green areas requiring re-shaping or re-construction. One of the sites has been selected as a pilot action area of LUMAT consisting in full recovery in order to create green park with recreational function. The area is a post-zinc wastes dumping site covering 6,5 ha located in the very middle of the city. The site is surrounded by dwelling houses, garages, workshops and a school building and on the east there is an underground coal mine.

The investment will consist in rehabilitation of the brownfield site located in the middle of the Ruda Śląska city. Phyto-stabilization technology will be used to make the site safe. The investment will create an available open space of a natural, "half-wild" character; due to the progressive greening it will achieve the character of a sub-regional park. The place will become the walking and biking route connection of two districts as key element of the peri-urban green infrastructure.

Synopsis

Project LUMAT is concerning integrated environmental management of land resources in functional urban areas. Cases of the LUMAT project functional urban areas in 7 countries present solutions of integrated environmental management which can be considered as activities contributing to enhancement of urban resilience to climate change.

A Study of Human Ecology and Resources Network

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Abstract

In order to protect people from variable external environment, buildings emerged. Therefore, there are always discussions of the relationship between humans and nature. Nature has its self-restoring equilibrium, however, nature cannot be considered without human participation (Cronon,1996). Due to respond these changes, many designers tried to modify the environment or create artificial works, and some have begun to explore sustainable system in design theory and practice. The relationship between humans and nature challenges the essential theory of architectural and urban design.

How does the city form? Humans gradually get together to a settlement and then occupy the space as their territory. Various settlements connect with each other through channel from point to point. Therefore, the network has been built and the city has formed. As the city developing, it may be constructed following the governmental planning, and mainly represent the capital and political impacts. Some planning strategy and practice think from a traditional top-down system, and try to balance the relationship of human and nature. However, back to the generation of city and the distribution of resources, instead of retracting to a traditional top-down system, a new interactive and bottom-up self-organize algorithm is necessary, to cope with the complicated network system.

Liwa oasis is strongly influenced by the distribution of scarce resources and topographic conditions in the desert, which is a typical city to research on the self-organize algorithm. It is located on the north edge of the Rub Al Khali desert. In addition, energy has become the most important driving force of the expansion of the Liwa oasis in the future. Because the existing Liwa oasis network system is constituted by settlement and nearby sabkhas, and the salt material distribution process, so it is potential to apply as inputs into an algorithm.

This essay will first argue the ethos of new Human Ecology, analyzing the algorithm in nature and the process of biological network in order to explain the distinction between human and nature more details. Secondly, it will focus on how the bottom-up self-organize algorithm transfer to design area. Specifically, it will give design proposals of Liwa, which apply a new algorithm as design method for the future planning. By researching on biological algorithm, applying bio-3d printing technology, developing digital simulation, the biological urban network algorithm will be established. In addition, in order to implement the urban design proposal generated by biological algorithm, it will consider the construction tools and the local matertials. Last, but not least, the biological urban network algorithm is capable to establish the link between the practical requirement of society development and the existing resource oriented network urban morphology, from top-down to bottom-up, from stable to dynamic, from homogeneous to diverse. It is based on this new human ecology, will be determined and discussed.

Key Words: natural systems, human ecology, biological self-organized network Algorithm

1. Introduction

Through relentless choices and changeable evolution of natural selection, the natural forms become perfect and various. The species of animals and plants has a rich biodiversity and keep good metabolic state with the environment. For a long time, architecture has learnt from the forms and structures of nature. Achim Menges (2011) establishes that natural systems reconcile in material structures which operated by internal physical restriction and external forces.

The operation and maintenance of buildings have continual influence on the environment. 'vernacular architecture' is an architecture type which was built by the inhabitants themselves and used local material. The building technologies were the experience by the owners which can adapt the changes of climate and meet their own needs. Vernacular architecture is an example which buildings adapt the nature. With the advent of industrial era, global environmental issues have received widespread attentions, and people's activities can not consider as individuals' actions. Global warming has been presented by Climate Change 2007 in the IPCC Fourth Assessment Report. It is a phenomenon about the rises in global temperature, melting of Antarctic and arctic glaciers and the increases of global average sea levels, which happened since 1750. Human activities have consumed large amounts of natural resources, and at the same time, emitted harmful substances to destroy the nature, including the burning of oil, the coal and fossil fuel. Particularly, buildings may become a medium to expose the fact that humans have caused damage to the nature. Humans have the try to find way to help with the sustainable development of the earth and the interaction between nature and human. There is also a need to change our design thinking of architecture and city, as buildings normally exist for a long time.

Since man and nature both share the common resources for the constructions and architecture always has close relationship with its surroundings, it is obvious that architecture literally becomes part of nature. Most generally, architecture design is not only about constructing buildings and other physical infrastructures, but also about designing and planning from the micro level to the macro level. The coded form in architecture which is the logic in the generation of form is similar or analogous to the genes in nature. Design thinking moves its focus from the form of a static nature to the inner logic of nature system, which is its process of morphology. In order to research on the complex nature system, computers first as research tools, not graphics tools, appearing in the history of architecture and urban design, influence the development of urban planning.

2. Design theory of the human ecology

2.1 the concept of new human ecology

The concept of 'human ecology' comes from 'ecology', but concentrates on the collective behavior of human interaction and the relationship with the environment. Biologists focus on the behavior of organisms and the transformation as the environment changes, while the sociologists did lots of similar research of human groups. From the urban designer perspective, human ecology can be described as a design theory which learn from the collective interaction of biology, but not only focuses on the influence of buildings to the nature as the common cognition.

In the book, 'Occupying and Connecting', Frei Otto(2009) said that urban planning theories nowadays need to follow the change of typical self formation processes. There is a need to research on the 'natural' town transport planning and try to find the way of solving problems by ecological ways. Otto explained that the occupation by a variety of classification standards, but focused on two ways which are 'random occupations(Otto, F 2009)' and 'attractive occupations(Otto, F 2009)'. Otto thinks random occupations means to fight for the largest possible territory. The attractive occupation means the attraction between the occupying subjects. Two ways in occupying processes exist and influence each other. Connection as the way of communicating and exchanging between occupants is as well important and cannot be ignored. Connection focuses on solving the optimal balance between convenient links and the shortest length of roads and the road system is derived and hierarchical. When considering the human settlement, after forming the connection road system, the process of its re-occupation will begin. The road system promotes an uneven regional development, and forms spread tension of settlements.

Therefore, the research framework of forming human settlement becomes from occupying to connecting, and then re-occupying. The theory includes the basic factors of settlement pattern formation mechanism, especially considering the complexity of the city. Figure 1 is a model of the theory of muscle memory in nature by Frei Otto. It can be divided into three stages. The first stage is forming a territory path network which is based on searching for food. The second stage is forming the settlement path network that connects between individual buildings. The third stage is forming the long-distance path network which connects the different habitations.

Figure 1: the model of muscle memory
Diagram reference: Occupying and Connecting, by Frei Otto

Basing on the framework of muscle memory, we can attempt to derivative a new concept of human ecology which focuses on generation and self-organized processes of human groups, emphasize the relationship between machine, human and nature. In simpler terms, the new human ecology tries to make a balance of human activities, buildings and environment, and pay more attention to help the sustainable development.

2.2 the methodology of new human ecology

From the perspective of the general theory of architecture, there is no distinction between nature and artifice. Natural morphogenesis, the development of evolution and process of changes, happens in a complex system, which is the combination of internal generation and external influences and forces, and eventually contains system-intrinsic material and form features. This kind of model which includes complex natural process assists by the computers may emerge the simulation visually and make logic mathematically. The Church Turing (AlanTuring, 1936) hypothesis established that the Turing Machine, which was invented in 1936 by AlanTuring, could repeat both the use of mathematical machines and nature. Thus it is not only help the development of mechanization, but also gives the potential to formulate natural morphogenesis. Another significant theory is presented by Von Neumann, which involves artificial and natural biologies, beginning with the basis of life.

Considering architecture as a material practice, the design process has a hierarchical connection which prioritises the process of formation and then its materialization. This suggests an alternative approach of technology in architecture design, which origins from morphological complexity, except distinguish materialization processes and generation of form. The latent potential of computation suggests that, this kind of analogy of evolutionary architecture needs rigorous geometric logic and reasonable simulation and the digital model can be deployed material characteristics, complex logic articulation in the material and structure systems.

John Holland (1975), gives a crucial system theory in relationship with natural analog model and his examples is about the how to optimize the complexity in unstable environments. Such problems seem to concentrate on the questions of adaptation and do not have a collective name, which could connect with various area, such as ecology, mathematics and also architecture. Accordingly, the coded information of form in nature is due to the genes and natural selection is on the foundation of coded information, which is also influence by the environment. Similarly, the coded manufacturing instruction in architectural model, which is in the real world but reflects the artificial life, is also environmentally dependent.

3. Design practice of the human ecology

As the concept of human ecology has developed deeper and broader, the recognition of the relationship between humans and nature has changed from separation to integration. Designers try to explore on the algorithm of nature and exploit the potential of machine, in order to looking for method of the interaction and long-term influences of humans and nature. This thinking suggests that is there a design method which can establish a sustainable system of the interaction between the collective activities of human and the changes of nature? With such an idea, a design proposal in urban scale proposes in Liwa Oasis city.

3.1 Nomadic self-organized network oasis city

The Liwa Oasis city is located at the Arabian Peninsula, on the north edge of the Rub Al Khali desert. In common sense, desert is defined as the middle of nowhere. However, it is not true, the desert is far more various and beautiful then we imagine. Even in a desert, where is full of sand, the sand also can become an excellent media to represent the various climate and geological condition. The landscape condition is an important factor in whole ecological system. Therefore, due to the diverse condition above, the species distributed abundantly and variously in the desert. Similarly, because of different ecological condition, the species distributed on the dessert is diverse as well. Furthermore, the desert is full of resource, especially energy resource, including fossil energy resource, such as oil and coal, and also sustainable resource, for instance, solar energy and wind energy. The exposure of the diversity of Rub Al Khali desert let us know how interesting and abundant of it, and it give us the motivation and also potential to develop new methodology of urban design in this area.

Unlike the other contemporary urban settlement area in United Arab Emirates, for instance, Dubai and Abu Dhabi, which were constructed following the governmental planning, and mainly represent the capital and political impacts, Liwa oasis is a self-organized territory which is strongly influenced by the distribution of scarce resources and topographic conditions in the desert. Because of this property, Liwa oasis was emerging as an ecological self-organize network system interacted with other resources network. For example, Liwa oasis was built on 16 century, mainly because its location was in the accessible radius of shallow groundwater resource network. Water was the most important resource in that period, because it is necessary for the nomadic people who are living and discovering in the desert. They were “scanning” the territory in the Desert without extract geological understanding, and tried to find the location which can easily access to the shallow underground water through manually digging wells. Some settlements emerged individually alongside the wells, and consequently connected together as a network oasis. Therefore, Liwa was built up as a nomadic self-organize network oasis city, mainly responding to the w ater resource distribution. However, today about 60% water usage in Liwa oasis is provided by the water desalination plants from the coastal area. This change means energy has replaced water as the most important local resource, when this water supplying strategy is actually using energy to replace the water consumption. Under this condition, the existing morphology of Liwa may be challenged.

In addition, in the 2030 master, Liwa is going to tr ansform from a farm area into a m ain tourism destination in the desert. Therefore, its resident population will be increase from around 20,000 to 65,000, and the annual tourist amount is aiming to grow from 30,000 to 90,000. Under this background, energy has become the most important driving force of the expansion of the Liwa oasis.

In the Liwa territory, there is a type of remarkable landscape, between dunes in-land sabkha (salt-plate). This landscape is a main tourism attraction, and also a potential energy source because it’s large reserves of salt. In addition, in the latest 20 years developing history, Liwa was expanding by cleaning and occupying sabkhas, which are normally located at the small basins and protected from the strong winds in desert by surrounding dunes. Because the existing Liwa oasis network system is constituted by settlement and nearby sabkhas, and the salt material distribution process, so it is potential to apply as inputs into an algorithm.

3.2 Biological self-organized network algorithm

Instead of retracting to a traditional top-down system, a new interactive and bottom-up self-organize algorithm is necessary, to cope with the existing complicated ecological network system. For this reason, the pr oject researches and e xperiments with the phy sarum polycephalum slime mold. Slime mold, Physarum polycephalum, is a mold, having an identity crisis as it has not been defined as a kind of mold. In the growing process, oats would be an element to attract the Physarum polycephalum and the formed branches can be efficient networks which is applicable to new design networks for the communication and transportation under a set of constraints of environment problem.

Figure 2 is an experiment of the network formation in Physarum polycephalum, which is similar to the network of tubes around Tokyo. Figure 3 is how slime mold grow exclusively along the shortest path possible between the two pieces of food, which was put at the start and the end of the maze. Until now all the experiments about slime mold were conducted by scientists. They have observed slime mold activities but these have not aimed at simulation for design cities. From the ur ban designer perspective, we want to use the slime mold algorithm into the ur ban design. What we are interested in is to use the intelligence self-organizing algorithm created by slime mold distribution into urban design making a shift for the future cities.This microorganism has similar behaviours strategy with nomadic people when they are searching and c ollecting resources. The behaviour of phy sarum is the combination of num erous cells inside. The interaction and communication of its cells can output a network generating process as optimized as artificial one.

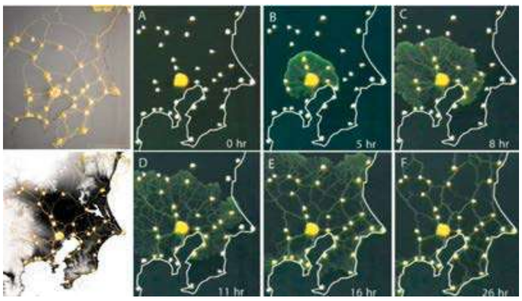

Figure 2: Nakagaki, et al. Rules for biologically-inspired adaptive network design
Diagram reference: Science/AAAS

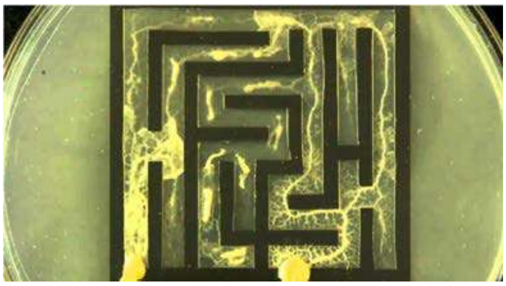

Figure 3: Nakagaki, Yamada, Toth Path finding by tube morphogenesis in an amoeboid arganism
Diagram reference: Science/AAAS

As mentioned in the chapter 2, Frei Otto said the muscle memory in the nature can be divided into three steps, which can leads to the simulation of the natural human settlement networks. It is similar to the growth of slime mold, whist expanding around in the medium, then concentrating on nodes and making a circle to surround the food sources, and last, becoming an optimized network connecting with each other to transfer the information.

Connecting with site, sabkha has a number of salt and water, which should be used for human activities. The network between residence and sabkha can be the analog model object to research. The slime mold, as biological model, can help with the algorithm in the sabkha network. Choosing the sabhka in Rub Al Khali to simulate the network between sabhka and residence. By applying bio-3d printing technology, high-resolution observation device and picture analysis algorithm, the project has developed slime mold as a biological network algorithm, to generate the time-based urban design proposals for Liwa territory. Figure 4 is the bio-3d print machine of some components to push the materials to the petri dish with the injector. Put food resource to the location of sakbha in desert and slime mold in the location of residence in Liwa and a picture of contour map as light source. The project also develops the digital simulation network algorithm from the strategy of slime mold in parallel, in order to provide design proposal in specific area, with higher accuracy.

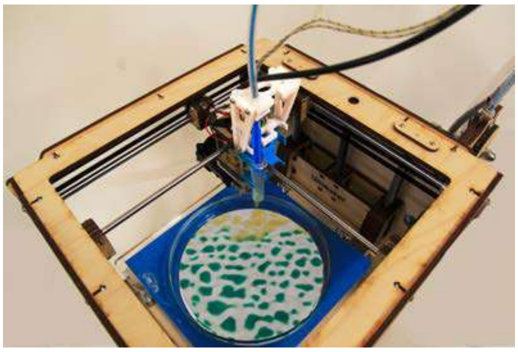

Figure 4: the Bio-3D print machine

3.3 Information process from biological network algorithm

Because the main output from the biological network algorithm are pictures(Figure 5). In this part, the project apply algorithm to convert the picture to density points, and then these points can use to generate the meatball to show the to show the thickness of the slime mold in the picture. Finally, by input these points into shortest path algorithm, we can regenerate the network of slime mold in the biological experiment as in the Figure 6.

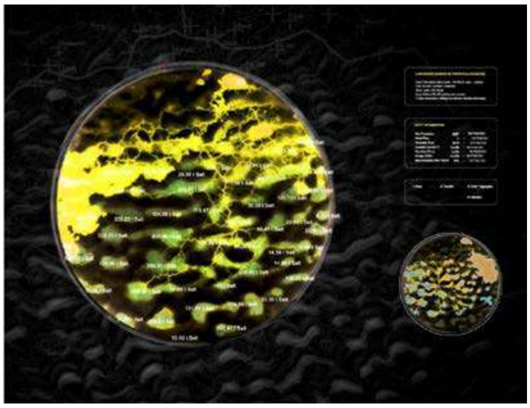

Figure 5: The interface of interpretating the experiment result from biological algorithm

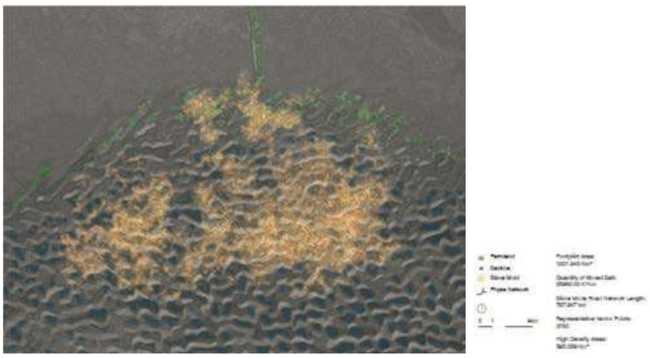

Figure 6: Apply shortest path algorithm to reconstruct the network of slime mold.

3.4 Ecologocial relational model

From above steps, we already can convert the biological experiment results from pictures to vector date and fi t to the site. However, in order to pr ovide a convincing urban design proposal, we need to c ombine the interpretating process with more complex site condition.

For example, In the 2030 master plan of Liwa oasis, the population will become 3 times as in present, from around 20,000 to 60,000, and the main industry in Liwa will shift from farming to tourism. To fulfil the requirements for the increasing population and development of industry, we need different amount of resource and infrastructures. And these resources also has relations in between, which means normally to fulfil the single requirement of one resource we also need to produce extra related resource.

Base on the input-output relation between different required resource, and the population increase target in master plan 2030, the project can build up a mathematics ecological input output model, it can be predicted the general requirements of each resource in each years. Figure 7 shows that the dynamic mathematics model is potential to link to the information interpretating process of the biological experiment, which can help that to develop as reliable urban design proposal.

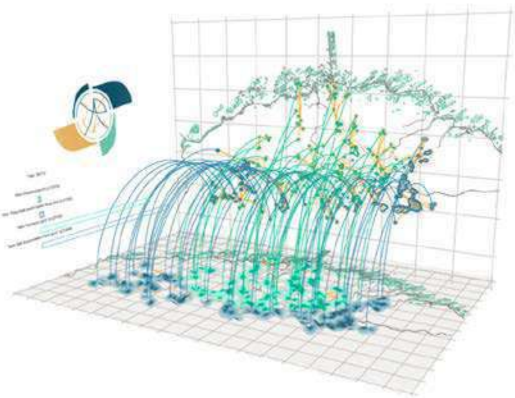

Figure 7: The interface shows the development progress in different year from the biological algorithm

3.5 Biological experiment information interpretation

From the research of the territory, it exposes that the existing morphology of Liwa oasis is expanding by occupying sabkha. In the process of occupying, people need to clean the salt on the surface, to avoid the high salinity environment to damage the building structure.In addition, it can be found energy has become the main force to drive the development, and salt is potential to a source of energy. In the other aspect, the behaviour of slime mold is actually re-distributing the resource on site to improve the transportation efficiency.

To sum up, these condition give us the reasons to translate the process of the biological experiment as and analog model of people expanding the city by re-distributing the salt material and occupying sabkhas. The data from the input-output model is the prameter to control the quantity and progress of this interpretation.

3.6 Physa self-organized network city

By applying physa self-organized biological algorithm, we can generate the urban design proposal contents different time stages, and provide suggestion on programs division, location, and material quantities. These system allow designers cope with the complex territory conditions and also fulfil the society develop requirement. In addition, instead-of traditional top-down city morphology, this methodology allow designers to develop new self-organized decentralized city.

3.7 Autonomous network builder

The Physa Biological Algorithm could be operated and run under different scale. Under the higher than 100 ti me amplification microscope, the cells of s lime mold moved in a v ery organize way. The swarm ovement of cells resulted in an oscillation fluid, and transform the diameters of the tube frequently. This organized swarm behavior was operated under a real time autonomous system. This property give us a new potential to ex tract detail real-time information from the Physa biological algorithm in a micro scale, rather than only observe the pattern of the macro network.

In some condition, salt is a precious resource in desert, and people may manually collecting with suffering of cruel climate condition. Although this scenario does not happen in Liwa now, but when salt is a potential resource of energy, it give us an argument to apply more coefficient way to harvesting salt from sabkhas. In the above research, we found the resource harversting behaviour of cells of slime mold have similarity of nom adic people's collecting activity in desert.

In the other aspect, In order to implement the urban design proposal generated by biological algorithm, swarm robot was introduced as autonomous builders in this system. Because the growing of phy sarum is the m acroscopical representation of the c ollective movement of i ts cells inside, which has the similar mechanism with swarm robots.

3.8 Computational self-organized network algorithm

Because the bi ological simulation has certain limitations in the ac curacy of the data processing and recording, we also manipulated the digital simulation as comparison and supplement. By setting up the agents as the swarm robot gatherer, and emit the collectable particles as the position of sabkha, simulation of swarm robot collection behavior is built up. In this simulation, we can clearly observe and anal yse how the agents collecting materials and interact with the territory. These may provide us more suggestions about how to program the swarm robot and design the salt infrastructure network.

Once decided applied swarm robot as the builder of the urban design proposal, the project needs more detailed information inter of s maller scale and accurate time. The bi ological algorithm is capable in large scale, but has many technical limitation in small scale. In the other aspect, digital simulation has advantage in provide very accurate feedback. Therefore, we extract the mechanism from the behaviour of phy sarum to developed a r elated digital algorithm. These algorithm will run in a smaller scale of ter ritory and m ainly affected by the salinity information.

When the swarm robots carrying materials and moving around Liwa territory, it is potential to construct specific urban prototypes and new landscape. For investigating this possibility, the project researches the energy producing and structure application of the resources, such as salt, fiber, and starch in Liwa territory. The project organizes these investigations as a material system, and connected it into the biological network algorithm, by applying digital simulation as in the Figure 8.

Figure 8: plan view of urban scale

4. Conclusion

Since man and natur e both share the c ommon resources for the constructions and architecture always has close relationship with its surroundings. Vernacular architecture is an example which buildings adapt the changes of climate and meet inhabitants' needs. It is not easy to ev aluate the bui ldings' ecological cost, especially when it needs to c onsider about the whole life cycle of buildings. With the ad vent of i ndustrial era, global environmental issues have received widespread attentions, and people's activities can not c onsider as individuals' actions. Global warming reminds us to pay more attention of gl obal environmental issues which caused damage by humans' activities. Particularly, buildings may act as a medium to ex pose the fact. There is a need to s hift the design thinking from separation to interaction between humans and nature. The new concept of human ecology focuses on generation and s elf-organized processes of human groups, emphasize the relationship between machine, human and nature. It pays more attention to help the sustainable development of earth.

Most generally, architecture design is not only about c onstructing buildings and other physical infrastructure, but also about designing and pl anning from the m icro level to the macro level. It i s important to m ention that the s elf-organisation rules in nature is about the process of metabolism and the pr inciples of th ermodynamics. Natural urban and t ransport planning is perfect as to find solutions to the ecological significance (Otto, F 2009).

In summary, the P hysa biological network algorithm generated design proposal in urban scale, and the digital network algorithm compute the des ign proposal in building scale, meanwhile the s warm builders and the m aterial system are the fi nal implements. These different research components consequently constructed a dy namic ecological network algorithm. This network algorithm is capable to establish the link between the practical requirement of s ociety development and the existing resource oriented network urban morphology, and form a new urban morphology, from top-down to bottom-up, from stable to dynamic, from homogeneous to di verse. This is a des ign approach which can establish a sustainable system of t he interaction between the c ollective activities of hum an and the changes of nature.

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Downtown Cairo Urban Regeneration – A Model for Future Urban Regeneration Plans with Energy Efficiency Interventions

Silja TILLNER, Architects Tillner und Willinger, Austria

The Implementation Plan is intended as a future prototype to explore new models for urban regeneration in historic zones that integrate energy efficiency into the plans, thereby linking planning and urban design measures for the improvement of mobility and the public realm with public and private investments in energy-efficient buildings.

1. Background on Population, Living Conditions and Environment

1.1 Population

Egypt is one of the fastest-growing countries worldwide and will continue to grow at such a speed that by 2050 it could surpass many others around the globe countries. If countries are depicted not according to geographic size, but to population figures based on internal growth (not considering migration), countries like India or Egypt gain disproportionate importance compared to their size. [1]

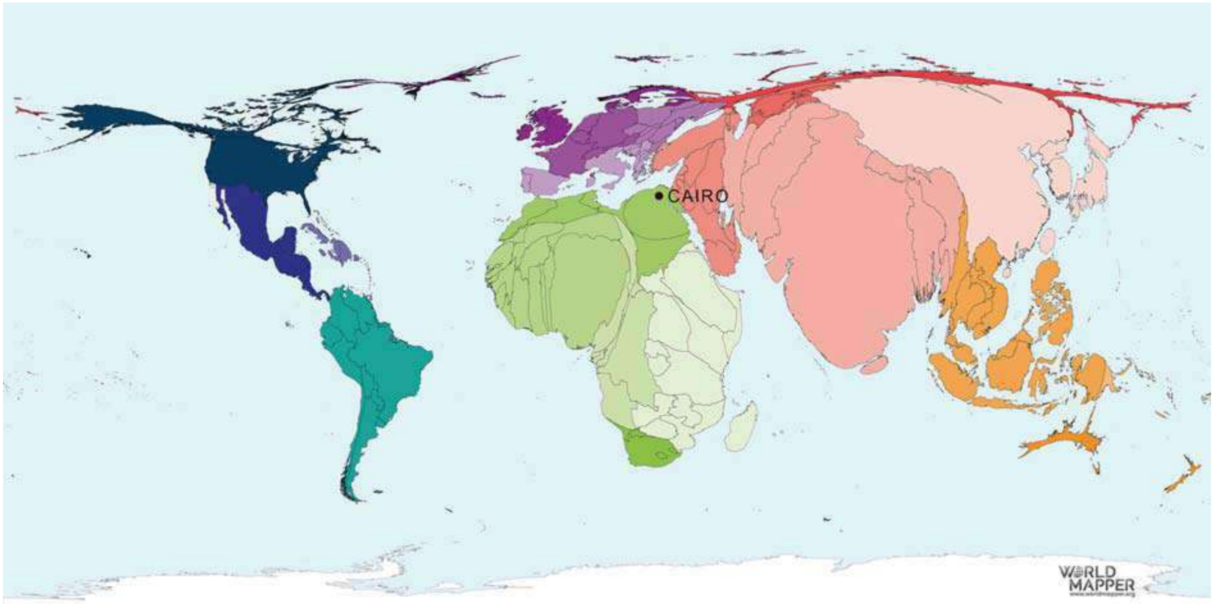

Figure 1: World Map based on internal population growth
Data source: https://worldmapper.org/maps/population-year-2050/?sf_action=get_data

Greater Cairo is a megacity with—considering the contradictory numbers—approximately 27 million inhabitants. Even in 2016, Cairo had an estimated population as high as 12 million, with a metropolitan population of 20.5 million, which made it the largest city in Africa and the Middle East.[2] This unprecedented growth rate has caused negative consequences for Cairo with regard to the environment, living conditions and economics.

Figure 2: Cairo is located in the desert, the fast growth of the last decades caused immense construction on formerly green spaces Data source: https://www.citymetric.com/fabric/cairo-has-dangerous-growth-problem-how-can-it-be-fixed-2865

1.2 Living Conditions

Seventy percent of Cairo's inhabitants cannot afford to live in an apartment, based on the supply of the official housing market, but have to refer to the informal market with all its negative environmental consequences. The informal market bases its supply on illegal land or construction, following three different strategies. Firstly, farmers transform their land zoned for agricultural use into building sites without providing adequate infrastructure, i.e., public transport and utilities (sewers, water, electricity, etc.). Secondly, already densely-built up residential areas are further densified with illegal buildings or additions. Thirdly, illegal structures are added onto the roofs of historic buildings (mainly on buildings from the late 19th and early 20th century in Downtown Cairo) without structural reinforcement or safe access. The government and nearly all private developers, in contrast, focus on the development of new towns in the desert [3] on the outskirts of Cairo to accommodate numbers that have more than tripled since the 1970s, far from public transit and current living quarters. This new town development in the desert is not only negative for the environment, but also for the quality of life of the workforce and their families, who would be separated from their workplaces and social contacts. That is the reason why many of these new housing developments have failed to be accepted. Some young families, however, are gravitating towards the fast-expanding satellite cities in pursuit of cleaner air and to avoid the negative impacts of high noise levels generated by the city, where waste disposal is hugely inadequate and water pollution is a significant issue for many communities.

Figure 3: Informal construction in existing residential neighborhoods
Data source: http://www.mei.edu/content/informal-areas-cairos-silent-urban-revolution

Downtown is currently the administrative center of Cairo and still houses all the government functions, but the ministries will soon relocate to the future capital, "New Cairo,"[4] which is under construction and proceeding fast. After its completion and the relocation of the ministries, as well as of the Egyptian Museum to Gizeh, the future of Downtown will depend on the success of revitalization efforts to make it more attractive as a place to live and work.

1.3 Environment

Cairo has been ranked as the second most polluted large city in the world, according to a report issued by the World Health Organization (WHO), which studied air pollution globally from 2011 until 2015. [5] The WHO report noted that seven million people worldwide die from exposure to polluted air, adding that nearly 4.2 million people died in 2016 from air pollution; pollution from fuel exhaust also resulted in the death of 3.8 million people in 2016. In 2017, the United Nations Environment Programme stated in a report that 40,000 people in different parts of Egypt all died from pollution. The report pointed to the absence of trees within Egypt's capital as leading to the increase of air pollution.

Hosting a population of 19.5 million, [2] Cairo [6] is considered to be the most congested city in Egypt. The Egyptian capital and its neighboring Nile Delta cities suffer from some of the worst air pollution on Earth. Two million cars on its clogged-up streets and a thousand factories surrounding the city cause severe pollution, which is aggravated regularly in the fall when farmers outside the city burn leftover rice husks. High emissions and Cairo's topography—the city lies in a valley surrounded by hills—and the extremely dry climate make the pollution even worse. In the fall, frequent temperature inversions settle over Cairo, stilling the winds and preventing the movement of air. As in other developing countries, the rapid urbanization and weak enforcement of environmental regulations have especially left the poorer urbanites vulnerable to bad air.

Figure 4: Smog over Downtown Cairo – illegal construction on rooftops
Data source: Silja Tillner

Almost all of the city's trees, its most effective dust filters, have disappeared, as has much of the surrounding agricultural land. Every year approx. 30,000 acres of undeveloped land is lost to urban sprawl. Cairo's notorious traffic, the abundance of old cars without pollution measures, the high-rise buildings and narrow streets that trap poisonous air close to the ground have all contributed to the city's consistent ranking as one of the world's most polluted cities. Lately, promising efforts have been taken to reign in the problem.

[…] perhaps, the public and private sectors both appear to have come up with some solutions to the rice straw-burning epidemic. Authorities appear to be slowly reining in illegal agricultural waste fires. An architect, Essam Hosni, has designed building blocks out of the straw, possibly providing an answer to Egypt's lack of affordable construction materials in the process. Potters in the capital's Old Cairo district have taken to packing their delicate wares with rice straw. [7]

1.4 Downtown Cairo – City Form and Function

Downtown Cairo is equivalent to the Khedival Cairo and was once called "Paris on the Nile" at a time when it was an urban oasis full of greenery. The urban lay-out of its formerly tree-lined streets and squares, the landscape design of parks, and the architecture of the buildings was of the highest quality, because the Khedives used the most beautiful European cities in France, Italy, Germany and Austria as models and hired the best craftsmen at that time to plan their city, open spaces and buildings. Downtown is full of valuable historic heritage and still the administrative center of Cairo, but it will change considerably when most of the government ministries move to the new capital.

2. EBRD Project – Strategy for Future Revitalization Projects – Ambition – Team

The Implementation Plan is intended as a future prototype to explore new models for urban regeneration in historic zones that integrate energy-efficiency into the plans, thereby linking planning and urban design measures for the improvement of mobility and the public realm with public and private investments in energy-efficient buildings. The EBRD supports private and public initiatives to revitalize the historic center and save its heritage with a financing model that offers sustainable alternatives to profit-driven private developments.
In parallel to the Government of Egypt's demonstrated intent to redevelop Downtown Cairo, the European Bank for Reconstruction and Development (EBRD) has emerged as an international development partner that is uniquely interested in Downtown Cairo and has taken a proactive approach to supporting the Government of Egypt's efforts. As such, the EBRD has commissioned technical assistance for the integrated and sustainable regeneration of Downtown Cairo by developing a strategic implementation plan for the regeneration of the area, maintaining its cultural and historical heritage, conducting energy and resource audits of major buildings in the Downtown area, and national policy engagement with key public and private stakeholders. [8]

Objectives of the Implementation Framework for Downtown Cairo Urban Regeneration
The Implementation Plan was launched by the EBRD as a future prototype to explore new models for urban regeneration in historic zones and urban fabric. [8]
Work on the Downtown Cairo Regeneration Implementation Plan began in early 2016 and has been implemented by an Egyptian-Austrian consortium of urban regeneration and building energy efficiency experts, led in Egypt by OHK Consultants. This international / local team [9] worked in close collaboration with the Cairo Governorate to develop the Implementation Plan.

Figure 9: Traffic in Downtown CairoDate source: Silja Tillner

3. Analysis of Current Conditions

The analysis of current conditions in Downtown Cairo shows they are a detriment to its citizens: Results from the analysis of the existing situation and the adaptive strategies developed to meet current and future challenges could contribute to the topics weather, water, food and energy. *(See pages 1-4)*

3.1 High Traffic Volumes

Current conditions have high negative environmental impact for the citizens because the high traffic volumes consist of many old and polluting vehicles. Since observations showed that many are mostly passing through Downtown or are drop-off traffic opportunities arise from possible changes in street-hierarchies. *(See page 10-11)*

3.2 Environmental Pollution Heat

Pollution levels have been severe *(see pages 1-4),* but the hot and arid climate, combined with a disadvantageous topography that prevents air circulation through winds, all add to the extreme overheating of the whole city, but especially the urban core in Downtown Cairo. Air-conditioning also aggravates the heat island effect.

3.3 Lack of Public Spaces

Historic parks have been demolished and newly designed open spaces, e.g., the large plaza above the underground parking garage at Tahrir Square, neither provides greenery nor shade. Since 2011, the public realm has been transformed into a high-security zone with few open spaces left for the public; the design lacks planting and instead mostly consists of hardscape and grass. The few remaining green spaces and street trees suffer from a lack of irrigation. Therefore, the Downtown Cairo Urban Regeneration Plan emphasizes the creation of new open spaces and the refurbishment of existing ones with lush landscaping.

3.4 High Energy Consumption

Most buildings (see pages xxx) do not possess passive measures for cooling, e.g., insulation, exterior shading or natural cross-ventilation, but instead rely on air-conditioning which not only heats up the environment, but also generates high energy costs. Since 2016, Egypt had to reduce its massive energy subsidies, which kept prices extremely low for decades, leading to steep rises in energy costs. Finally, because of these high prices there is a new interest in reducing energy consumption and investing in building improvements. Therefore, the Downtown Cairo Urban Regeneration Plan emphasizes energy audits of public and private buildings, the training of local experts, and a set of recommendations for technical building improvements.

3.5 Built Form

3.5.1 Situation

The Urban Morphology Map of Downtown Cairo shows four different patterns of urban fabric that exist in Downtown Cairo. These different patterns developed over the course of time and reflect the planning and building styles of different eras. The orthogonal and radial patterns in particular derive from the original plan for Khedival Cairo, which was developed by European (mainly French) planners and inspired by the Haussmannian plan for Paris. These different patterns generate the diversified and exceptional urban fabric of Downtown Cairo. Its definition, clarification, strengthening and exploration will form the base for the further process and the development of an urban revitalization strategy.

Figure 5: Urban Morphology Map 8) Data source: Architects Tillner & Willinger

3.5.2 Opportunity

This unique morphology presented a great potential for urban design strategies for future revitalization, since it structured Downtown into distinct characteristic areas. The proposals built upon this differentiation thematically with regard to their content, as well as technically concerning proposed measures in the public realm, i.e., streets, squares and parks. The circular squares and connecting diagonal streets especially served as starting points and foci for revitalization, i.e., backbones in a network of measures for creating a pedestrian-friendly environment.

The radial pattern originates from three circular squares and two streets that break the regular orthogonal grid and diagonally connect these squares. Comparable to recent traffic-calming measures in Paris, [13] these circular squares and diagonal streets present an opportunity to create unique places within the Downtown grid. The design measures focus on supporting pedestrians, e.g., widened sidewalks, reduced parking, landscaping, etc.

The orthogonal pattern is characterized by perpendicular roads of different hierarchies and defines rectangular land parcels of similar size. The opportunity here lies in the differentiation of the various street hierarchies. Local, quieter and narrow streets will become pedestrian-friendly thanks to the removal of street parking and the introduction of special landscaping that invites pedestrians to slow down and rest . Wider streets and the linkage to Ramses Railway Station will be strengthened in their business-oriented character, i.e., the movement of pedestrians will be supported while not ruling out vehicular traffic.

Cairo's organic fabric is typical of traditional, older neighborhoods that are more residential in use. Narrow, curved streets and similar building heights define its homogenous organic fabric. The relatively high density and residential character present a challenge for potential interventions; therefore, these districts are considered secondary for regeneration in the future and were recommended for protection, as they provide affordable housing for low-income residents, near their workplaces in Downtown.

The fourth defined structure within Downtown's borders is spaces defined by voids and predominantly large, freestanding buildings like in the area around Tahrir Square or the undeveloped site at Azbekaya. Historically, this typology originated for important buildings, e.g., palaces, theatres or museums (the Egyptian Museum or Abdeen Palace). These undeveloped spaces present yet another opportunity for regeneration, and landscaping could be used to achieve important linkages, primarily to the Nile River and Islamic Cairo.

4. The potential to develop adaptive strategies and become climate-proof is high thanks to existing strengths of Downtown Cairo, e. g. the metro, high-density neighborhoods with mixed-use heritage buildings

4.1 Metro, Railway, Buses

Currently, Downtown is well served with public transport with metro lines, an extensive bus system and the railway station at Ramses Square. Metro Line 3 is under construction and will further improve the public transport network. Usage is high, but the ways to and from the transport stops are highly uncomfortable due to the negative climatic conditions and, particularly for women, are often unsafe. This leads to the high rate in drop-off traffic with especially Uber having become a major form of commuting service. The buses are stuck in traffic with all the individual vehicles and therefore not very effective. Furthermore, they are jam packed and often unsafe for women.

4.2 Density and Mixed-Use

Downtown Cairo is a truly mixed-use city center with retail uses on the ground floors, offices and apartments on the upper floors. At the shop opening hours from 10 am until 10 pm streets are busy with shoppers, especially in the cooler evening hours. Apart from these hours and on major holidays streets are deserted because many apartments are rented, but actually vacant depending on the area; light industrial uses and workshops are also found on ground floors, especially car repair shops, because streets are cluttered with dysfunctional vehicles and not compatible with pedestrian-friendly mobility and street concepts.

4.3 Open Space

The extension of the public realm is limited in Downtown Cairo and there are not enough green spaces. An option for increasing the amount of open space is reorganizing the already existing public space by introducing pedestrian space instead of roadways.
Downtown Cairo's historic gardens have largely disappeared and only a few remnants of the historic public spaces are visible today, e.g. the park connected to Azbekaya still partially exists and is a melancholy reminder of its former historic grandeur. The unique opportunity to again complete the park and bring it back to its original state according to the historic plans and recreate its former splendor will be used by the Cairo Governorate following the DCRP

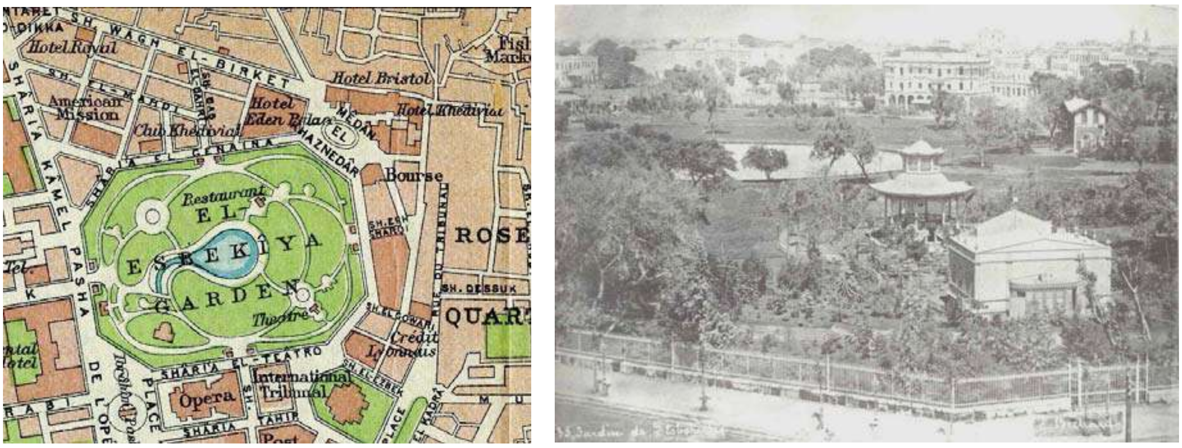

Figure 6: left: Historical map of Al Azbakeyah Garden, right: Historical picture of Al Azbakeyah Garden Data source: National Library Vienna

4.4 River Nile Waterfront

The embankment of the River Nile (see figure 7) and its environment offers an open space resource for Downtown Cairo as a continuous pedestrian promenade that currently suffers from a lack of connectivity. An option is to improve the pedestrian movement and linkage with safe crossings across Nile Corniche, and to include the existing bridges as a part of any new embankment design. By extending the embankment with platforms the pedestrian experience of the bridges can be expanded with safe terraces. A river transport terminal with ferries—like Venice's Vaporetto system—is an additional offer.

5. Vision and Guiding Principles

The guiding principles build on and reinforce existing strengths and address current deficits.

The following measures could lead to a more resilient city that takes into account its limited resources: improvements in infrastructure and resource-efficiency, mobility, landscape and urban design. Downtown Cairo could become a city center with less pollution as a result of a shift in the modal split towards clean public transport, improved connectivity for pedestrians and an overall strategy for a greener Downtown with unique open spaces embedded in its historic ambiance.

5.1 Guiding Principles

Fourteen guiding principles were established to govern the regeneration efforts, providing detailed guidelines for considerations like structure and development form, land use and massing, public realm and pedestrianization, access and mobility, as well as infrastructure and municipal services.

Figure 7: left: Situation Nile embankment now, right: Photo montage with added terrace
Data source: Tillner & Willinger

5.2 Concept Master Plan

The assigned area of Downtown was organized into different "regeneration zones" which share certain characteristics and introduces Strategic Urban Plans for five of these zones, setting a detailed planning methodology and toolset that can be replicated across Downtown.

5.3 Land Use and Massing

Guidelines that determine how the existing urban fabric, both in its massing/morphology and uses, could change in light of existing land and building ownership and historic preservation.

5.4 Public Realm and Pedestrianization

Guidelines that determine the improvement of existing public spaces and the creation of new ones, as well as the strategic conversion of vehicular areas into pedestrian-oriented spaces that encourage a more vibrant cityscape.
With an open space net work, a refurbishment of the public realm related to public transport hubs and connected pedestrian paths in green corridors, landscaping and shading squares, parks and greening flat roofs. The environmental quality as a result of street infrastructure would be improved through better hard and soft landscaping, lighting improvements, and street furniture.

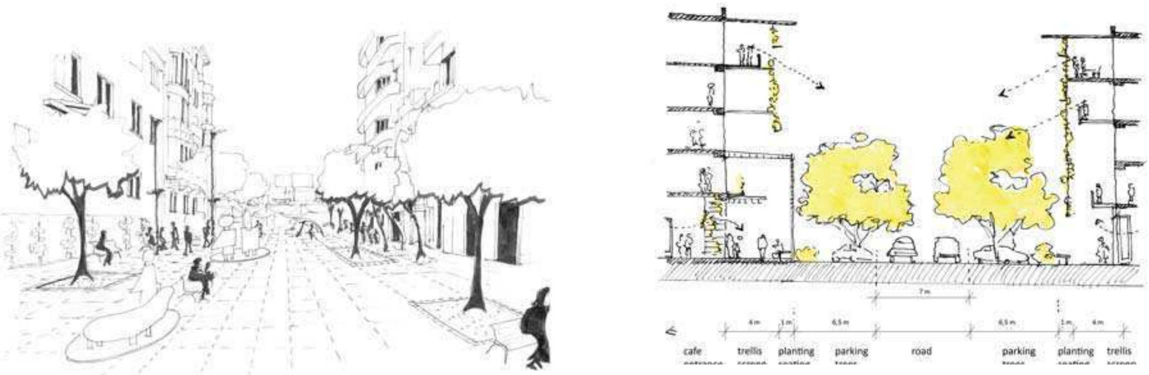

Figure 8: left: Pedestrianized street, right: Section of a "green street"
Data source: Architects Tillner & Willinger

5.5.1 Public Realm Interventions

Streetscape and public realm improvements, a framework of general regeneration interventions and energy efficiency upgrades in the public realm:
The categorization for the urban regeneration of Downtown's streetscape, energy efficiency performance and typology has emerged from project area analysis as well as best practices from the Project Team's 9) urban regeneration experience. Categories cover several regeneration themes. *Streetscape Upgrades* encompass existing public spaces and squares, as well as major north-south and east-west corridors, and entail the refurbishment and improvement of streetscape elements, including hardscape, landscaping, furniture, lighting, signage, and other streetscape amenities.

Pedestrianization involves changes in squares that currently have high vehicular traffic and pedestrianization which entails the removal of vehicular traffic. *(Opera Square - figure 9)*
Public Space Creation encompasses strategic vacant plots or open areas often currently being used as parking lots (Bab al-Louq) and entails their development as public spaces.

5.6 Open Space Strategy

Downtown Cairo , i.e. Khedival Cairo, has comparable density to European cities built at the same time as the building boom of the Gründerzeit in the late-19th century. Therefore, in the areas with intact historical urban fabric, only a few open spaces exist besides public squares and streets, larger ones at the edges of Downtown. The few publicly accessible spaces, e.g., the central green at Tahrir Square, are heavily used in spite of their environmentally disadvantageous situation, surrounded by heavy traffic. Therefore, these undeveloped spaces present a unique opportunity to provide more of these urgently needed resources for Cairo's residents. The goal is an evenly distributed network of green open spaces across Downtown, reachable within a walking distance of 500 meters and connected by landscaped streets, and linkages to the River Nile in the East and the Garden City in the South.

Parks, Squares and Open Spaces

"Open spaces," e.g., squares and parks, in Downtown Cairo, suffer from restrictions on accessibility which were implemented after 2011 . An opportunity arises from transforming vacant sites and reopening currently closed open spaces to the public. Most open spaces have to be redesigned to meet the current needs of the Downtown population.

Figure 9: Data source: left: Silja Tillner, right: Architects Tillner & Willinger 8)

Opera Square

This historic square, once the most prestigious in Downtown Cairo, has seen better days. Its significance, however, lies in being situated along the main east-west entry gateway into Downtown and a connection point to Islamic Cairo. This zone is of extreme strategic importance. Though quite challenged by intensive vehicular use, it lies in proximity to Azbekiyeh Park and the Continental Hotel—key regeneration catalysts—as well as a Governorate office building that has potential for intervention. The iconicity of the square and its historic significance mean that successful regeneration efforts are likely to have a "multiplier effect." Opera Square is to regain its status as a viable public space, rationalizing and optimizing different forms of mobility to catalyze regeneration in the surroundings.

5.6.1 Open Space Zonation

The aim is a greener Downtown with unique open spaces embedded in its historic ambiance with tree-lined streets, parks and shaded open spaces. The zonation characterizes different types of open spaces . Typologies, guidelines and a catalogue of recommendations that define desired qualities and apply to the different zones were developed for each category. The following categories were proposed:

5.6.1.1 Pedestrian-Friendly Streets

These streets will form the backbone of pedestrian circulation and connect important entry points, i.e., gateways, with main attractions. They will offer attractive and safe paths to the stations and will include major shopping streets which are highly frequented by pedestrians.

Pedestrian linkage will be achieved with an attractive, safe, and landscaped network of paths with better street lighting, seating areas, sanitary facilities, bus shelters, etc. Pedestrian-friendly streets have certain design characteristics, e.g. shaded sidewalks due to the planting of numerous new trees, safe wide sidewalks with handicap accessibility and places to rest, Vehicular through-traffic should be reduced by rerouting traffic to more peripheral streets and slowing it on central pedestrian spines and shopping streets with 30 km/h speed limits, traffic lights, and speed bumps. Driving lanes will be reduced and parking lanes eliminated, the space redistributed to wider sidewalks.

Public transport needs to be prioritized, providing attractive and safe bus stops with bus-shelters providing shade, lighting, and surveillance.

5.6.1.2 Pedestrianized Streets

They are proposed on streets that are currently of no significance for the road network and are used more for parking than driving. They will connect to the existing pedestrian network. and will be reserved for pedestrians. Urban design measures, see 5.6.1.1 apply here as well.

5.6.1.3 Existing Pedestrian Network

Existing passageways and pedestrianized streets are continued and connected to new pedestrianized and pedestrian-friendly streets.

5.6.1.4 Urban Square and Circular Squares

Urban squares are connected to the pedestrian network, serving as areas of rest and contemplation within the bustle of Downtown. Landscaping will be introduced to provide shading. Roundabouts are important landmarks and will become exceptional places.

5.6.1.5 Park/Green Space

Currently, Downtown Cairo has very few parks to offer its citizens. There are only a few possibilities within Downtown's densely built-up fabric to create new parks. Landscape design and plant selection should be sensitive to the climate and scarce water resources. The atmosphere should be inviting for families and provide enough spaces for children to play, as well as for rest and contemplation.

5.6.1.6 Connecting Open Space

There are two main connections missing: in the west, to the River Nile and its promenades and in the east, to Islamic Cairo. Specific proposals for Opera Square, Nile see figure 7, 9

6. Access, Mobility, and Transportation

Like in all megacities, transport is a major challenge for the Greater Cairo Metropolitan Area with more than 20 million inhabitants. To guarantee well-functioning and sustainable mobility in cities of such size, an adequate high-capacity public transport system is required. Over the last decades, Cairo's population has been growing faster than its infrastructural and mobility services. Major infrastructure projects, such as the Metro, may have arrived too late. [10] Nevertheless, the introduction of the Cairo Metro in 1987 was a major step towards sustainable mobility. The evolution of the modal share shows the positive effect of the Metro's introduction, creating a significant modal shift toward public transport. After 1987, the modal share of cars decreased significantly. The modal share of buses also decreased while informal transport with shared taxis increased significantly. Non-motorized traffic (mainly walking) accounts for 32% of all trips in Cairo. [11] Compared with European or North American cities, this is a very high share.

While there is broad agreement among stakeholders that mobility solutions offering reduced vehicular traffic must be a part of any regeneration attempt, there is considerable disagreement on the scale, location and form of these interventions. The process of thinking should follow the principles on traffic reduction and pedestrianization in Downtown Cairo, including the fact that 40% of vehicular flow in Downtown Cairo is reportedly “drop-off traffic;” as much as 80% of vehicular flow in Downtown is purely through-traffic. The DCRP is proposing a redesign of Downtown Cairo’s vehicular flow and street hierarchy.
Car Volume and Speed Reduction: Reduce motor traffic volume and traffic speed
The ambition in Downtown is that to optimally reduce both vehicular traffic *and* speed in each street to privilege pedestrians, enhance road safety, improve air quality, reduce noise, and afford a better pedestrian streetscape quality. One way of looking at this is to reduce a street’s current position in the road hierarchy and move it towards the bottom—local streets and roads that have the lowest speed limit (30km/h).

The pedestrian network is mainly defined by the street network, with a few pedestrian zones and passages. The main pedestrian traffic flows have their source at public transport stops, mainly the Metro, with many areas of conflict between pedestrians and vehicules.

7. Specific Measures and Implementation

Five Priority Areas were defined in consultation with the Cairo Governorate, those zones that, if planned and implemented, would have the most catalytic effect on the broader regeneration of Downtown Cairo as a whole were selected.
Priority Area Concept Planning: All five concept plans made concrete and spatially delineated recommendations for regeneration interventions in the following categories:

7.1. Streetscape Amenitization

Streetscape Amenitization encompasses existing public spaces and squares, as well as major north-south and east-west corridors, and entails the refurbishment and improvement of streetscape elements, including hardscape, landscaping, furniture, lighting, signage, etc.

7.2. Pedestrianization Prioritization

Pedestrianization Prioritization involves changes in squares that currently have some degree of vehicular traffic as well as various streets and corridors, and the creation of pedestrianized corridors that entail the removal of all vehicular traffic. Mobility Improvements encompass squares that are currently centers of mobility interchanges as well as various streets and corridors, the optimization of existing mobility patterns, whether through intersection redesigns or shared street infrastructures which continue to allow vehicular traffic, but in ways that improve pedestrian movement.

7.3. Exterior Lighting

Exterior Lighting encompasses the systematic upgrading of exterior lighting to energy efficiency and more durable fixtures, recognizing current inefficiencies of existing luminaries.

7.4. *Sustainability*

Sustainability includes the introduction of key green building interventions such as photovoltaic panels and green façade structures, particularly for governmental and institutional buildings where these interventions can more readily be financed.

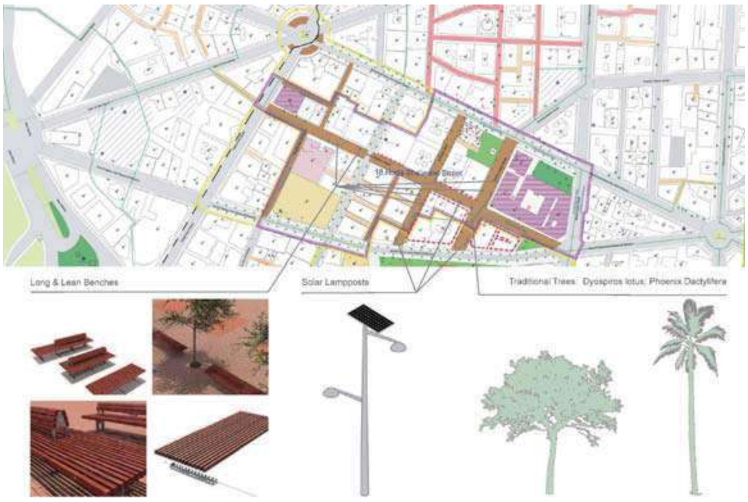

Figure 10: Street furnishing
Date source: Architects Tillner & Willinger 8)9)

7.5. Public Space Creation

Public Space Creati on encompasses strategic vacant plots (often currentl y being used as parking lots) and ent ails their development as publ ic spaces, particularly in the form of extensions to and expansions of adjacent or nearby publ ic spaces and squares. *They were planned in detail in response to local needs and conditions*, e.g. *representative for the measures in these zones* are *Opera Square*, see fig. 9 *and Bab al-Louq. The visison* is to reclaim Bab Al-Louq as a public space, which serves as an “urban interchange” (as opposed to a vehi cular interchange) that links Tahrir Square t o Abdeen Square, and Downt own’s charismatic southern neighborhoods.

Regeneration Interventions

Street furnishings (see figure 10) are provi ded in the area of Bab Al-Louq Square and in the pedestrianized areas near-by. Trees and l andscaping are to be provi ded on the boul evard streets and along the pedestrianized northern edge of the square.

All streets that are to becom e boulevards will feature expanded si dewalks through the conversion of parking lanes. Pedestrian crossings w ill be upgraded at strategic points along busy, e.g. El-Tahrir Streetswith formal pedestrianization on adjacent quieter streets.
Substantial opportunities exist on Opera Square (see fi gure 9). Trees can be added t o the Square, while greenscape can be provi ded on the pl atform, a de-facto, 24-hour pedestrianized zone. Energy-efficient lighting for the open spaces and the façades is intended for the Opera Parking Structure and the Continental Hotel. Green façade features and photovoltaic roof panels are proposed for the Opera Parking Garage.
The introduction of a scul ptural, five-meter, raised platform above the traffic interchange of Opera Square and the reacti vation of the green space di rectly east of the Parki ng Structure will dramatically improve the area.

8. Implementation Framework for Cairo Governorate’s Green Building and Energy Efficiency Efforts in Downtown Cairo Urban Regeneration

Guidelines were devel oped to prom ote building energy effi ciency in Downtown Cai ro’s unique built environment in public and private buildings and in public amenities. Downtown’s framework conditions were st udied, especially its historic urban f abric. The po tential for “greening” buildings in Downtown Cairo was examined.
Rehabilitating the Buildings of Downtown Cairo to Better Standards
This project has m ade efforts to further the development of sustai nable building standards, and has produced a set of guidelines and cases about what is needed t o modernize Downtown’s building stock and make it m ore efficient. Urban sustainability and green

considerations for energy efficient buildings, green walls, landscaping of roofscapes and solar panel installations should be integrated as part of any building modernization.

Public Building Upgrades and EE Retrofitting

Heritage: Many of Downtown Cairo's historic buildings of outstanding value are worthy of being included in a registry similar to European cities with a comparable historic building stock from the end of the 19th and the beginning of the 20th century, e.g.,Paris or Vienna, making heritage in spite of the neglect the single most valuable asset for urban regeneration.

Opportunity

The protection and safeguarding of heritage buildings and districts would lead to a greater attraction of Downtown Cairo for its citizens. Since buildings also tell stories, not only about architecture, but also about people, as was described in the book *Discovering Downtown Cairo* [12], a well-preserved historic district with landmarks along a historic trail would create attractive linkages to the past and stimulate an active interest in the history of the city.
The total building stock in Downtown Cairo is estimated to be 1,492 buildings, of which 8% are government buildings of primarily office and institutional uses 8). As a result of a detailed building analysis and energy audits8) several types of energy efficiency considerations such as exterior treatment, lighting, electromechanical systems and services were identified.

8. Conclusion and Future Outlook

The Urban Regeneration Plan for Downtown Cairo could become a blueprint for future efforts in other cities in the developing world and in Eastern Europe facing similar challenges. The innovative revitalization approach combines classic components of urban design with novel energy-saving and educational measures (which are usually separated), i.e., the energy retrofitting of public and private buildings. The approach is based on valueing what exists – and builds upon it - a sensitive and practical planning method which allows the integration of the needs of stakeholders and leads to a higher acceptance than previous plans.

For Downtown Cairo this implementation oriented plan has, for the first time in its lengthy planning history, offered the Cairo Government and the authorities a practical handbook with strategies, guidelines and detailed proposals including cost estimates. The Cairo Governorate is currently proceeding with the implementation of Opera Square as a catalytic project and will continue with further measures in the public realm and building renovations.

These measures would – if implemented – contribute greatly to reducing pollution-levels and cooling the city center. Downtown could become a sustainable model for other neighbourhoods in Cairo.

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District cooling in Sanya Haitang Bay: energy integration in urban planning from theory to practice

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Abstract: Cooling demand counts for a high proportion of the energy consumption in hot and humid cities, thus contributing massively to carbon emissions. This situation is amplified in rapidly growing Southern Chinese cities, while integrating energy into urban planning is also a challenge given the complexity of the Chinese Planning system. However, a recent planning case in the new district of Haitang Bay in Sanya, at the most southern point of China on Hainan Island, proves the contrary. The resulting action of the “Smart and Low Carbon planning” of Sanya is the implementation of a multi-energy district cooling system, with the potential of reducing CO2 emissions up to 30 per cent. The case of Sanya not only shows the impact of energy-led urban planning, it also validates the effectiveness of district cooling solutions in hot and humid cities in the context of climate change.

1. Cooling, the new frontier of climate change planning

1.1 The rise of the global building cooling demand

Indoor building environments count for a large proportion among the energy consumed and carbon emitted in today’s world, contributing around 40% of the total energy consumption. Among all types of energy consumption, heating, ventilation and air conditioning (HVAC) systems are the biggest contributors. Providing highly comfortable indoor environments is indeed the inevitable challenge for buildings. In public buildings such as offices, shopping malls, sport centers, etc., energy consumption for cooling can represent over 50% of the energy demands (Pérez-Lombard, 2008).

In hot and humid climates, the well-known traditional building techniques of adjusting to microclimate through natural ventilation are far from fulfilling the needs of modern comfort, and air conditioning in particular is surging. Today, air conditioning already accounts for about 40% of power use in Mumbai, India. More than half of Saudi Arabia’s peak summer power consumption also goes for air conditioning. The Vietnam Housing Management Organization’s has stated that 54% of its energy consumption was used on housing cooling (Huang, 2016).

People living in hot and humid climates tend to use air conditioners more frequently and for longer period of times than in other climates. The high temperature gas discharged by air conditioners worsens the outdoor environment and leads to a vicious cycle of increasing energy use in hot and humid climates. As the tropics and subtropics become increasingly urban, industrial and affluent, energy demands for comfort are evolving differently than they have historically across the global North (Waite, 2017).

Already, HVAC account for 35% of total primary energy in the United States and is expected to reach similar proportions in China within five years. About 87% of US buildings are now air conditioned, and trends in the developing world suggest it is advancing fast down the same route. In this regard, China makes no exception in the trend of growing cooling demands in hot and humid climates, driven by a rapidly expanding urban middle class.

Globally, cooling demand is rising exponentially in cities. Reducing it has become the new frontier of climate change initiatives. The United Nations Environment Program is promoting actively District Energy Systems in cities, describing it as “one of the least-cost and most-efficient proven solutions in reducing emissions and primary energy demand” (UNEP, 2015).

1.2 Growing cooling demand in Chinese Southern cities

Since the opening to market reform in the 1990s and the urban expansion policy implemented subsequently, China has greatly seen its real estate and construction industry booming. With the economic development and the urbanization process, more and more people will be concentrated in this area, and they use more and more energy.

The hot and humid climate zones in China are located in the middle and lower streams of the Yangtze River experience a primarily subtropical monsoon climate and a monsoon humid climate. The area also holds the two most economically developed regions in China: the Pearl River Delta and the Yangtze River Delta, concentrating more than half of China’s population and more than 60% of the country’s GDP.

According to the data of 2017 from National Bureau of Statistics of the People’s Republic of China, the average per capita housing space of residents in 2016 was 40.8 square meters. In cities the same index was 36.6 square meters, which increased nearly five times compared to the 6.7 square meters in 1978, and it continues to expand.

According to the 2017 China Building Energy Consumption Report, China’s total energy consumption for buildings in 2015 was 857 million tons of standard coal, which accounted for 20% of the total national energy consumption. The three most significant factors that impact energy consumption for buildings are: the size of the urban population, the GDP of the area, and the climate zone (Li, 2009).

The overall quality of China’s outdoor thermal environment is also degrading each year. Up to 65% of residential areas in China have a thermal index that is higher than the safety index of 32ºC wet-bulb globe temperature, and 78% are above the thermal comfort index of 28ºC wet-bulb globe temperature (Fang, 2014). Hot and humid areas have longer and hotter summers, increasing the enormous demand of cooling and dehumidification through air conditioners. With the rise of living standards in both urban and rural areas, the energy consumption for air conditioners in buildings is bound to increase continuously, and most severely in the Southern part of the Yangtze Basin.

Regional disparities in energy production and consumption follow economic development; energy consumption per capita in these relatively developed regions is significantly higher than the less-developed regions, with a quality of energy also being above the national average (Zhang, 2008). The energy efficiency map in China follows the same spatial dynamic, going from lower to higher values from West to East (Chen, 2017). Hence, achieving a demonstration program in Southern and Eastern coastal areas in China could make a significant impact.

2. The challenges of energy planning integration in China

In China, the trend of research in decentralized energy as a carbon reduction solution appeared in the late 1990's, and rapidly became a focus as China started to commit itself into climate change issues. From the initiatives driven by green building energy saving programs in 2008, it evolved to comprehensive low carbon energy planning at the scale of cities and regional planning (Zhao, 2012). However, the ambition of integration in the Chinese planning system (or *duoguiheyi*) is confronted to the bureaucratic rigidity and power struggle between administrations, making it difficult to implement (Tzou, Du, 2017).

Currently, two main types of plans co-exist regarding energy in China's planning system. The first, the Energy Development Plan, considers the overall supply and demand relationship and energy strategy at the macro-level of the country. The second, the Energy Engineering Plan monitors at the micro-level of cities and districts the sub-energy systems' infrastructures (electricity, heat, gas).

2.1 Energy Development Plan

Energy Development Plan is a five-year thematic plan developed by the National Development and Reform Commission (NDRC) that involves multiple levels, including provincial the central government level, the provinces, the cities and the counties. The national level focuses on macro issues such as the total energy consumption and its intensity, the energy structure adjustment, the energy development layout, enhancement of energy efficiency and quality, improvement of energy safety, strategy of energy autonomy, innovative developments, etc. In city and county levels, the Energy Development is planned according to the local needs which are different in each area. Ma (2016) considers the county's Energy Development Plan primarily should include aspects such as a reasonable forecast of energy demand, clear development goals and direction, and the main objective and initiatives.

2.2 Energy Engineering Plan

Energy Engineering Plan is a thematic plan developed in the Ministry of Housing, Urban Rural Development (MOHURD), involving levels of cities, counties and townships. The content of the Energy Engineering Plan is similar at each level nationwide, and primarily includes the three main engineering plans which are the city's power supply, gas and heating plans. Although in the "Measures for Formulating City Planning" (MOHURD, 2005) it is required by law the urban overall planning to "ensure integrated objectives and protection requirements such as the ecological environment, land and water resources, energy, and the nature, historical and cultural heritage protection", comprehensive energy planning is rarely present in the current urban planning in China. This reflects that energy issues are not widely recognized in urban planning (Cao, 2010).

2.3 Challenges of urbanization

Urban planning practices tend to consider energy issues in partial and separate ways, following the framework fixed by the system of planned economy. Energy supply is increased when there is an increase of population, energy infrastructure is planned to follow the city expansion. Along with rapid urban development, energy systems have become more disordered and fragmented, while still struggling to keep up with the pace of urban development.

Under the urbanization movement of "Planning for growth" (Wu, 2015), conflicts between energy supply and demand are quite obvious to happen at a local scale. At the beginning of a region's development, the occupancy rate is low and the load is small, therefore energy suppliers will adopt various measures to encourage energy consumption for the purpose of earning profits. When the region is fairly developed and there is a higher occupancy rate, the original planning can no longer satisfy the demand. The energy supply will be pushed to expand. After the energy supply is expanded, a new cycle of consumption begins which will lead to wasting of resources and unreasonable use of energy, thus forming a vicious cycle. This urban planning practice aimed to constantly satisfy the energy demands is today obsolete and is missing its goal of integration.

Besides, the weak position of Energy Engineering Planning in the planning system makes it more influenced by the evolution of land layout and the thematic plan contents, rather than the overall requirements of the energy system. The lack of coordination between each type of sub-energy leads to contradictions and limitations at the implementation level. Planning methods of energy issues in China also lack of maturity, making it more difficult to adapt itself to the more and more complex status of energy in cities (Cao, 2010).

Problems are worsened in hot and humid areas. Unlike heating, district cooling has not become a necessary chapter in urban planning. If district cooling or combined cooling heating and power is not considered, the cooling energy is then usually provided by electricity. The increasingly large power load of air conditioners is however inevitable. Many cities have had to adopt methods such as deliberate power cuts, “abandoning production, preserving air conditioners”, creating a huge load difference between peak and off-peak periods. This has led to a low efficiency in power investment (Long, 2008).

3. Innovative Energy-led Urban Planning in Sanya

Energy experts in China have been calling in recent years for an integrated approach at the early planning stage of cities (Long, 2008). Since the Chinese government has committed itself to the Paris COP21 Climate change agreement, some noticeable initiatives are worth mentioning, showing the trend of energy preservation in planning. In particular, the recent climate change initiative in the city of Sanya can be seen as a successful attempt of planning integration of low carbon energy practices in hot and humid climates.

3.1 The existing energy status of Sanya

Sanya is located at the southern tip of China, on Hainan Island, with a tropical ocean monsoon climate, an annual average temperature of 25ºC and more than 2,500 hours of sunlight annually. With an urban area of 3,200 km2, Sanya is the most touristic coastal city in China, also serving as an important maritime and military base for the South China Sea. In 2015, the local population was 748,900 hab., while hosting 15 million tourists annually (10.6% growth).

In 2015, total energy consumption in Sanya was 1.5 million tce (ton coal equivalent), with an increase of 4.94% from 2014. Thereinto, tertiary industry consumed energy 935,100 tce accounting for 61.96% of total consumption, being the key field for energy conservation. In primary industries, secondary industries and civilian sectors, energy consumption accounted for 6.88%, 15.44% and 15.72% of total energy consumption, respectively.

The energy structure includes electricity, oil, natural gas and coal. As the main energy resource, electricity occupied 56.56% of total energy consumption in 2015. The peak electricity load in 2015 was 566 MW (megawatt), while by the total power install capacity (excluding solar projects) was 162.2 MW, which means Sanya relies heavily on electricity import from the grid.

The existing energy planning

Following the national system, Energy Engineering Plans in Sanya include only the Electricity Plan and the Gas Plan, respectively managed by two separate municipal services. There is no Cooling Plan, and Energy efficiency issues are discussed in the Green building, Industry and Transportation plans. Past energy efficiency initiatives have been hard to implement, due to the lack of a systemic energy planning and the non-existence of relevant regulations and indicator systems, besides the usual difficulties caused by rigidity of bureaucracy.

Challenges of energy conservation in Sanya

Because of the lack of energy management, limited technical maturity, high energy consumption and high emissions, non-optimal consumption behaviors are still very common in Sanya. With the ongoing fast paced urbanization and the increase of urban population, the energy needs in Sanya will continue to grow. The city will face the following challenges:

1) With the particularities of a tropical coastal touristic city, power consumption of Sanya will keep its seasonal features, with peak power demands and a difficult balance of supply and demand;

2) The potential of local power capacity is very limited – Sanya mainly relies on the input of external electricity;

3) The energy structure is quite simplistic; new energy has not been well developed in Sanya.

3.2 Smart and low-carbon energy planning of Sanya

Being the pilot city for low-carbon development in Hainan Province, Sanya has committed to realize an in-depth transformation for the 13th Five Year Plan (2016-2021) and has launched a "Sanya Low-carbon Energy Planning and Action Plan" (Courtot & Tzou, 2016).

Aiming to tackle climate change and reduce CO2 emissions, all aspects of energy in the city are analyzed jointly: the structure of the energy demand (electricity, heating, cooling, hot water, gas), the energy efficiency solutions that can reduce this demand, the structure of the external energy supply (existing mix and its evolution) that contributes to fill this demand, the local potentials for renewable energy, and the complementarities between energy and other urban infrastructure (waste, water, transport, etc).

The urban land planning information integrated into Geographic Information System (GIS), are then combined with satellite image to classify each block by construction time sequence – constructed, under-construction, short term and long term development; and identify urban morphologies, composed of typical buildings.

To evaluate the evolution of energy needs in Sanya, we distinguished 14 typical urban morphologies and 16 typical buildings (Fig. 1).

Finally, the energy demand (cooling, hot water, electricity) of each block at different time periods could be achieved based on the blocks' information (land function, limited height of buildings, FAR, location) and the defined morphologies it belongs to.

Fig 1. Urban morphology classified by energy demand typology

Energy demand evaluation

The evaluation of the energy demand used GIS to integrate the urban planning and geographic information, from both time and space. A mapping of the energy demand (cooling, hot water, and electricity) could be then realized based on urban morphologies, at different time periods (Fig. 2).

Fig 2. Energy demand evolution in Sanya 2016-2030

Buildings are the largest energy consumers in Sanya, with space cooling being the most significant. Today, construction standards applied in Sanya are well adapted to the local climate conditions, leaving only limited improvements to be made on the building envelop.

However, energy demand in buildings will continue to rise as the tertiary sector will develop. Revenues of permanent residents will increase, with a rising need for comfort and domestic equipment. According to studies, cooling demand for permanent residences in Sanya will rise by up to 15% per year in four years.

By analyzing the energy demand evolution in Sanya, three zones with a large upcoming increase of the energy demand and a relatively large share of tertiary buildings were identified. Each of the three zones has its specific load structure and available energy resource, and therefore its specific optimal district energy solution. Haitang Bay is the most energy intensive of these zones that could strongly benefit from high-efficiency district energy solutions (Fig.2).

Local energy resources analysis and carbon reduction actions

Studies have been conducted to identify opportunities to exploit the local energy resources, combining the evaluation of 40 technologies covering local production and energy efficiency solutions. Comparing the results of a set of simulation, cross-checked with collected consumption data, high efficient equipment and adapted human energy behaviors are identified as effective solutions to reduce energy consumption of air-conditioning. While further improving building envelops out of the existing building thermal regulation is found to have only a slight impact on energy consumptions.

A full range of energy efficiency actions, technologies and behaviors have been evaluated and quantified in terms of cost, energy economy, and avoided CO2 emissions. This evaluation is based on detailed local conditions of climate, building thermal characteristics, occupation patterns, and energy usage behaviors. The deployment potential of each action has been quantified in space (building plot granularity) and in time (period by period following the phasing of the urban development).

This approach is based on local conditions and their expected evolutions - population, building stock, energy usage, and natural resources. Individual actions were identified, with cost/benefit analysis and evaluation of the deployment of potential actions.

From a technical point of view, the planning is quantitative and evaluates the potential deployment volume of each action, its emission reduction potential and analyzes the techno-economic feasibility for implementation (Fig. 3).

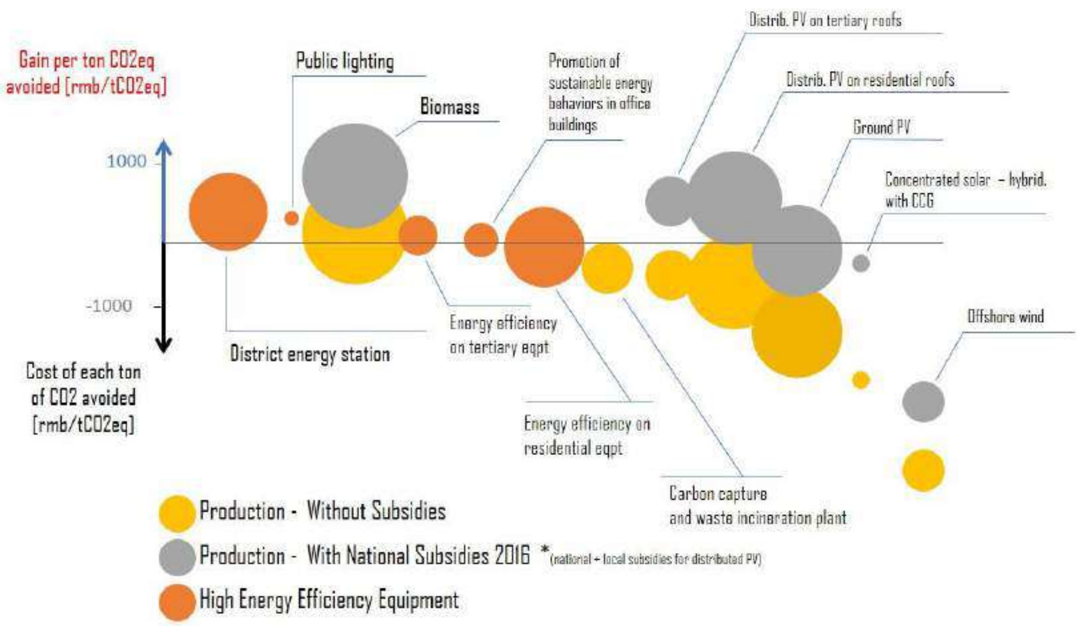

Fig. 3 - Summary of carbon reduction actions

With consideration of natural and economic condition, Sanya has potential to develop roof PV and biomass technology. According to the existing situation in Sanya, high efficiency energy equipment and good energy behaviors could significantly reduce building energy consumption. Meanwhile, district energy system could decrease energy cost and also achieve considerable CO2 reduction in new district and urban renovation zones.

On a side note, the energy-led urban planning practiced in Sanya has inaugurated a new type of “Urban Energy Plan” at a higher position in the Chinese planning system. It should be considered as an extension of the Energy Engineering Plan into urban planning, as well a mean of implementation for the Energy Development Plan, to achieve a reasonable utilization of energy hence the carbon reduction goals.

With sustainable development held as a core principle, the Sanya Low carbon planning is already a case of “best practices” in China, especially because it leads to the implementation of the largest urban district cooling network in China in Haitang Bay.

4. District Cooling in Haitang Bay

Famous for its white sand beach, Haitang Bay is 28km away from the city center in the northeast of Sanya, with a long strip of 22 high-end hotels and an estimated population of 250,000 by 2030. As the main resulting action of the “Sanya Smart and low-carbon planning”, the City government has launched in 2018 a thirty years concession contract to a multi-energy District Cooling project, aiming to provide chilled water, electricity and hot water to users in Haitang Bay, mainly the high-end hotels and public buildings.

4.1 Energy demand and simulation of supply and demand

Energy demand surveys have been conducted in the preliminary phase by inspecting existing hotels’ cooling systems, one by one. Daily utility consumptions of hotels have been collected for an entire year in 2016. The cooling demand is closely linked to outside temperature, not the hotel occupancy rate. This is because all hotels keep the maximum temperature of 26^0 C all year round, even with no occupancy. Similar studies have been made to better understand the behavior habits of electricity consumption.

Based on energy demand curve characteristics of hotels, the electric, cooling and heating demands have been simulated by professional energy demand simulation platform. The planning of new hotel construction and design in Haitang Bay has also been inspected to assess the increase of cooling, heating and electric demand expansion (Fig. 4).

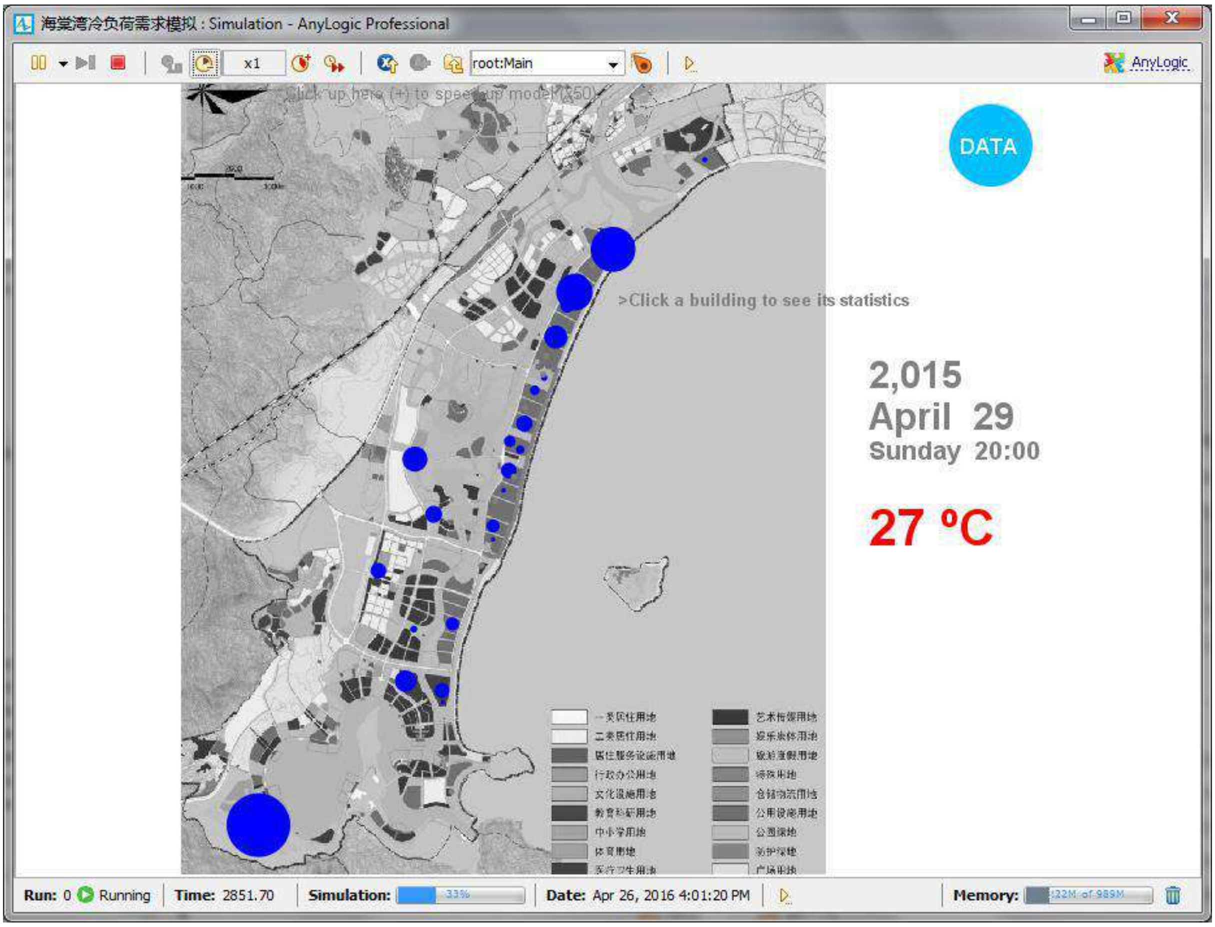

Fig 4. Energy demand simulation in Haitang Bay

4.2 A high CO2 reduction performance

A comprehensive energy saving system has been designed with heat recovery, seawater use, ice storage and combined cooling heat and power (CCHP). Four energy stations with a total installed capacity of 86,400 refrigeration ton (RT) in chillers and 8.8 MW in generators will be built for this project. The average annual cooling capacity is 649,760,000 KWh after completion. Meanwhile, a Smart network would be built on the energy internet for Smart energy production and distribution according to users' demand.

Urban development phasing was also taken into account, each energy station being designed according to the predicted growth of energy needs, to avoid having oversized systems during the early phases of the urban development.

The energy stations are a combination of high efficiency chillers, ice-storage, heat pumps and back-up boilers, with a total installed capacity of 86.400 RT in chillers and 8.8 MW in generators. The coefficient of performance (COP) calculated for the systems raises from 2.35 to 3.2, an increase of 36%, which results from the use of large-scale highly efficient centrifugal chiller (30% more efficient than the conventional chiller), and collective efforts of advanced simulation tools for system design, operation optimization and maintenance of district cooling projects.

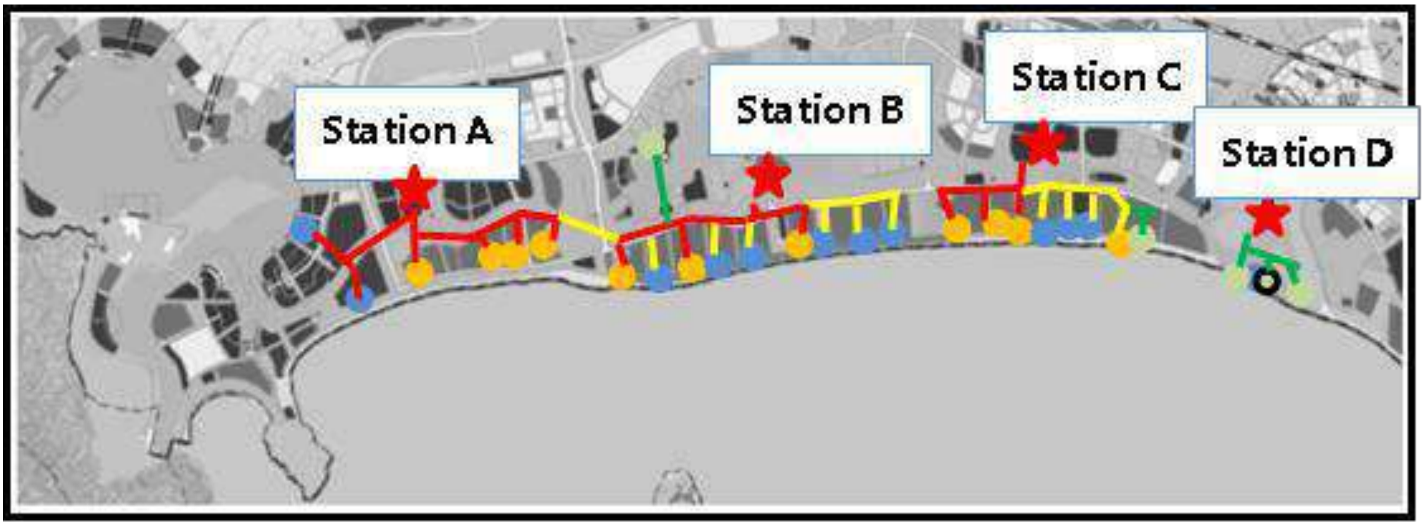

Fig 4. Localization of the four energy stations in Haitang Bay

Four energy stations are linked through an optimized "Smart network" that acts as a back-up during peak loads, ensuring energy efficiency, stability and safety in Haitang Bay. The concept of "Fourth generation network" has been introduced, applying multi-energy complement, big data, cloud service as well as artificial intelligence for the Smart and centralized network control, operation and management (Fig. 4).

Thanks to the CCHP and ice storage, the general electricity consumption would be effectively reduced by half after completion of the four stations, from 276.5 GWh to 115.3 GWh. After completion, 32.553 tons of standard coal could be saved every year. In comparison to the conventional individual central air-conditioning system, 81.802 tons of CO2 would be reduced, counting for 16 per cent of the total amount of emissions of Sanya City according to the 13th Five Year Plan. The system can eventually be optimized with sea cooling or an additional gas fired CCHP and reach 30 per cent of CO2 reduction.

Aside from CO_2 emission reductions, the Haitang Bay district cooling pilot project has also achieved other benefits, including: affordable energy provision; reduced reliance on energy imports and fossil fuels; economic development and community control of energy supply; local air quality improvements; and an increased share of renewables in the energy mix.

4. Conclusion

Satisfying the increasing cooling demand while reducing the CO_2 emissions have become the major challenge of cities in hot and humid climates. With the still growing urbanization rate, the stakes are high in reducing the cooling demand for Southern Chinese cities. In China, another layer of complexity is added with the incoherencies of energy planning handled by different administrations working in silos, making low carbon energy solutions difficult to be integrated at the planning stage of new districts cities.

In this context, the climate change initiatives taken in Sanya lead the path towards new and innovative practices in planning. In line with the CO_2 reduction objectives of the city, the Smart Low Carbon Energy Planning of Sanya successfully integrates energy issues at the early stage of urban planning, delivering guidance to balance the energy consumption and supply from the demand side in the long term, and providing carbon reduction actions.

The main resulting action is the implementation of a District cooling in the most energy intensive luxury hotel area of Haitang Bay. The Smart multi-energy system is tackling successfully the urban energy challenge by reducing carbon emission up to 30%, a first of a kind performance at this scale in China.

Climate change is calling for a more integrated approach in planning. With multi-benefits for hot and humid climates, district energy solutions become relevant parameters for measuring the degree of urban planning integration. On a side note, this trend indicates in a way the end of the “Planning for growth” paradigm in China, opening a new era for more consideration to resilience and energy preservation in urban planning.

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Water Sensitive Urban Planning as Adaptation Strategy

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Synapse
Cities in areas getting hotter and drier have to find alternative approaches to manage the increased demand for water versus the shrinking supply, while also climate proofing their cities. Water sensitive urban design as an adaptation strategy integrates the management of urban water resources with urban planning.

1. Introduction

Water is one of the most vulnerable and threatened resources in the world that should be protected and managed for the survival and well-being of people. Water is also a hazard that people should be protected from, for too much or too little water threatens our survival and well-being (Rosenzweig, et al., 2015; Prüss, et al., 2002).

Urbanisation and its associated opportunities and challenges has resulted in an increase in the demand for water in cities (UN Water, 2017). While the demand for water is growing, the supply of fresh water is being compromised by climate change, amongst others. Water is predicted to be the "primary medium through which early climate change impacts will be felt by people, ecosystems and economies" (Butterworth & Guendel, 2011). It is thus vital to understand the impacts of climate change on urban water supplies, as well as the vulnerability and exposure of people, infrastructure and economic activities to weather-related hazards, to be able to adapt accordingly. A water sensitive approach is aimed at integrating the management of urban water services and resources with urban planning (Celeste, et al., 2013). As the basis for an adaptation strategy it includes various adaptation actions aimed at regenerating water services as well as reducing the impact of hydrological climatic events (Armitage, et al., 2014). This paper argues that water sensitive urban design should be used to frame the strategy for adapting cities projected to become hotter and drier in future. It discusses a framework to select adaptation actions linked to the risk profiles of cities as part of a water sensitive adaptation strategy.

2. The growing demand for water in cities

Urbanisation poses a challenges to water supply. As urban populations worldwide continue to grow, the demand for water in cities grow due to the sheer increase in the number of people and economic activities. Simultaneously, water consumption per capita (and the resultant quantity of waste water) rises as economic development increases due to changing lifestyles, before it levels off or eventually declines per capita (Yang & Jia, 2005; Popkin, 2006; Anisfield, 2010). In many developing countries where urbanisation rates are high, and expected to remain high for decades to come, much of this growth is occurring in places without hard infrastructure (Bahri, et al., 2016). Informal settlements, extensions on the periphery of cities, and rapidly growing small towns all have to be supplied with water (Bahri, et al., 2016). However, limited resources and capacity has meant that municipalities struggle to keep up with the demands, resulting in growing water service backlogs (Fatti & Patel, 2013; Muller, 2007). Furthermore, ageing water delivery infrastructure is not always maintained adequately, or has in many cases reached the end of its design life, leading to significant water losses through leakage (SAICE 2011; Bahri, et al., 2016; Multikanga, et al., 2009). Many cities thus face the huge challenge of managing current water use as well as planning for increasing future water demand against a shrinking supply, yet current water management and infrastructure tend to be fixed (World Bank, 2018).

Urbanisation poses a threat to water sources. Population pressures may lead to groundwater pollution and a deterioration of stormwater quality. Higher building densities mean an increase in impervious areas and therefore increases in the volume and rate of stormwater runoff, leading to greater flow rates and volumes in watercourses, and increases in risks for downstream flooding and erosion (Armitage, et al., 2014; Wong, et al., 2012). Studies also show that 80-90% of all wastewater generated in cities in developing countries is not properly treated before being discharged into surface water bodies. The collection, treatment and disposal of increasing quantities of wastewater is a major challenge for cities in both developed and developing countries (UN Water, 2017).

All of these issues combined, with increased vulnerability and risk to environmental hazards, place water at the nexus of the development challenge (SADC, 2012).

3. The impact of climate change on cities and water systems

Changes in the climate have significant impacts on the water systems of cities, particularly in regions that will become hotter and drier. The demand for water is increasing while the water supply is impacted by rising temperatures through higher rates of evapotranspiration and decreasing run-off, placing severe strain on already stretched water systems (Engelbrecht, 2017). Changes in the frequency, severity, duration and distribution of extreme weather events can affect the quality and supply of water, sanitation services and infrastructure (Armitage, et al., 2014; Carmon & Shamir, 2010).

The existing water supply and sanitation infrastructure was heretofore designed for different resource availability and water use. Such historical infrastructure is increasingly under greater pressure owing to changes in the climate and demand for water. Changes in the climate may have the following impacts on cities' water systems:

Climate related events and impacts	**Potential impacts on urban water systems**
Storms, flooding and intense rainfall	• Put pressure on or overwhelm the design capacity of existing drainage infrastructure; • Overwhelm stormwater management systems that lead to backups that cause localised flooding or greater runoff of contaminants such as trash, nutrients, sediment or bacteria into local waterways; • Cause stormwater runoff to wash pollutants, sediment and nutrients into water sources. These can threaten drinking water sources, diminish water quality, and complicate water treatment processes; • Lead to, and increase, erosion and larger sediment loads that can cause a reduction in water storage capacity as a result of the rapid sedimentation of storage reservoirs; • Disrupt water services and cause breakdowns in pipelines that distribute water; • Cause sewage contaminated flooding where stormwater drainage and sewerage systems are combined; • Inundate toilets and/or sewage treatment facilities that increases the risk of contamination of the environment;

	• Lead to the destruction or the deterioration of the structural integrity of basic water infrastructure; • Contaminate water sources, leading to increases in the incidence of water-related and waterborne diseases; • Cause a rise in groundwater that puts sewage treatment plants at risk when they are positioned on low-lying ground due to their reliance on gravity; • Cause a rise in groundwater that decreases the efficiency of natural purification processes, resulting in an increase in the risk of the spread and contamination of infectious diseases and exposure to toxic chemicals;
Decrease in precipitation and drought	• Lead to insufficient water resources being available to meet the demand by households and economic activities for the operation and performance of water systems such as to flush sewage systems adequately; • Concentrate pollutants and limit dilution due to lower streamflow; • Increase the drying up of water sources and, for vulnerable communities, a resultant extension in the distances that must be travelled in order to access water;
Increased temperature	• Affect the quality and availability of water supply; • Result in a reduction of surface water availability from an increase in evaporation from reservoirs and lakes and a decrease in stormwater runoff; • Increase water demands for industrial and domestic water use; • Increase the extent and rate of algal growth in nutrient-enriched surface waters; • Impact on how sewage systems operate.

Table 1 – The impact of climate change on urban water systems (Mottaghi, et al., 2015; Wong, et al., 2012; Daniell, et al., 2015; Climate Change Adaptation Resource Center, 2018; NIWA, 2017)

In summary, the potential impacts of climate change on the supply of water in cities include a reduced flow of water posing possible shortages in water, an increase in the demand for and use of water, increased stress on future water supply, the contamination of water through sewage systems, a decrease in surface water, a decrease in stormwater runoff, increases in water tariffs, as well as water related health problems.

"An understanding of the known risks posed by existing climate variability reinforces the need for responses that are robust to both existing variability and future uncertainty, alongside other pressures on resources, systems and services" (Oates, et al., 2014). Cities need to prepare for the widely anticipated consequences of climate change which will put at risk access to safe drinking water and adequate sanitation. Compromising on these qualities will have many secondary and tertiary effects on development, the environment and human health (Butterworth & Guendel, 2011).

4. Adapting water systems to climate change

The upgrading and expansion of the water system is an urgent developmental concern that is also an opportunity to adapt to climate change. The development of new water resources and the adaptation of existing urban water systems to become more resilient will require a range of different solutions, many of which will take time and/or result in substantial costs (Sikaundi, et al., 2016). These solutions will need to respond to issues such as the availability of water resources, the nature and condition of existing water infrastructure, the availability of resources and capacity to develop and manage systems, and existing urban demand patterns for water. These systems must also achieve defined minimum water standards (CSIR, 2018).

Water systems in urban areas can be divided into two categories. The first category consists of water services that provide water for everyday use, for instance for drinking, cooking and cleaning (Sikaundi, et al., 2016). The second category consists of water resources that manage water in catchment areas, urban rivers and streams as well as runoff and stormwater generated within and around urban (Sikaundi, et al., 2016). When adapting to climate change both the water services and the resources need to be addressed. Increased water self-sufficiency should be an objective. By expanding the water mix a larger variety of water resources are accessed to reduce the current reliance on surface water. These can include groundwater, rain- and stormwater harvesting, water recycling and the reuse of grey water (SA Government, 2015). The importance of maintaining and rehabilitating water systems cannot be overemphasised. Maintenance sustain and improve water systems over time, whereas an increase in the backlog in maintenance result in significant wastage and unreliable water services. Upgrades and expansions to the water system can be used to increase water service revenues and provide a firm foundation for further improvements to water infrastructure in urban areas.

When adapting water systems to climate change, Venema and Temmer (2017) names the following principles to be kept in mind:

- Build robustness: Draw upon multi-barrier water protection principles by integrating procedures, processes and tools that prevent contamination/pollution of drinking water in providing infrastructure and services. Decentralisation, mechanical robustness and non-reliance on centralised power/energy sources are some options.
- Promote redundancy: Focus on diversity of water sources for water supply, such as groundwater, rainwater and stormwater harvesting, to mitigate adverse conditions such as droughts and floods that impair the quality and availability of conventional water sources (dams and rivers).
- Resourcefulness: Creative re-use of and retention of water that minimise reliance on conventional water resources and centralised supply networks that are vulnerable to climate change. Rainwater harvesting from roofs and other catchment areas, green roofs and parks for water retention are some options, as well as neighbourhood level bio-retention, vegetated filter strips, permeable pavements and grassed swales to maximise the retention of run-off, nutrients and suspended solids (silt) to be used as alternative sources of water.

In adapting cities to climate change, water-wise cities, water-sensitive cities or water-smart cities are becoming more popular in the discourse. Water sensitive urban design features can be used to adapt places to, and reduce, the impacts of climate change in urban areas.

5. Water sensitive urban design

Water-sensitive urban design is seen as crucial to the delivery of cities of the future (Ministry of Interior, 2011). Many urban areas in hot and dry climates are more likely to experience extreme heat, decreased precipitation as well as more intense and extreme weather events. Hotter and drier conditions will put stress on water resources, while extreme weather events such as intense rainfall will place huge burdens on urban drainage systems leading to an increase in risk of urban flash floods (Carmon & Shamir, 2010; Brown, et al., 2008). Growing urban populations also put pressure on water services and resources, requiring careful planning (ACT Government, 2014). In the past, water systems were designed in a linear way, i.e. sourcing, treating, transporting, distributing, collecting, treating and disposing water. This highly technological approach is resource intensive and results in the fragmentation of the urban water cycle (Armitage, et al., 2014). Cities thus need to adapt their conventional approach to urban water management at the macro-level by adopting a transdisciplinary approach that considers the environmental, social and economic consequences and opportunities of water management (Ministry of Interior, 2011).

Water sensitive urban design (WSUD) is a development framework aimed at integrating the management of urban water services and resources such as stormwater, groundwater, waste water and water supply with urban planning and design (Celeste, et al., 2013; Brown, et al., 2008). WSUD aims to reconfigure cities in a way to enable regenerative water services while also reducing the impact of hydrological climatic events on urban environments (International Water Association, 2016; Brown, et al., 2008; Armitage, et al., 2014; ADB, 2012). This approach emphasises cities as crucial water supply catchments and as crucial places for the provision of ecosystem services. The notion of using wastewater, greywater, recycled water, and harvesting stormwater for gardens, parks and green areas, as well as for sanitation purposes is gaining importance (Maksimović, et al., 2015). By treating all types of water as a valuable resource, a diversity of water sources can be pursued through centralised and decentralised infrastructure. Such diversity reduces the stress on surface and groundwater resources, and introduces new sources of water to the urban water systems (ADB, 2012; Brown, et al., 2008; Wong & Brown, 2008).

The objectives of WSUD are to design, plan and manage urban landscapes to improve water security, climate proof cities, manage and reverse water pollution, improve and protect the health of ecosystems and receiving water bodies, contribute to human wellbeing and public health, to address resource efficiency and energy transition, reduce the ecological impacts that are associated with water management, support affordable living through the reduction of long term costs that are associated with the management of water, and create more liveable cities by linking water infrastructures to aesthetical and recreational land uses (Hoyer, et al., 2011; Armitage, et al., 2014).

Water sensitive urban design include the following practices at various scales:

- Incorporating green infrastructure aimed at capturing and treating stormwater for a range of uses (McCormick & Dorworth, undated);
- Protecting the supply of water against increasing variability of annual and seasonal precipitation and runoff by building additional infrastructure for the storage of water such as storage tanks or reservoirs (ACT Government, 2014; SADC, 2012);
- Developing new groundwater sources, increasing the groundwater recharge potential and decreasing the discharged wastewater to public sewers (Angiello, et al., 2017; McCormick & Dorworth, undated; SADC, 2012);
- Diversifying and improving water supply sources, including the reuse and recycling of water (ACT Government, 2014; SADC, 2012);
- Treating stormwater to be discharged to surface waters or reused and treating wastewater or minimising the generation of wastewater (Celeste, et al., 2013; Harisyanti & Ryanti, 2017);
- Reducing flood risks through the integration of the design of urban drainage solutions with urban infrastructure design (Angiello, et al., 2017);
- Incorporating flood protection infrastructure in the design of developments in order to prevent the contamination of sources of water supply and treatment works (ACT Government, 2014);
- Using inclusive public spaces, multipurpose space and infrastructure and roadside green infrastructure to enhance the liveability of urban areas with visible water (Angiello, et al., 2017);
- Encouraging riparian buffers along streams, rivers, and waterways and maintain floodplains (McCormick & Dorworth, undated);

- Adapting and modifying urban materials of roads, roofs, etc., to minimise their impact on the pollution of water (Angiello, et al., 2017);
- Making use of street trees, rain gardens, green roofs, infiltration trenches, cisterns, rain barrels, vegetated swales, wetlands and porous paving to reduce the runoff from storms and to decrease the pressure on treatment facilities (ACT Government, 2014; McCormick & Dorworth, undated);
- Clearing alien invasive vegetation from infested catchments, and landscaping with indigenous vegetation to further reduce runoff and the need for irrigation (McCormick & Dorworth, undated);
- Using ground and surface water conjunctively, together with water sources at household level such as roof water harvesting in order to mitigate the impacts of disruptions related to weather on any given component of the system (ACT Government, 2014);
- Employing conservation technologies that reduces demand such as leakage management, detection and repair, water efficient fixtures and appliances, water metering and pricing, and pressure management (Fisher-Jeffes, et al., 2012; Elliot, et al., 2011; GreenCape, 2016).

Stormwater management deserves special mention here because it constitutes a big part of WSUD, called sustainable drainage systems (SuDS). Conventional urban stormwater management focuses largely on managing the quantity (flow) of stormwater by collecting runoff and channelling it away from the city as soon as possible to prevent flooding. This has led to the erosion of natural channels and pollution, resulting in environmental degradation (GreenCape, 2016). WSUD approaches stormwater as a resource and asset rather than a nuisance (Mottaghi, et al., 2015). Stormwater design calculations will be affected by climate change in numerous ways such as through the increase in the frequency and intensity of heavy rainfall events, and through changes in the antecedent moisture loading of soils and the average water supply in storage ponds (Shaw, et al., 2005). Stormwater can be transformed from a possible hazard into a resource by capturing stormwater close to its source with infiltration galleries, detention basins, green roofs, porous asphalt and cisterns (Elliott, et al., 2011).

The performance of WSUD can be measured against its efficiency in conserving water in various urban land uses and in irrigated open spaces; against runoff quantity and quality in urban developments and roads, streets and thoroughfares (for example by assessing whether there have been resultant reductions in total pollutant loads as compared to untreated runoff from storms, or whether the capacity of drainage systems has not been exceeded); and lastly against whether WSUD are designed in an integrated way, i.e. whether it supports the relevant development objectives through the engagement of relevant stakeholders at the appropriate stages of planning, designing, constructing and managing WSUD (Government of South Australia, 2013).

6. Framework for water sensitive adaptation planning

Spatial planning, land use and urban design decisions have long lasting consequences for the supply and demand for water services and resources (Rozenzweig, et al., 2015). Both the impacts of the availability of water on land use as well as the impacts of land use on the availability of water have to be considered when dealing with water resources and their management. Water sensitive adaptation measures should thus be identified and integrated with urban planning as early in the planning process as possible (Grau, undated).

It is not usually necessary or possible to apply every WSUD technique there is, but it is also highly unlikely that any single action on its own will suffice to deal with climate impacts. A basket of actions should be selected with the possible impacts of climate change in mind that incrementally reduces the frequencies and volumes of runoff, flow rates and pollution and takes local conditions into consideration (Van Niekerk, 2018; Vermont Department of Environmental Conservation, 2010; Grau, undated). It would be more effective to implement a basket of measures that will combined the mitigation of long term effects with short term adaptation impact. A framework for selecting such a basket of actions is proposed in Figure 1. This framework was developed for South African cities in an ongoing research project called the Green Book (CSIR, 2018), but can be applied elsewhere. The steps below were followed to develop this framework:

1. Potential climate hazards were identified from climate change projections (South Africa in the case of the project). These hazards included coastal flooding, inland flooding, heat stress, drought, and wildfire.
2. The extent of the local urban planning function was defined, and utilised as criteria for selecting adaptation actions from a literature survey. The local urban planning function was extensively defined to include spatial planning, land use management, environmental planning, engineering services, and landscape and urban design.
3. Based on this criteria, a survey was undertaken of existing local and international adaptation plans, strategies and academic literature to compile a wide-ranging menu of adaptation actions. Much of what is proposed as adaptation actions, is simply good planning practice but essential to mitigate the impacts of climate change.
4. Each adaptation action was linked to one or more climate hazards, and also given a property as being a win-win adaptation action, a no-regrets action, or a low regrets action[i]. This property can be linked to the adaptive capacity or vulnerabilities of a place, i.e. if the economic base as well as the population growth trends of a place are in decline, then it is possible to only select those actions that do not involve a huge capital investment, i.e. soft adaptation actions.
5. Relevant adaptation actions were then selected and organised in a framework according to the planning function they fulfil. These were tested with a focus group for their relevance to the local planning function and then refined.
6. The next step was to structure the framework in a hierarchy and to connect adaptation actions to each other in the hierarchy (see Figure 1 below). Thus if you select one action, the linked actions will also be recommended. This is to ensure that a single proposed action is supported within a hierarchy of urban planning instruments. For example, if heat stress is projected to become more extreme in future, one of the adaptation actions proposed under the urban landscape and design category is to design shaded public spaces. The associated actions in the hierarchy are to identify such spaces in the spatial plan, and to protect them through land use management.

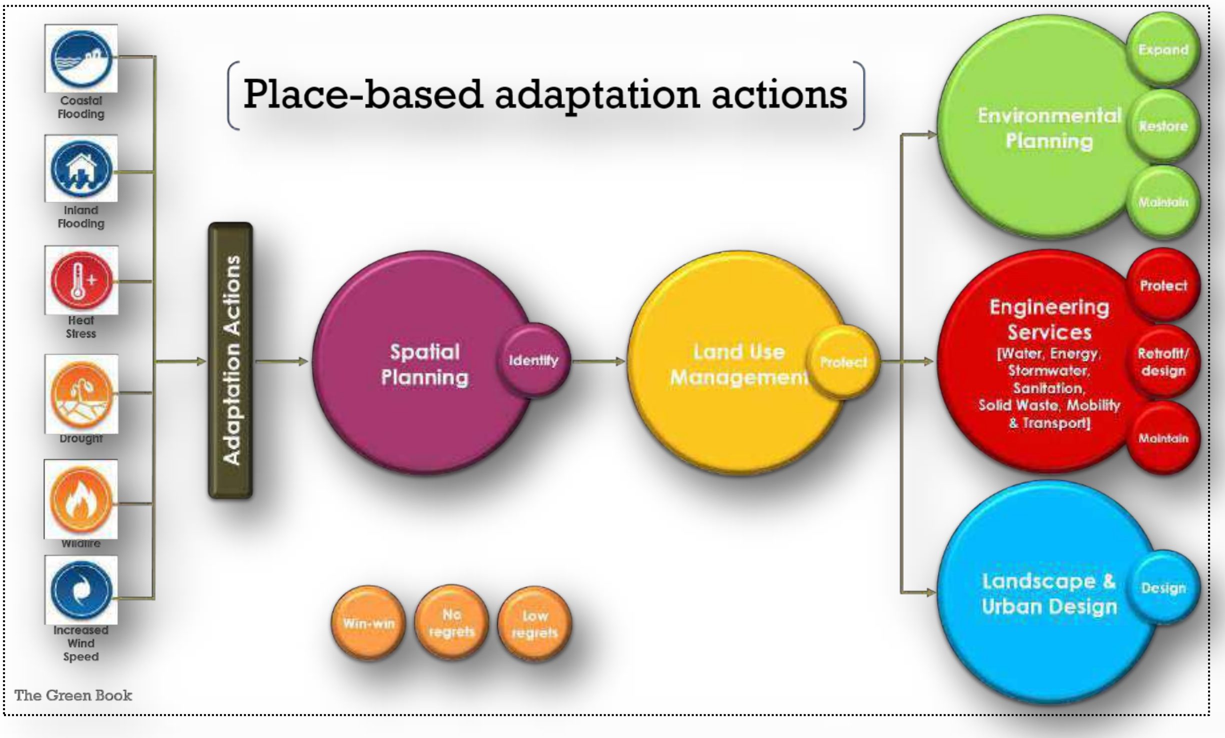

Figure 1: A framework for selecting place-based adaptation actions (Van Niekerk, et al., 2018)

To illustrate how this applies to water sensitive urban planning, say for example a city is projected to become hotter and drier, and at risk of recurring drought in the future. The city's economy is strong and diversified, and the population is growing. Water-sensitive urban design will be crucial to address the future demand for water in the city. Using the proposed framework of adaptation actions, a basket of adaptation actions linked to drought as a hazard will be suggested, each action linked to a hierarchy of planning functions. It is up to the planner then to select all supportive adaptation measures to be integrated into the various related planning instruments. An example would be that 1) the spatial planning instrument(s) is used to identify all the potential water sources in the city as part of a decentralised water provision system; 2) the land use management instrument(s) is used to protect all the potential water sources from development or pollution; and 3) the engineering services function design a diversified water supply system that includes using alternative water sources, recycled water and grey water for non-potable purposes.

The proposed framework assists in selecting the most appropriate adaptation actions as part of a WSUD adaptation strategy, and ensures a single action is supported in a hierarchy of planning instruments, if appropriate.

7. Conclusion

Climate change not only contributes to existing urban challenges, but will also create more problems that will have to be dealt with in the future. It therefore becomes important for planners to be familiar with and thoroughly comprehend the current and potential impacts, to limit and prevent these challenges, particularly in the water sector. Cities are facing the challenge of transforming already fully or over-extended water services infrastructure into systems that can deal with the current and future combined pressures from continued rapid urbanisation and climate change. However, due to the enormity of the urban challenges, the costs of upgrading or replacing old infrastructure to provide immediate services often outweigh any considerations and decisions regarding future climate change. Often cities have limited technical capacity and resources to manage existing water infrastructure, let alone plan and develop new infrastructure that is more sustainable and resilient to climate change. Addressing climate change in urban water systems could therefore be complex, but is an opportunity to address a number of development challenges simultaneously. As water infrastructure may last over 100 years it is important that new infrastructure take into account climatic change that may occur during its lifetime. The development of new water systems and the upgrading of existing systems offer the opportunity to develop systems that are more resilient to future impacts of climate change. It also offers an opportunity to leapfrog conventional wasteful approaches with more effective and resilient systems (Muller, 2007; Bahri, et al., 2016).

Water sensitive urban design should be considered as the basis of city-wide planning instruments in places that are becoming hotter, drier and more at risk of severe climate events. There are numerous potential benefits to water sensitive design for cities:

- Economic benefits include savings on capital costs and costs for water quality improvement, as well as increases in market value from the improved aesthetics that come with some WSUD measures.
- Social benefits include opportunities for the linkages of community nodes through the use of open space, amendable residential and urban landscapes and improved visual amenity. Adapting to climate change is also an opportunity to aim for higher levels of services in unserved areas by leapfrogging the intermediate step of communal services (WHO & DFID, 2009).
- Environmental benefits include the protection it offers for sensitive areas from urban development, contributing to the maintenance of the hydrological balance in cities by encouraging the use of natural processes of evaporation, infiltration and storage, enhancing natural habitats, and supporting the restoration of urban waterways (Van Hattum et al., 2016). Adapting to climate change is also an opportunity to integrate water source sustainability from the outset into new programmes and not as an afterthought (WHO & DFID, 2009).

Given these benefits, this paper proposed a framework for selecting appropriate adaptation actions to be included in a WSUD adaptation strategy that would ensure adaptation actions are not loose standing, but integrated into a hierarchy of planning instruments.

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i ***Win-win actions*** contribute to adaptation whilst also having other social, economic and environmental policy benefits, including those relating to mitigation. ***No regrets actions*** yield benefits even in absence of climate change and where the costs of the adaptation are relatively low vis-à-vis the benefits of acting. ***Low regrets actions*** are relatively low cost and provide relatively large benefits under predicted future climates (CSIR, 2018).

Urban surface use optimization for climate resilience improvement

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Synopsis

In the current scenario of massive urbanization and global climate change, the urban surfaces and their characteristics have a key role in pursuing resiliency and sustainability objectives at the city scale. This paper discusses the potential uses of urban surfaces and proposes a systemic approach aimed at their optimization. The methodology, which is customizable for different climates, is tested in a residential district of Bolzano (Italy), which is taking part to the European project SINFONIA. In the case study area, several solutions have been systematically applied and integrated, demonstrating the potentialities of such an holistic approach.

1. Introduction

The massive urbanization and the rapid grow of urban population worldwide, estimated to result in more than 6 billion inhabitants by 2050 (United Nations, 2015), are accentuating various energy and environmental issues clearly related to anthropogenic causes. In this scenario, cities are receiving increasing attention; several mitigation and adaptation strategies are proposed to tackle issues related to urbanization and the correlated effects of climate change (Moraci *et al.*, 2018). Green building solutions, water surfaces, and solar active energy systems are just some of the strategies that are being developed and tested to increase the resiliency and sustainability of cities. However, these are often applied as single and sectorial solutions, impeding their integration and the creation of synergies. As a result, the urban surface is becoming a scattered patchwork of solutions, which reduces the capability of cities in responding and adapting to external environmental pressures, and in mitigating the effects of climate change. Furthermore, the lack of a systemic approach generates disharmonized policies and conflicts in the urban surface usage, which prevent the creation of resilient and sustainable urban areas.

This paper aims to propose a systemic approach to the optimization of the urban surface use, and to demonstrate its relevancy in the maximization of urban resiliency and sustainability. The methodology presented contributes to the debate on resilient cities by answering to the following questions: a) What are the best uses for specific surfaces in a city? b) How can different surface usages be integrated to maximize the throughput avoiding conflicts? c) Which criteria should be considered to optimize the urban surface usage?

2. Background

Several studies have demonstrated the link between urban development and climate change, and the unique climate risks, such as urban heat island and flooding, faced by urban areas (Doherty, Klima and Hellmann, 2016; Wang and Wang, 2017) . In this scenario, the urban surfaces and their characteristics have a key role. Indeed, the replacement of natural, permeable surfaces, with mineral materials is responsible of the significant increase of air temperature in urban areas compared to the surrounding environment (i.e. urban heat island effect), and of the land sealing resulting in surface storm-water runoff problems (Tsoka, Tsikaloudaki and Theodosiou, 2017). Furthermore, the low albedo (i.e. reflectance to solar radiation) of materials applied on the majority of the urban surfaces is cause of the increase of solar radiation absorption and of the consequent high surface temperatures observed in cities. The territorial expansion caused by the urbanization increased the land consumption and caused relevant changes in the land use. Therefore, the reduction of green spaces produces a serious environmental degradation, and a decrease of latent heat emission. The latter is cause of the reduction of cooling and further raise of air temperature (Taha, 1997). Heat removal through convection is also prevented by the increase of building heights in urban areas that is responsible for low induced wind velocities. The raise of air temperatures in cities does not only worsen outdoor thermal comfort conditions, but has also negative impacts of human health. Furthermore, it increases the energy consumption for cooling, causing peaks in the electricity demand in hot climate conditions (Santamouris *et al.*, 2016).

2.1 Urban surface uses

In this scenario of increased urbanization and global climate change, it is becoming crucial the capability of cities to: (i) protect people and infrastructures from extreme events like heat waves and floods, and (ii) use their resources efficiently by being self-reliant on energy, food, and water. The use and characteristics of urban surfaces play a key role in addressing these resiliency and sustainability objectives. Five major clusters of surfaces uses are identified as the most promising:

1. Smart coats: consist mainly in solutions aimed at decreasing the absorption of solar radiation in the urban environment. They can be subdivided in two groups. a) Finishing materials or paintings characterized by highly reflectivity to solar radiation and by a high emissivity factor, known as cool materials. These characteristics help decreasing urban surface temperature and minimizing the corresponding release of sensible heat to the atmosphere. Cool materials can be used either on the building envelope or on pavements and other urban structures. The use of reflective materials is associated also to important energy benefits as the cooling load of buildings is reduced (Santamouris *et al.*, 2012). b) Water retentive or porous pavements are applied on ground surfaces to increase evapotranspiration (i.e. water transfer from the land to the atmosphere through the combined processes of plant transpiration and evaporation) and to avoid storm-water runoff.
2. Green: urban greenery contributes to the improvement of urban environmental conditions through different processes: i) direct sun shading, ii) evapotranspiration, iii) mitigation of air movement, and iv) regulation of the heat exchange through the building envelope. In this view, urban greenery solutions can be classified as: a) trees, grass, and vegetation applied in outdoor areas, and b) green building elements (i.e. green roofs and façades). The latter may also produce direct benefits on indoor comfort conditions (Coma *et al.*, 2017).
3. Water: the main purposes of natural water retention measures and artificial water surfaces are to: (i) reduce the impact of urban development by restoring the natural water cycle, (ii) promote in-situ management of storm-water runoff through infiltration (Bortolini and Zanin, 2018), and (iii) remove summer urban heat through evapotranspiration (Santamouris *et al.*, 2016).
4. Urban agriculture: aimed at the production of food, urban agriculture play an important role in the food security and environmental sustainability of a city. As a form of green infrastructure, urban farms and rooftop food gardens contribute to reduce urban heat island effects, mitigate storm-water impacts, and decrease the energy embodied in food transportation (Ackerman *et al.*, 2014).
5. Solar energy systems: within cities, renewable energy can be generated by means of active solar systems, i.e. solar thermal (ST) and photovoltaics (PV), using the surfaces of the building envelope or other elements of the urban landscape (Kanters, Wall and Dubois, 2014).

For each cluster of urban surface use, the main solutions are listed in Table 1, together with the main and secondary objective targeted.

Table 1: Main solutions for each cluster of surface uses. The main (dark green) and secondary (light green) objectives pursued.

USES	SOLUTIONS	OBJECTIVES					
		Resiliency			Sustainability		
		Urban climate optimization	Urban habitats and biodiversity improvement	Urban hydrology and storm-water management	Self-reliance on energy	Self-reliance on food	Self-reliance on water
Smart coats	Cool finishing materials applied on buildings' vertical surfaces						
	Cool roofing systems						
	Cool/reflective pavements						
	Use of finishing materials with different albedo						
	Water retentive paving systems						
	Porous ground materials						
Green	Vertical greening systems						
	Horizontal greening systems						
	Planting and greenery						
	Urban parks						
Water	Sprinklers and water curtains						
	Natural water bodies						
	Artificial water surfaces, fountains						
	De-paving						
	Rain gardens						
	Water squares						
	Aquaculture						
	Aquaponics						
Urban agriculture	Rooftop agriculture						
	Urban farming						
	Vertical farming						
Solar energy systems	Photovoltaic panels						
	Building integrated photovoltaic systems (BIPV)						
	Photovoltaic application in landscape and urban furniture						
	Photovoltaic road pavements						
	Solar thermal panels						
	Road pavement solar collector systems						
	Shelter design						

2.2 *Conflicts and integration*

The majority of the uses and solutions discussed in Section 2.1 are applied independently one from another, highlighting the lack of a systemic view inclusive of synergies and hybridization.

This trend is causing inefficiencies, competition in the use of urban surfaces, and the diffusion of scattered intervention characterized by the absence of a general planning framework. In this scenario, the individuation of the main conflicts and possibilities of integration between different uses is an important step toward the definition of a systemic approach to the optimization of urban surface uses. Table 2 considers the integration of the five surface use clusters discussed in Section 2.1.

Table 2: Conflicts and potential integrations between different surface uses. Rows: main uses; columns: potential secondary uses.

	Smart coats	Green	Water	Urban agriculture	Solar energy systems
Smart coats		? May be used in combination	✗ Impervious surfaces	✗ Use of the same surfaces	? Higher reflected radiation
Green	✗ Use of same surfaces		✓ Increase of permeability	✓ Compatibility	? Research on-going
Water	✗ Conflicting solutions	✓ Microclimate regulation		✓ Compatibility	? Non-conflicting surfaces
Urban agriculture	✗ Use of the same surfaces	✓ Compatibility	✓ Aquaculture and aquaponics		? Use of PV as shading system
Solar energy systems	✗ Use of the same surfaces	? Research on-going	? Non-conflicting surfaces	✗ Use of the same surfaces	

The application of smart coats, mainly highly reflective materials, increase the sealing of urban land; therefore, it conflicts with the surface use for urban agriculture and water systems, which require the presence of permeable soils. In addition, the integration of smart coats with greening or solar energy systems is not possible on the same surface. However, the conflict between the solutions may be avoided when applied on different domains. As an example, cool asphalt applied on ground surfaces is compatible with greening at the building envelope scale. While the increased solar reflection due to the application of cool materials may be beneficial for the energy production of nearby active solar systems (Lobaccaro *et al.*, 2017). Green surfaces are fully compatible with water solutions, as they imply the same heat mitigation processes, and with urban agriculture, while they conflict with solar energy systems. However, recent studies are focusing on the integration of the latter through the application of photovoltaic systems on green roofs (Chemisana and Lamnatou, 2014), and the creation of a multifunctional system integrating building greening and PV (Penaranda Moren and Korjenic, 2017). Water surfaces are compatible with urban agriculture, as they can be used for aquaculture or aquaponics (Al-Kodmany, 2018), and with green solutions. On the contrary, they are not compatible with solar energy production. However, water solutions are mainly applied at ground level, where the shadow casted by buildings and trees reduces consistently the amount of solar irradiation, making these surfaces unsuitable for the installation of solar active systems. Therefore, in the majority of cases, there is no direct conflict. Urban agriculture and solar energy systems are conflicting, since they both aim at using surfaces with good solar exposure. A recent study has conducted a comparison between rooftop food production and energy generation, highlighting the benefits and costs produced by the two solutions applied in Mediterranean climates. The results have shown that, under the modeled conditions, food production is more beneficial than energy production in terms of financial return and local job creation (Benis *et al.*, 2018). Integration between solar energy systems and urban agriculture may be obtained through the application of semi-transparent PV modules on greenhouses roof (Cossu *et al.*, 2016).

3. Methodology

The methodology proposed in this study implies sequential and logical steps to address local climate and morphological aspects for the urban surface use optimization in consolidated urban areas.

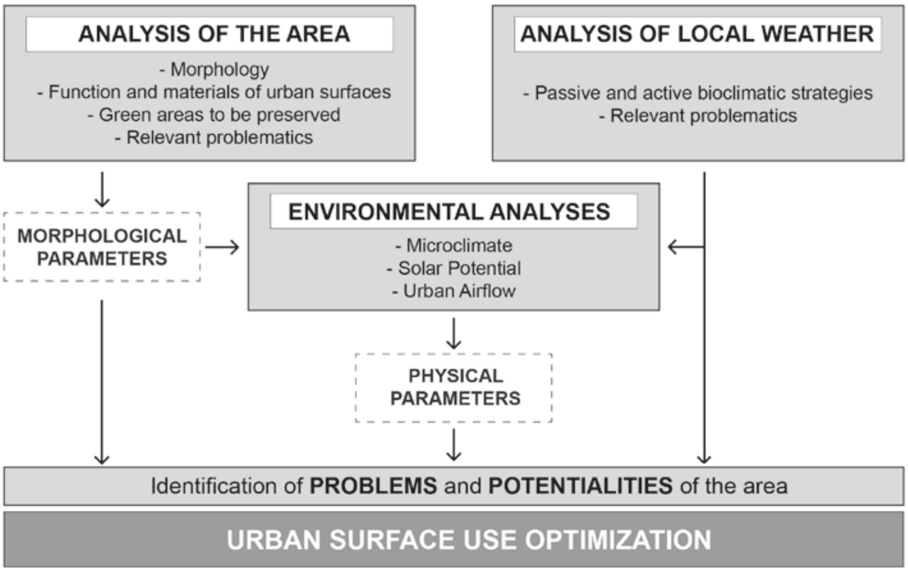

Figure 1: Workflow of the presented methodology.

3.1 Morphological and climate characterization of the area

The methodology, schematized in Figure 1, starts with the analysis of the selected area. The morphology, the function and materials of the urban surfaces are examined with two objectives: (i) outline the main features of the district, and (ii) collect relevant input data for the environmental models. In this stage, the area is also characterized by the individuation of its relevant problematics (e.g. presence of areas prone to flooding, etc.) and positive features (e.g. green areas to be preserved). In parallel, the local weather is analyzed to clearly understand the local conditions and to determine truly responsive passive and active bioclimatic strategies (Lobaccaro *et al.*, 2018). Successively, sets of environmental analyses are conducted on the three dimensional model of the district to: (i) characterize the local conditions and (ii) test responsive solutions, depending on the resiliency and sustainability objectives set for the area. This step includes:

1. Solar potential analyses: aimed at identify the most irradiated areas and the surfaces most affected by overshadowing;
2. Microclimate analyses: focused on the definition of the local climate conditions, the identification of the main problematics of the area, and the verification of the impact of specific modifications in the urban surfaces use;
3. Urban airflow analyses: to evaluate the natural ventilation in the district.

In the final step, the physical and morphological parameters obtained by the analysis process are used as guidelines to define the optimal usage of each surface in the district. One of the strength of the methodology is its replicability worldwide. Hence, since it is based on the three-dimensional model of the analyzed urban district and on the local weather data, the methodology may be reproduced in every morphological and climate condition.

3.2 Tools and indexes for environmental analyses

Several tools may be used as support during the analysis process. In this study, the three-dimensional model of the district was created using the Windows®-based NURBS modeler *Rhinoceros* (McNeel Robert and Associates, 2015). The solar simulations to evaluate the solar potential of the urban surfaces were run using the solar dynamic simulation tool *DIVA-for-Rhino,* a validated *Radiance/Daysim*-based software (McNeil and Lee, 2012) . Finally, the numerical model *ENVI-met*, version 4.0, has been used to analyze the microclimate conditions in the district in the different scenarios. *ENVI-met* is a 3D prognostic microclimate model that simulate the surface–vegetation–atmosphere interactions in urban complex environments with spatial resolution of 0.5 to 10 m and temporal resolution of 5 to 10 s (Bruse and Fleer, 1998). The analyses have been conducted for the 29th July 2017, selected as representative of a typical hot summer day. Finally, the human comfort at pedestrian level in the district has been evaluated using the Physiological Equivalent Temperature (PET), a thermal index developed by Höppe to assess the thermal comfort in outdoor environments (Höppe, 1999; Matzarakis, Mayer and Iziomon, 1999). The value of PET identifies the thermal perception by human beings and the correlated grade of physiological stress; the range from 18°C to 23° C corresponds to “comfort”, above 35 °C to “hot”. PET values above 41°C describe a “very hot” thermal perception related to extreme heat stress conditions (Matzarakis, Mayer and Iziomon, 1999).

3.3 Case study area

The proposed methodology is tested for the urban surfaces use optimization in an existing residential district in the city of Bolzano.

Bolzano (UTM 46°29'53.8" N, 11°21'17.1" E) is located in the north-east of Italy, at a height of 265 m above sea level. The city is situated in the center of south-eastern Alps in a basin surrounded by four mountain ranges, whose significant height impedes balancing currents and moisture. As a consequence, the climate in Bolzano is categorized as moist continental (“Dfb”) according to the Köppen-Geiger classification (Kottek *et al.*, 2006), and is characterized by strong seasonal fluctuations. Due to its location and climate characteristics, Bolzano is often affected by high temperature and heat waves during summer (Papathoma-Köhle *et al.*, 2015), when it is ranked often among the hottest Italian cities. In summer, air temperatures (T_{air}) often exceed 35 °C, with maximum peaks up to 40 °C. Furthermore, a significant increase in the number of tropical nights (i.e. nights with a minimum temperature equal or higher than 20 °C) has been observed in recent years. Until 1995 the tropical nights where less than five per summer, while in 2010 have reached the number of 20 (Papathoma-Köhle *et al.*, 2015). The historical meteorological data series show an increase in the mean annual T_{air} of more than 3 °C in the last 30 years (Lobaccaro *et al.*, 2018). In this scenario, the city of Bolzano represents an interesting case study for its location, its climate features, as well as the need to mitigate summer conditions.

The district selected is one of the five areas in Bolzano taking part to the Smart Cities European project SINFONIA *(Smart Initiative of cities Fully cOmmitted to iNvest In Advanced large-scaled energy solutions*) (SINFONIA, 2017), and it includes two social housing blocks (i.e. buildings S1 and S2 in Figure 2) and the nearby buildings. The morphology of the area is characterized by the presence of five urban canyons: *Via Milano* and *Via Cagliari* from north to south; *Via Brescia*, *Garden*, and *Via Palermo* from west to east (Figure 2). The latter is one of the main roads connecting the eastern and southern areas of Bolzano, while *Via Milano* and *Via Cagliari* are secondary roads. *Via Brescia* is mainly used by the residents to access the underground parking lots, and present a green area with trees running alongside. *Garden* is the central public area between buildings S1 and S2 and it is characterized by grass surfaces and vegetation of different species and dimensions. In the framework of SINFONIA project, whole-building refurbishment and technological interventions have been undertaken. This work aims to expand the evaluation of SINFONIA's impact at the whole district by considering the urban surfaces in a systemic approach.

Figure 2: a) Top view of the case study district. Highlighted in red the two SINFONIA building blocks (source: Google Earth); b) Aerial view.

3.3.1. Scenarios of urban surface use

In this study, five different scenarios of urban surface use have been simulated (Table 3). In the *Baseline* scenario, the morphological characteristics and the albedo of the urban surfaces were maintained unvaried from the actual situation in order to characterize the microclimate and environmental features of the district. Successively, three new scenarios have been modeled to address the main needs of the area, each considering a single use of the urban surfaces. In the *Cool* scenario, materials with higher albedo have been applied on roads and pedestrian paving, at the ground level, and on the roof surfaces, at the building envelope scale (Maleki and Mahdavi, 2016). The *Greenification* scenario implies the modification of the building envelopes, with the application of vertical and horizontal greening systems (Jänicke *et al.*, 2015). While in the *BIPV* scenario, the effect of solar active systems applied on façades and roof surfaces with suitable solar potential has been investigated. The results obtained from the *Baseline* scenario were used as reference values for comparison with the others. Finally, based on the outcomes of the previous scenarios, a final configuration of the district has been outlined. In this *Integrated* scenario, the systemic application and integration of several solutions has been addressed to demonstrate the potentialities of a holistic approach to the urban surface use optimization.

Table 3: Characteristics of the scenarios of urban surface use simulated in the study.

Scenario	Surface	Solutions
Baseline	Roads	-
	Public areas	-
	Buildings	-
Cool	Roads	Cool grey asphalt with albedo 0.40
	Public areas	Cool pavement with albedo 0.50
	Buildings	Cool paint with albedo 0.80 on the roof
Greenification	Roads	-
	Public areas	-
	Buildings	Façades: vertical greening systems Roof: horizontal greening system with grass
BIPV	Roads	-
	Public areas	-
	Buildings	Façades: BIPV on surfaces with suitable solar potential Roof: PV panels
Integrated	Roads	Cool grey asphalt with albedo of 0.40 on the main roads (i.e. *Via Palermo*, *Via Milano* and *Via Cagliari*). Increase of green areas of 10%
	Public areas	
	Buildings	

	Façades: vertical greening systems on (i) surfaces exposed at south, (ii) façades along the roads with higher T_{air}; BIPV on the surfaces with suitable solar potential. Roof: PV panels on the most irradiated surfaces; cool paint with albedo 0.80 on the remaining areas.

4. Results

In this section, the relevant results related to the five simulated scenarios are discussed along with the significance of addressing the use of urban surfaces through a systemic and holistic approach.

4.1 Microclimate conditions in the district

The microclimate analysis of the *Baseline* scenario has been focused on the evaluation of the main climate parameters. Air temperature (T_{air}, Figure 3a), surface temperature (T_s), mean radiant temperature (T_{mrt}, Figure 3b), global shortwave solar radiation (Irr_{SW}), and wind speed (W_s, Figure 3c) have been assessed in selected points for each urban canyon. Finally, solar analyses (Figure 3d) led to the identification of the most irradiated building envelope surfaces potentially suitable for the installation of solar active systems.

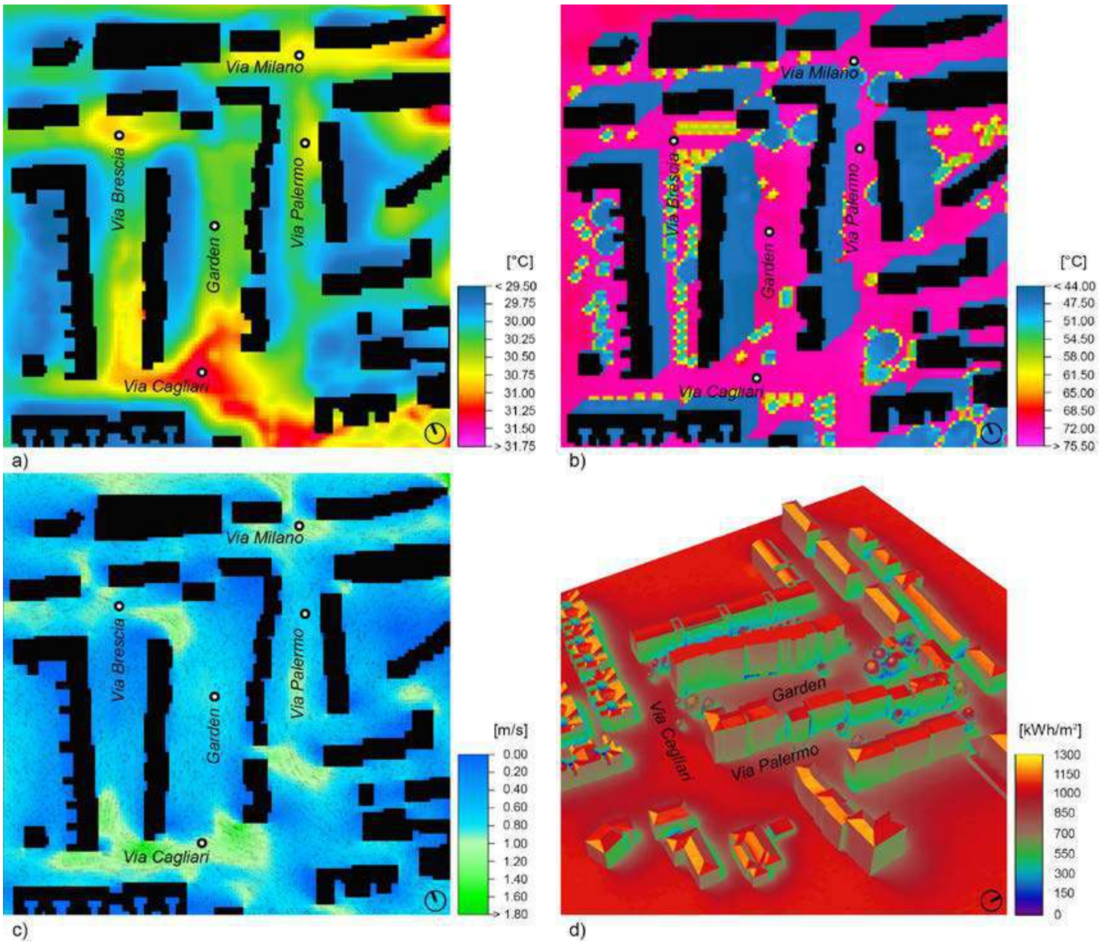

Figure 3: *Baseline* Scenario: a) Air temperature; b) Mean radiant temperature; c) Wind speed and direction vectors; d) Average annual global solar radiation.

The results show that the main problem to be addressed in the area is summer overheating, which is exacerbated by the frequent heat waves, as discussed in Section 5.3. In the analyzed day (i.e. 29th July 2017), the peak of the thermal stress is achieved at 15:00. The hot spots (i.e. areas with high level of thermal stress) are localized in *Via Palermo* and *Via Cagliari*, where T_{air} reaches 30.8 °C and 31.4 °C respectively (Table 4). In both the urban canyons, the T_{mrt} is higher than 70 °C and the PET higher than 50 °C, corresponding to a high level of human thermal stress. The wind flow pattern around buildings (Figure 3c) ensure comfortable and safe wind conditions for pedestrians (Blocken and Carmeliet, 2004).

Table 4: Microclimatic characteristics of significant spots in the urban canyons.

Urban canyon	H/W	Ground material	T_{air} [°C]	W_s [m/s]	T_s [°C]	T_{mrt} [°C]	Irr_{SW} [W/m²]	PET [°C]
Via Palermo	0.60	Asphalt	30.73	0.63	47.62	72.95	990	52.00
Garden	0.56	Loamy	30.27	0.80	42.17	72.34	1 004	50.20
Via Brescia	0.84	Asphalt	30.93	0.77	44.00	63.23	1 006	45.70
Via Milano	1.36	Asphalt	30.77	0.68	47.52	72.24	1 012	51.10
Via Cagliari	0.78	Asphalt	31.38	0.83	44.10	71.43	1 020	50.50

4.2 Effects of the simulated scenarios

To improve the microclimate of the district, two scenarios have been defined based on the most diffused mitigation technologies (i.e. cool materials and green solutions). A further scenario has focused on the district self-reliance on energy by considering the maximization of the urban surfaces' potential energy production. Figure 4a shows the air temperature difference between the baseline and the *Cool* scenario. The cooling effect of the albedo increase is visible mostly at the c enter of *Via Palermo*, *Via Cagliari* and *Via Milano*. The maximum cooling effect of 0.4 °C dissipates by reaching the limits of the roads and the central areas of the district. The increment of the ground surfaces' solar reflectivity produces an average decrease of surface temperature by around 2.6 °C, but causes at the same time an increase of T_{mrt}, which produces a consequent worsening of thermal comfort conditions at pedestrian level. This is demonstrated by an average increase of PET by 0.5 °C. Regarding the *Greenification* scenario, the vertical green façades and vegetated roof does not produce a significant cooling effect in *Via Palermo* and *Via Milano* hot spots, while T_{air} is reduced at the center of *Via Brescia* and *Garden* by up to 1 °C. In *Via Palermo*, the air temperature is slightly increased (i.e. ΔTair = + 0.6 °C) due to the reduction of wind speed caused by the presence of vegetation at both sides of the urban canyon. However, considering the overall effects in the district, this scenario leads to a significant improvement of thermal comfort, reducing PET by around 0.5 °C. Finally, the *BIPV* scenario does not pr oduce relevant modifications in the microclimate conditions of the district; in this scenario, PET is slightly reduced by about 0.3 °C.

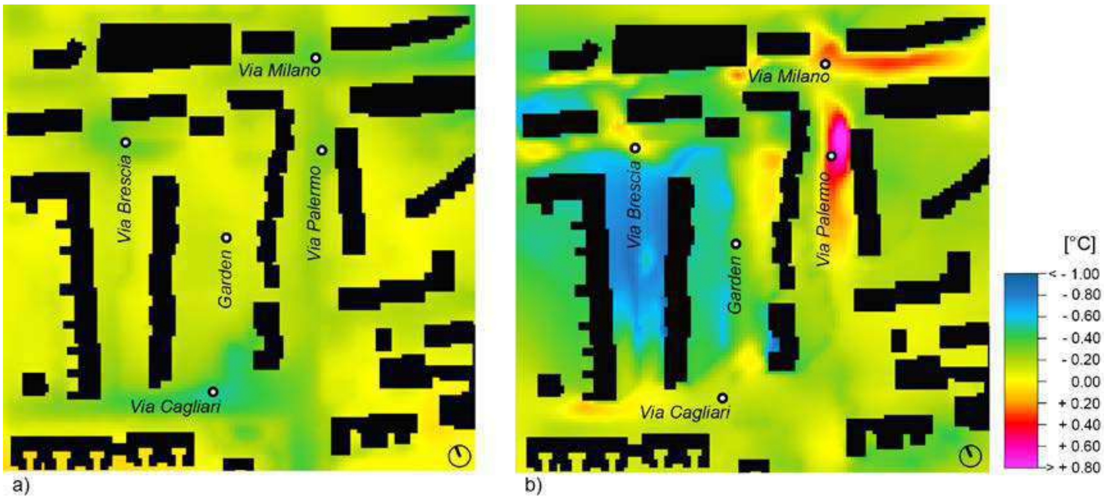

Figure 4: Comparison between *Baseline* and simulated scenarios - Absolute T_{air} difference: a) *Cool* scenario; b) *Greenification* scenario.

4.3 Final scenario of urban surface use optimization

The final configuration of the district (i.e. *Integrated* scenario) has been outlined based on the result of the *Baseline* scenario (Section 4.1) and of the simulated scenarios (Section 4.2). The urban surface use has been defined with a systemic approach. The objective set has been double: (i) to improve the microclimate conditions by combining some of the mitigation strategies previously analyzed and the increment of vegetated areas, and (ii) to increase the energy self-reliance of the district by taking advantage of the surfaces with a good solar exposure (Figure 5a). In terms of microclimate conditions, the air temperature is reduced in all the hot spots (Figure 5b). Furthermore, the combination of increased relative humidity, and decreased surface and mean radiant temperature, produces a reduction of PET in all the urban canyons (Table 5). The more significant improvements in term of outdoor thermal comfort are registered in *Via Palermo* (ΔPET = - 1.4 °C), *Via Milano* (ΔPET = - 2.6 °C), and *Via Cagliari* (ΔPET = - 0.8 °C), which resulted to be the canyons with the higher thermal stress in the *Baseline* scenario. Finally, in the *Integrated* scenario, the installation of solar systems on building envelope surfaces with suitable solar irradiation (i.e. $Irr_{SW} \geq 950$ kWh/m^2) has been considered. The sum of the suitable areas on façades and roofs covers 6 500 m^2, with a corresponding annual solar potential of 6 320 MWh/a.

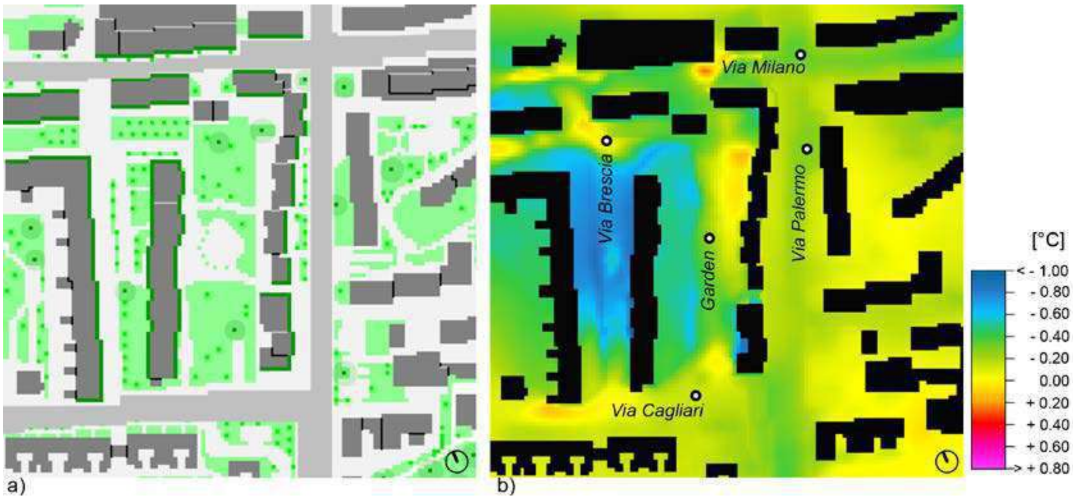

Figure 5: a) Final configuration of the district; b) Comparison between *Baseline* and *Integrated* scenario - Absolute T_{air} difference.

Table 5: Absolute difference of the main microclimatic parameters at 1 m a.g.l. in the *Integrated* scenario compared to the *Baseline* scenario.

Urban canyon	**ΔT_{air}** [°C]	**ΔRH** [%]	**ΔW_s** [m/s]	**ΔT_s** [°C]	**ΔT_{mrt}** [°C]	**ΔIrr_{SW}** [W/m^2]	**ΔPET** [°C]
Via Palermo	-0.05	0.56	0.06	-0.65	-1.35	0.23	-1.40
Garden	-0.10	0.70	-0.04	-0.14	-1.40	0.78	-0.70
Via Brescia	-0.13	1.99	-0.21	-1.18	-1.15	-5.12	0.00
Via Milano	-0.33	0.86	0.42	-3.58	-0.78	-2.73	-2.60
Via Cagliari	-0.40	0.83	0.01	0.78	-0.94	1.26	-0.80

5. Conclusions

The main purpose of the study was to develop and test a systemic approach aimed at the optimization of the urban surfaces use in consolidated urban areas. The preliminary discussion on the main uses, their conflicts and potentialities for integration, highlighted the lack of a systemic approach for the optimization of urban surfaces. In this scenario, a methodology is proposed to systematize the results of morphological, climate, and environmental analyses. In the first step, the analysis led to the identification of the main negative and positive features of the district. Successively, the solutions to be applied have been defined based on the main resiliency and sustainability objectives set for the area. Optimal uses of surfaces have been identified in terms of (i) outdoor microclimate and thermal comfort, and (ii) solar active strategies. The final configuration, in which several solutions have been systematically applied and integrated, demonstrate the potentialities of a holistic approach to the urban surface use optimization. The thermal stress in the district is reduced, with PET values up to 2.5 °C lower than in the *Baseline* scenario, and the potentialities of the most irradiated surfaces have been exploited by installing solar systems. Future developments of the study will address (i) the effect of other solutions for surface use and, (ii) the definition of quantitative thresholds and guidelines for the optimization process. Furthermore, the possibilities and potentialities for the inclusion in urban planning instruments of indications on the surfaces uses will be investigated.

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The study on the performance of sponge city construction based on land use planning——cases of Canghai new area in Wuzhou

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Abstract:
There is still deteriorating trend of China's urban water environment, heavy rain and waterlogging disasters are still multiple. In addition to the concept of rainwater management is relatively backward, the overall planning of land use planning and road planning, green space system planning and other special planning is not organic combination, lack of the fast and efficient feedback mechanism. Meanwhile, the Ministry of Housing and Urban of China issued the "sponge city construction performance evaluation and assessment methods (Trial)" also emphasis on post-evaluation and assessment, can not be an early stage of the effective assessment of the planning stage.
The two aspects of urban storm water disaster prevention and surface runoff, which are closely related to the land use planning, are chosen in this paper as the main research object, the concept of sponge city construction performanceis defined, the specific evaluation index is selected, and the calculation function is put forward, with the typical case study, the space Model simulation, statistical analysis and other research methods, through the GIS analysis, CAD, Civil 3D and PCSWMM modeling, practical case and ideal model comparative research and other technical means, the sponge city construction performance is studied qualitatively and quantitatively, and mainly on quantitative study.
There are two main results in this study: a method to quantify the performance of sponge city construction based on land use planning is explored in this paper through the application of the assessment model, and comparative evaluation of multiple plans in the early stage of planning. Based on the land use planning, some strategies to improve the performance of sponge city construction are put forward.

Key Word:
Sponge City, Quantitative assessment, Model, land use planning

Most cities in China today face a variety of water crises: water shortage, water pollution, urban rainstorms, increased surface runoff, falling groundwater levels, shrinking and even loss of aquatic habitats (Wang Hao, 2011). These problems which are systematic and comprehensive are not caused by a single water sector or a functional department. If we want to solve these "water problems," we need a more systematic and integrated solution. The "sponge city" theory is based on the basic characteristics of China's water conditions and the "water problems" it faces. In the construction of the sponge city, what can be done in the planning field and what kind of contribution can be made is still unclear.On July 10, 2015, the <Measures for the Evaluation and Assessment of Sponge City Construction Performance (Trial)> issued by the Ministry of Housing and Urban-Rural Development of China was also mainly to evaluate the performance of China's sponge city construction. Once the city is built, it will become a fact. After-the-fact evaluation can only evaluate the quality of the previous plan, but there is no way to change the existing facts. Therefore, it is particularly important to make an effective and reliable assessment of different planning schemes before the construction of the sponge city, and to select better schemes and further optimize them.

1. Sponge City Construction Performance Evaluation Method and Simulation

1.1. Definition of Sponge City Construction Performance Concept

The performance evaluation content of this paper is mainly in the urban planning land use planning, which belongs to the program evaluation before the implementation of the plan. The selected indicators are the urban storm flood control and surface runoff. The definition of the sponge city construction performance concept is based on the above considerations, and the concept can be defined as: land use planning to prevent floods in urban storms and to control the comprehensive ability of surface runoff.

1.2. Sponge City Construction Performance Evaluation Function

The performance evaluation of sponge city construction includes two major indicators: urban storm flood control and surface runoff, and urban storm flood control includes whether there is heavy rain or not, and the total accumulated water time and total water volume in the flood water in the flood season. According to the item index, this study uses AHP(Analytic hierarchy process) to conduct qualitative and quantitative evaluation and decision-making on the evaluation of the final sponge city construction performance. The sponge city construction performance hierarchy is shown in Figure 1.

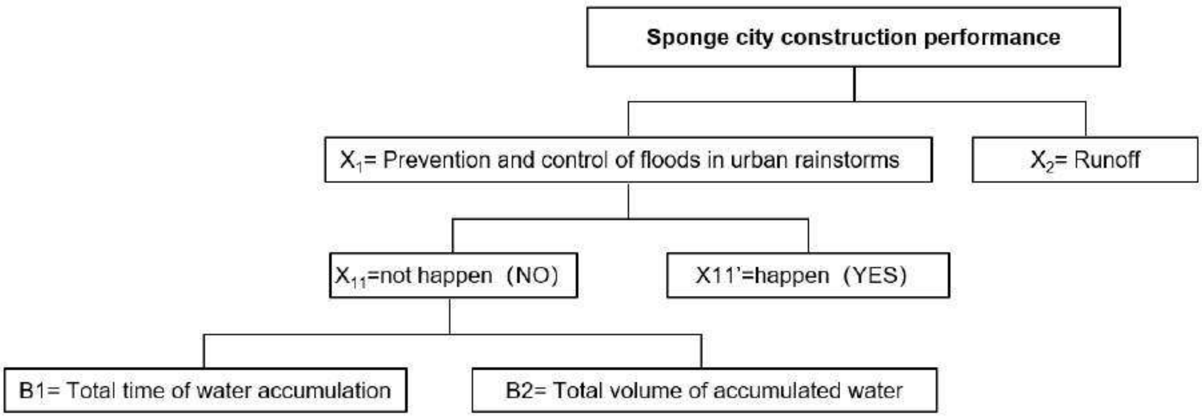


Figure 1. Sponge City Construction Performance Hierarchy
Source: author paint

1.3. Experimental Platform and Tools (PCSWMM software)

SWMM developed by EPA is a dynamic precipitation runoff simulation model, which is mainly used to simulate the time and long-term water and water quality simulation of a certain city. The evaluation software PCSWMM used in this paper is the commercialized software developed by the Canadian Institute of electronic water Resources based on the SWMM model.

1.4. Multi Scheme Model Simulation Method and Process of Sponge City Construction Performance

Through model simulation, a set of effective methods to observe and compare the multi scheme of land planning is set up in the early stage of planning, and the difference of the construction performance of the different land use scheme can be reflected as true as possible so as to select the better scheme and optimize it.

1.4.1. Establishing a multi-scheme model

The establishment of a multi-program model first requires the introduction of basic data, including geological data, climate data (including temperature, evaporation, wind speed, etc.), hydrological data (including rainfall, evaporation, etc.), terrain data and other data. The second is to introduce different land use planning schemes into the model.

1.4.2. Model simulation output data analysis

The total surface runoff of each land use plan, the total time of flood disasters and the total amount of floods were compared, and the performance index of sponge city construction was obtained. Then, the sponge city construction performance evaluation function was used to compare and score each plan, and better plan was selected and optimized.

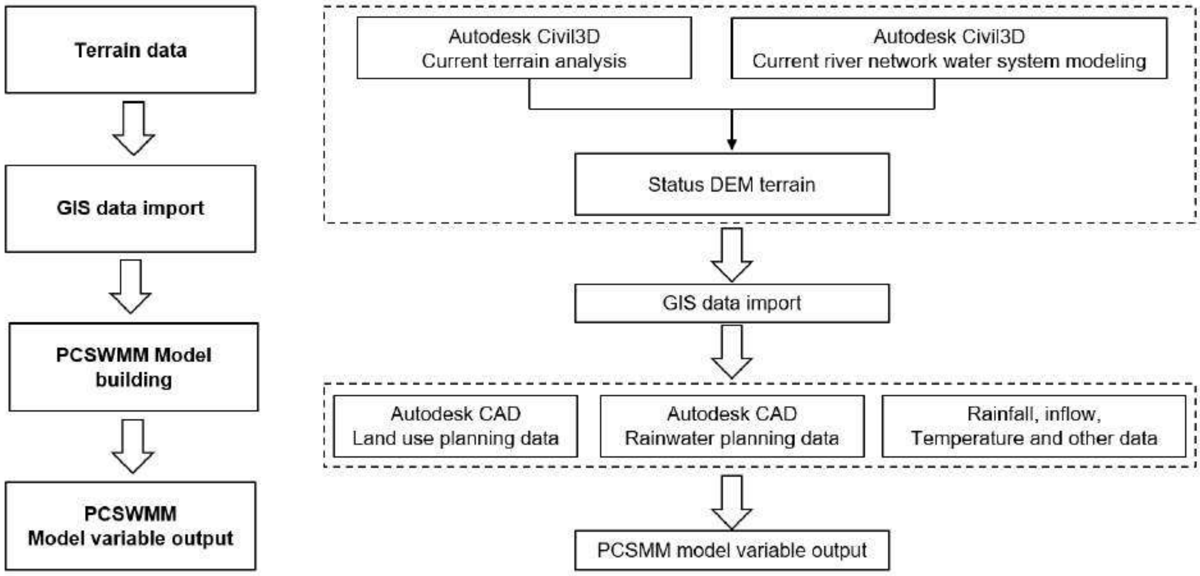


Figure 2. Schematic diagram of the modeling process
Source: author paint

2. Empirical Study on Performance Simulation and Evaluation of Sponge City Construction

2.1. Case Overview

Wuzhou is located in the eastern part of Guangxi China, located in the middle reaches of the Pearl River Basin, with an area of 12585 square kilometers and a population of 3.4 million. The research object of this paper is located in the south side of Cangwu County, Wuzhou City. The specific location is shown in Figure 3. It has been invaded by heavy rain and flood for many years.

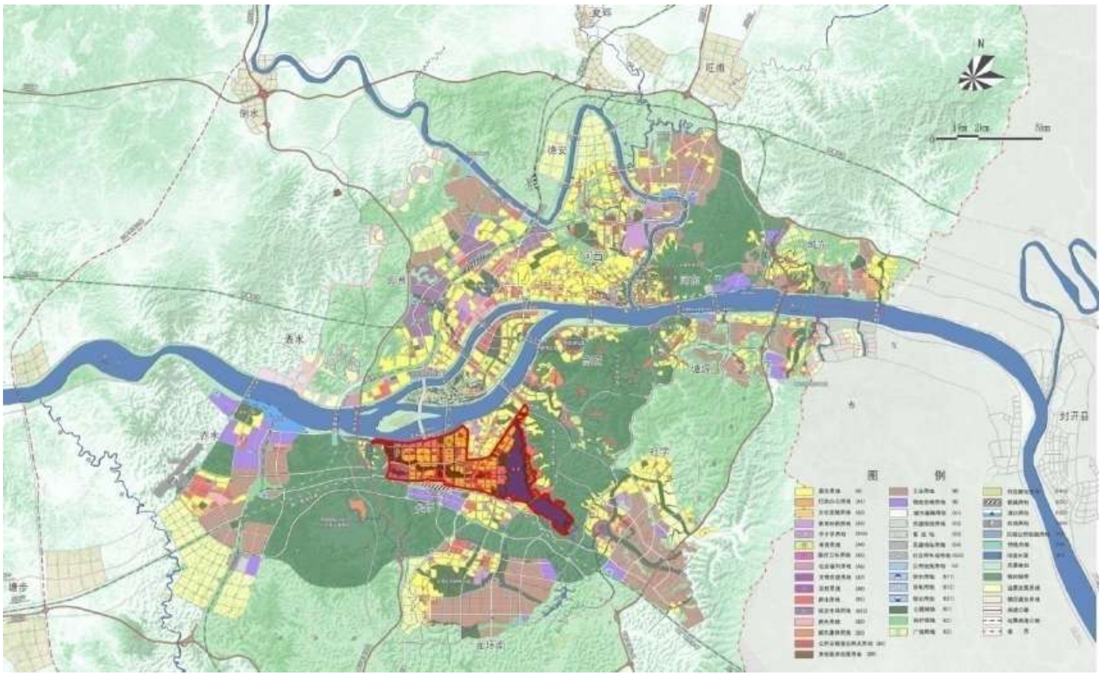
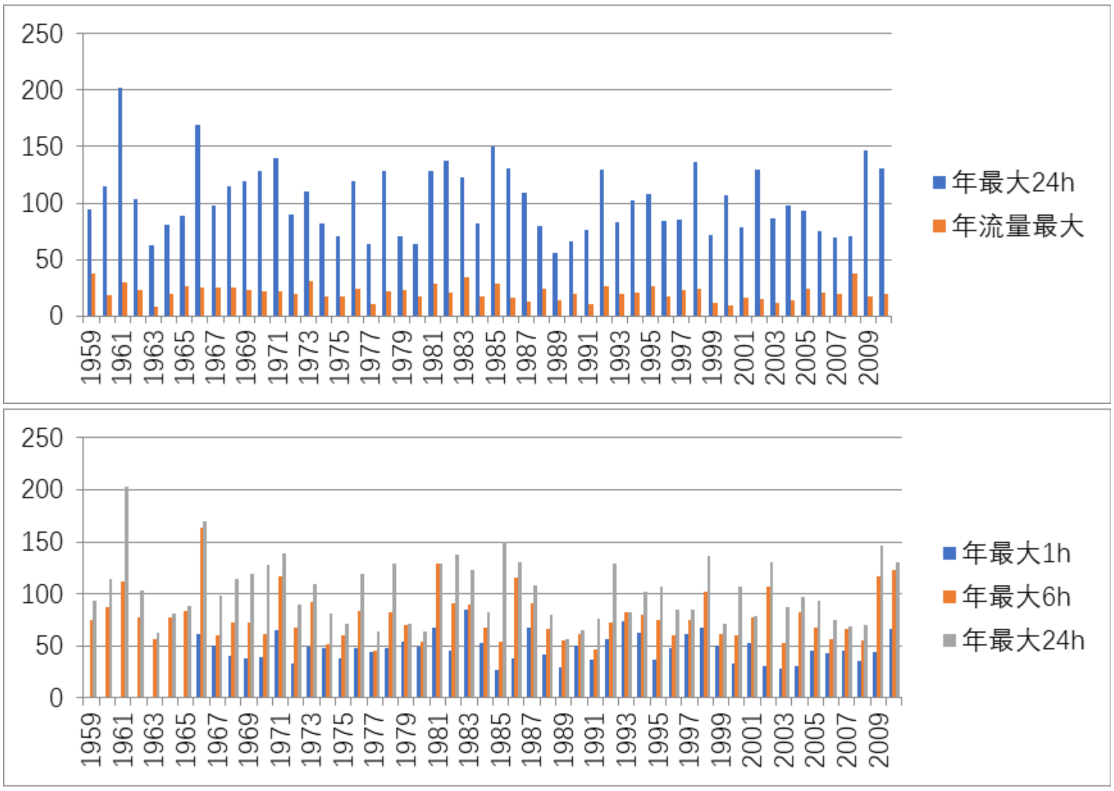


Figure 3. Location map of the study area
Source: author paint

The research in this paper is mainly aimed at the prevention and control of urban flood disasters and the surface runoff in different rainfall day study areas, especially the heavy rain days, and the evaluation of the performance of sponge city construction in different land use planning schemes. Therefore, the historical rainfall data within the study area is especially important for this study. According to the statistics of rainfall from 1959 to 2010 in the study area (the data is not classified because of the confidentiality of the data), the statistics are shown in Figure 4.



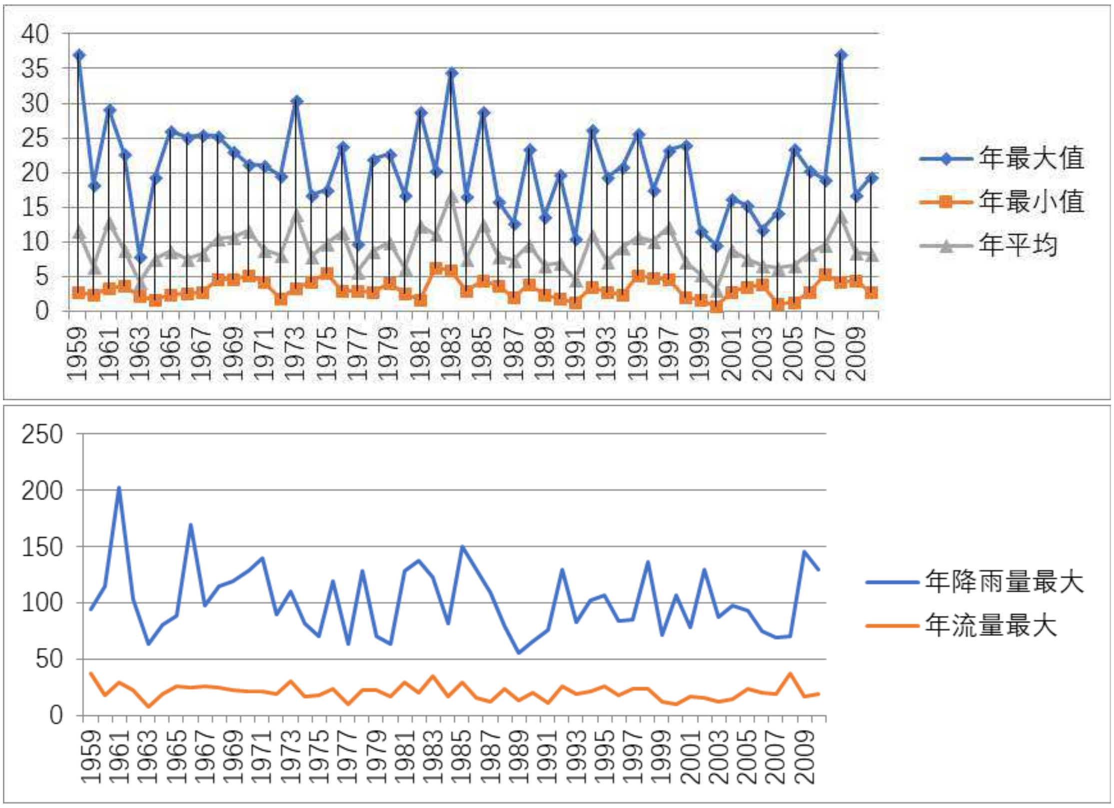


Figure 4.1959~2010 Annual Xiaohebu Hydrological Station Annual Rainfall & Flow Statistics
Source: Xiaxiaohebu Hydrological Station

2.2. Sponge City Construction Performance Model Simulation

In this paper, two sets of representative rainfall data of Wuzhou Rainy Day (Rainstorm Day and Light Rain Day) are selected, and the rainfall data of two rain days are recorded in the three-season land use planning model, and six different scenarios are obtained. .

Table 1. 24-hour rainfall on two rainy days

Time	Rainfall on March 30, 2014	Rainfall on April 22, 2014
0:00	7.1	0
1:00	0	0
2:00	2.8	0
3:00	8.9	0
4:00	3	0
5:00	0	0
6:00	10.3	0
7:00	0	0.5
8:00	0	0.6
9:00	14	0.7
10:00	16.5	0.8
11:00	6.5	1.2
12:00	3	2.3
13:00	0	3.7
14:00	9	5.2
15:00	3	5.1
16:00	10.5	3.4
17:00	23.5	3.5
18:00	0	1.1

19:00	1.5	0.9
20:00	0	0.4
21:00	0	0.3
22:00	0	0
23:00	0	0
汇总	119.6	29.7

Source: Xiaxiaohebu Hydrological Station

Scene 1 is scenario 1 in the rainstorm day model simulation scenario on March 30, 2014, scenario 2 is scenario 1 on the April 22, 2014 rainy day model simulation scenario; scenario 3 is scenario 2 on March 30, 2014 rainstorm day Model simulation scenario, scenario 4 is scenario 2 simulation scenario on April 22, 2014, rainy day model; scenario 5 is scenario 3 on March 30, 2014 rainstorm day model simulation scenario, scenario 6 is scenario 3 in April 2014 The 22nd rainy day model simulates the scene.

Figure 5. Scene 1, 2 initial state
Source: author paint

Figure 6. Scene 3, 4 initial state
Source: author paint

Figure 7. Scene 5, 6 initial state
Source: author paint

According to the performance evaluation indicators of the sponge city construction and research needs, the total green area, green space rate, total water area, water area percentage, total rainfall, total surface runoff, average water storage volume, maximum water storage volume, he number of rainstorm disaster points, the time of the most torrential rain disaster, the average torrential rain disaster time, the total time of the torrential rain disaster, the total flood amount of the torrential rain disaster, and the average flood amount of the torrential rain disaster point are comparative parameters.

Table 2. Statistics of different scenes

Data	Rainy day on March 30, 2014			Rainy day on April 22, 2014		
	scene 1	scene 3	scene 5	scene 2	scene 4	scene 6
Total area of green space (hectare)	561.50	370.44	326.80	561.50	370.44	326.80
Greenland rate (%)	32.33	21.33	18.82	32.33	21.33	18.82
Total water area (hectare)	121.18	335.96	490.06	121.18	335.96	490.06
Percentage of water area (%)	6.98	19.35	28.22	6.98	19.35	28.22
Total rainfall (million cubic meters)	207.70	207.70	207.70	51.58	51.58	51.58
Total surface runoff (million cubic meters)	149.58	127.88	110.01	27.52	25.16	21.91
Average water storage volume (million cubic meters)	25.43	31.40	88.85	4.00	3.49	8.17
Maximum water storage volume (million cubic meters)	69.15	101.58	276.94	7.35	6.21	22.49
Number of rainstorm waterlogging disaster points	26.00	34.00	8.00	0.00	0.00	0.00
The longest rainstorm waterlogging time (H)	11.69	11.85	4.18	0.00	0.00	0.00
Average time of rainstorm waterlogging disaster (H)	5.97	4.41	3.74	0.00	0.00	0.00
Total time of rainstorm waterlogging disaster (H)	155.20	149.80	29.91	0.00	0.00	0.00
Total flood water of rainstorm waterlogging	65.68	22.61	18.35	0.00	0.00	0.00
Average flood volume at the point of rainstorm waterlogging (million cubic meters)	2.53	0.66	2.29	0.00	0.00	0.00

Source: author paint

2.3 Analysis of model simulation results

(1) There are differences in the performance of sponge cities in different land use schemes.

(2) High green land ratio does not necessarily represent low surface runoff.

(3) The area of green land does not play a significant role in terms of prevention and control of rainstorm waterlogging.

(4) The size of the water area does not necessarily play a decisive role in the prevention and control of rainstorm waterlogging disasters.

(5) Water density plays an important role in the prevention and control of rainstorm waterlogging.

3. Urban Land Use Optimization Strategy

3.1. Set Up an Ideal Model

The research area of this paper is very large, there are many types of land use, and the geological conditions are also very complicated. Therefore, the surface runoff obtained, the time of flood disaster, the total amount of flood and other data of the model simulation are a result of many factors. It is difficult to determine which specific factor plays a decisive role in a certain result.

A series of ideal models are established, that is, without considering the changes of topography, soil characteristics, groundwater conditions and erosion, only certain presets and changes are made for the variables to be studied, and the model output data is collated according to the research purpose, trying to figure out the relationship. According to the research needs, three sets of ideal models were established to study the pre-development and post-development changes of the site, the role of the green space system and the difference between the urban functional land.

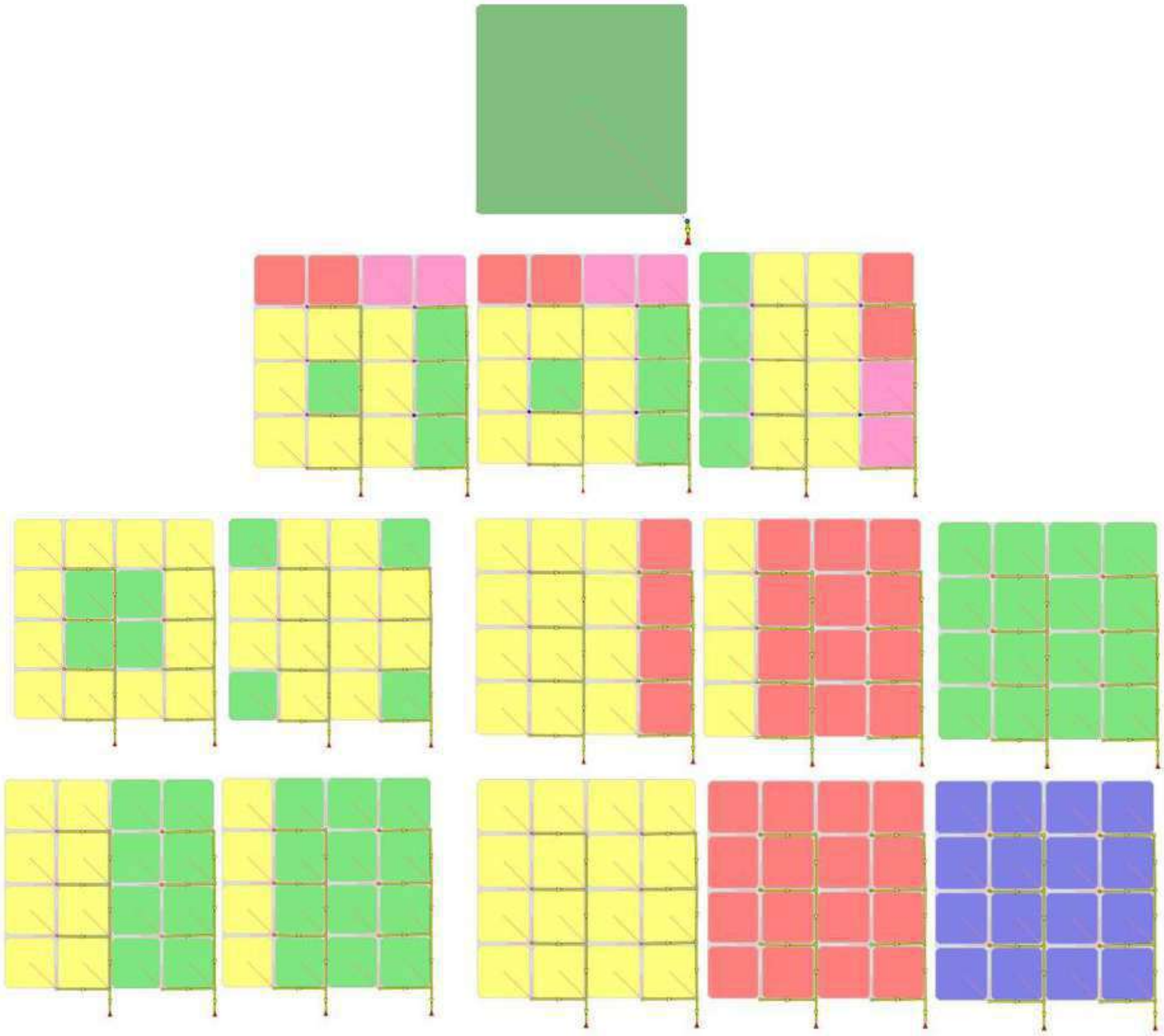


Figure 8. ideal model diagram
Source: author paint

3.2. introduction of LID (low impact development) control technology

Three LID technical measures of ecological detention unit, green roof and rainwater garden were introduced, and program 3 were introduced to establish model simulation to compare the effect of LID control measures on the construction performance of sponge city.

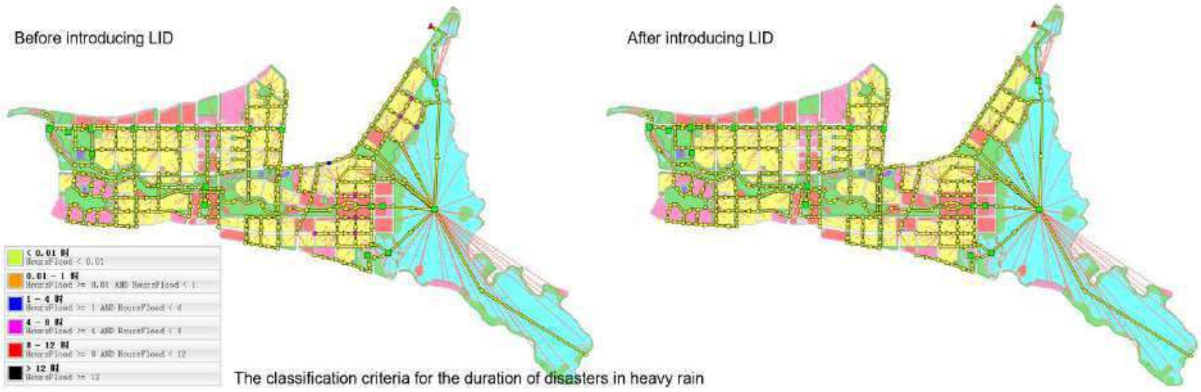


Figure 9. contrast map before and after the introduction of LID
Source: author paint

3.3. Model simulation conclusions and land use optimization strategies

3.3.1. Model simulation conclusions

(1) The LID control technical measures have no obvious influence on the evaporation amount and the infiltration amount under the conditions of constant temperature, wind speed and land structure.
(2) LID control technology measures can greatly control the total amount of surface runoff, and the effect is more obvious on light rain days.
(3) After the development and construction of the cities, the surface runoff will be increased due to the increase of the surface impervious rate. However, the surface runoff may be reduced to some extent or even lower than before the development if the LID control technology measures are introduced reasonably.
(4) The different proportion of urban functional land area will affect the surface runoff and urban rainstorm waterlogging disaster prevention and control, so the urban land area ratio has an impact on the construction performance of the sponge city.
(5) The functional land of the city has little effect on the evaporation due to the impervious rate, but it has an effect on the amount of infiltration, surface runoff and total flood, and with the increase of impervious rate, the amount of infiltration decreases and the surface runoff Increase, the total amount of floods increased.
(6) Green land is more conducive to increase the amount of infiltration, reduce the total surface runoff, and improve the ability to control surface runoff; however, in the prevention and control of flood disasters in heavy rain, the green rate does not play a significant role; In the green space system layout, centralized layout and decentralized layout have their own advantages and disadvantages.

3.3.2. Land Use Optimization Strategy

The delayed water body can effectively improve the construction performance of the sponge city. The natural rivers and lakes or artificial excavation should be used as much as possible in the planning, but at the same time, the water density of the urban river network should be reasonably improved.
In the drainage planning, the rainwater should be discharged into the natural water body as soon as possible; when the funds are allowed and the planning is feasible, the rainwater pipe diameter should be increased as much as possible, and LID technical measures should be introduced;
Urban planning does not necessarily pursue high green rate; in the layout of green space system, centralized layout and decentralized layout have their own advantages and disadvantages.

4. Research Results and Applications

4.1. Theoretical Results

There are mainly two theoretical results of this research: preliminary exploration of the performance evaluation method of sponge city construction based on land use planning perspective and empirical research, through the specific indicators of sponge city construction performance evaluation, and the application of sponge city construction performance evaluation model to form a set of methods to quantify the performance of sponge city construction, making the study of sponge city more rational; This paper propose a strategy to improve the performance of sponge city construction based on the perspective of land use planning.

4.2. Research applications

This paper focuses on the urban planning stage of sponge city construction, focusing on the overall planning land use planning level in urban planning. Through the construction and operation of the simulation model, this paper try to propose a method that can quantify and evaluate the performance of sponge city construction, and analyze it. The optimal scheme is selected through this method. This paper proposes a strategy to improve the performance of sponge city construction based on the perspective of land use planning, which can be used to optimize the scheme of the design stage of land use planning.

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Investigation of Regional Coordinated Development Based on Watershed Comprehensive Management for Greater Beijing Region

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Abstract:

This paper is to provide a feasible plan for the ecological and economic coordinated development of the Greater Beijing Region in the predictable future by comprehensive management in ecological watershed units. In order to solve the problems of economic development and ecological protection and prove its feasibility, we would like to point out the following aspects for the relevant department to pay attention to: 1) we would like to break the regional boundary and establish a comprehensive management unit with natural basin as a partition; 2) we would like to develop different development patterns according to the different potential of the small watershed unit. To answer for this need, we have brought about the small watershed unit development model based on the following four systems: the water environment system, the leading industrial system, the urban system and the traffic system. In conclusion, it is of primary importance to capital's ecological barrier by coordinated development of the economic and ecological in West Beijing Corridor.

Key words: Regional Comprehensive Management; Watershed Comprehensive Management; Small Watershed Unit; West Beijing Corridor; Ecological Security

(Supported by Beijing-Tianjin-Hebei space planning series of courses in School of Architecture, Tsinghua University)

1. Introduction

1.1 Background

The Greater Beijing Region has entered the process of world urban development due to its special status, rapid population growth and economic and social development, and is now forming a world urban special zone. In recent years, Beijing and its surrounding areas (especially in the northwest) have begun to suffer from such ecological and social problems as bad atmospheric environment, shortage of water resources and unbalance of economic development. There are ecological barriers around the world's megacities. For Beijing, the western area of the Greater Beijing Region is located in the buffer zone between North China Plain and Inner Mongolia Plateau, where a natural valley corridor lies. The valley corridor in the western area of the Greater Beijing Region (hereinafter referred to as "the West Beijing Corridor") is on the Windward and Upstream side of Beijing, where most of the Yanghe River Watershed flows through.

The urban belt in the corridor is highly related, but its economic development levels are far apart. Taking Zhangjiakou (the city which Yanghe River Watershed mainly flows through) as example, the analysis results show that the per capita GDP of Zhangjiakou ranked ninth in the 11 cities of Hebei and was 28.8% of the per capita GDP of Beijing in 2017(Zhu et al., 2017). Approximately 21% of the Greater Beijing Region has encountered water shortage problem, and the groundwater resources are seriously consumed. The region is in urgent need of water resources. Miyun Reservoir and Guanting Reservoir are two important reservoirs in Beijing, of which 96% of the Guanting Reservoir is derived from Yanghe River Watershed. 40% area of the two major reservoirs is in Zhangjiakou. Yanghe River Watershed is an important water conservation area, and its ecological environment is directly related to the ecological security of Beijing's water source.

1.2 Study Area

The Greater Beijing region includes Beijing, Tianjin and Hebei province generally, but the surrounding areas of Beijing tend to be regarded as “Poverty Belt Around the Capital City” with Zhangjiakou city, Chengde city and part of Baoding city in it as most of the Poverty Counties are in that belt. the uncoordinated development is considered to be the biggest contradiction in the Greater Beijing Region, which is an important background factor for the whole study.

Especially in the northwestern part of the Greater Beijing Region, it also assumes the function of ecological barriers of the capital, so that the economic development of the part is restricted. The northwestern part of the Greater Beijing Region is an area of concentrated contradiction between ecological protection and economic development, where is the study focus.

The West Beijing Corridor is the core zone of Yanghe River Watershed which belongs to Haihe River Basin as the major groundwater source for Hebei Province, which is the key area of the study.

Guanting Reservoir is located downstream of Yanghe River Watershed, at the junction of Beijing and Hebei province, which act as an important water source of the Greater Beijing Region. The management of the small watershed unit that Guanting Reservoir lies in is a typical case of the comprehensive management of inter-governmental watershed.

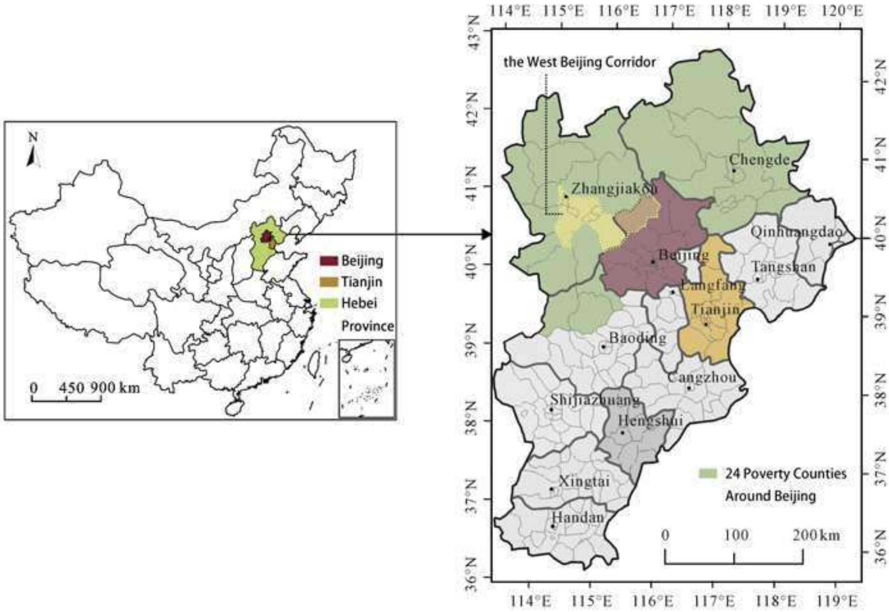

Figure 1: Location map of the Greater Beijing Region, Poverty Belt Around the Capital City and the West Beijing Corridor within the Administrative Area

Source: drawn by the author with modified base map from Zhu,2017.

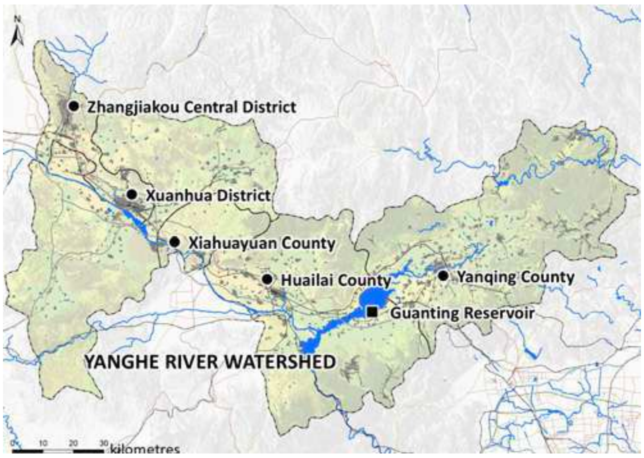

Figure 2: Yanghe River Watershed in the West Beijing Corridor within the Administrative Area

Source: drawn by the author with modified base map from Google Map.

2. Necessity Demonstration of Comprehensive Watershed Management

2.1 Empirical Study on Integrated Watershed Management

Since the 1930s, many transnational or cross-administrative rivers such as the Tennessee River, the Mississippi River, the Blackstone River, the Volga River, the Thames River, and the Amazon River have all undergone comprehensive rectification and development and have achieved great achievements (Wang, 2010). The initial motivations for water environment management in these basins are inconsistent, either for the distribution of water resources, for the treatment of water pollution, or for flood control, but the successful experience of watershed management in river basins provides a consistent inspiration. The first is to establish a unified management organization and ensure its authority through relevant legislation; the second is the coordination of overall interests and local interests.

The integrated management of the Tennessee Valley in the United States originated in 1933.The promulgation of the TVA Act resolved the most important issues in energy, environmental management and economic development, such as power generation, flood control and reforestation, and has now formed a comprehensive watershed management and sustainable development goals. Since the establishment of the Tennessee Valley Authority in the 1930s, the hydropower project, the nuclear power station and the development of clean energy, the social and ecological environmental benefits of the area are all upholding a sustainable and dynamic development view (Tan & Wang, 2002). It gives us three inspirations: (1) to establish a comprehensive watershed management organization; (2) to change the way resources and environment development, focus on the improvement of resource and environment use efficiency, control population growth within the region, and change from extensive to large It is a fine type; (3) to avoid the “path dependence” of river basin development, change the phenomenon of single heavy industry development as the main body, and advocate industrial diversification.

The planning of the Black Rock River Canyon in the United States is a typical of natural corridors development mode. Blackstone River Gorge has good resource condition, and the industrial sites and cultural relics have shaped the uniqueness of this place. In the special management plan "Reflecting on the Past, Looking to the Future", specified the objectives of interpreting history, educating the citizens, balancing heritage and economic development, and promoting the revitalization of the basin, which will develop in the three periods are short, medium and long under the big development goals (Wang & Sun, 2001). Its inspiration lies in the key nodes along the river research and development, the restoration and reconstruction of the river structure, the encouragement of cultural festivals and exchanges, setting development goals in stages, and the full use of the social and economic value of natural resources.

2.2 Requirements of Integrated Development of the West Beijing Corridor

Starting from the comprehensive watershed management is of great necessity to improve the regional integration. From the perspective of the corridor itself, the continuous Yanghe River valley is connected in series with every important city on the West Beijing Corridor. Every aspect of the problem must be solved through comprehensive watershed management.

Firstly, at the ecological level, there are problems such as lack of water resources, poor water quality, and imperfect water resources compensation mechanisms.; Grazing causes a large number of grassland and forest vegetation to disappear, resulting in hydraulic erosion of soil and desertification. Although recovery has begun in recent years, the overall ecological environment condition is still lower than the policy target. To maintain soil and water and make good use of the high-quality ecological resources in the corridor, we need comprehensive watershed management. Secondly, at the level of industrial economy, the existing ferrous metal industry, traditional electric power, and chemical industry in Zhangjiakou have greatly damaged the water quality of the watershed (Hebei Province Government, 2016). However, from the economic perspective, the West Beijing Corridor is still in relative poverty. To achieve industrial transformation and economic development on the basis of ecological conservation, we need to solve it from the overall perspective of the watershed. Thirdly, at the cultural level, starting from the Qin Dynasty (221-206 BCE) as a passageway for the people, the Ming Dynasty (1368-1644 AD) as a part of the Zhang-Ku Avenue, the West Beijing Corridor has superimposed the culture of different historical periods on it, forming the multicultural context of the Corridor, which influenced the development of settlements point in the valley. To carry out unified development and avoid homogenous development and vicious competition also needs to be solved from the overall perspective of the watershed.

In conclusion, most of the problems in the West Beijing Corridor are centered on Yanghe River Watershed, and It cannot be solved in a single administrative area. Therefore, comprehensive watershed management is chosen as the focus of regional planning.

2.3 The West Beijing Corridor Development Prospects

The sustainable development commitments at the global level, the coordinated development at the regional level, and the planning policies for water security are all relevant to the comprehensive management of the northwestern watershed in Greater Beijing Region.

Habitat III the Quito Declaration promotes the development of inclusive, safe and sustainable resilient cities actively (United Nations, 2016). *The National Development and Reform Commission's 13th Five-Year Plan* strengthens water security, promotes river system remediation, maintains basic ecological water demand, enhances water storage capacity, and scientifically implements cross-border river development and management. At the same time, it is required to improve the regional coordinated development mechanism, innovate regional cooperation mechanisms, and strengthen coordination and cooperation in inter-regions and the whole basin (the State Council of the P.R.China, 2015). *The "Beijing-Tianjin-Hebei Collaborative Development Plan"* emphasizes comprehensive management of river basin and promotes the construction of water ecological civilization. The basin and regional issues are very serious, such as the shortage of surface water in the Beijing-Tianjin-Hebei region and the water allocation in the upper and lower reaches. In the context of regional coordinated development, the sustainable use of water resources requires the three forces of the Beijing-Tianjin-Hebei, and innovation and reinforce of integrated river basin management are needed (The Political Bureau of the P.R.China, 2015).

In addition, the requirements for easing Beijing's non-capital function, the development of natural and cultural tourism around the capital region, and the construction of transportation facilities such as the Beijing-Zhangjiakou high-speed railway have brought new opportunities for the development of the West Beijing Corridor. The goal of integrated development will be achieved through comprehensive planning of the Yanghe River Watershed.

3. Development Problems of the West Beijing Corridor

The unique location advantages, the accessibility of the transportation system, the long history and the rich resource endowment have made the advantages and potential of the West Beijing Corridor. However, Zhangjiakou is within the poverty region around the capital; Ecological development and economic development are extremely unbalanced.

3.1 Protection of Ecologically Sensitive Areas Restricts Urban Economic Development

The biggest conflict of the region lies between ecological protection and economic development. There has been an increasing hidden danger for extensive development, showing low efficiency in concentrated use of lands, which has now become the restrictions of regional development. Taking regional ecological capacity into consideration, there are obvious issues concerning unsustainable resource utilization, ecological deficit, which means the current energy consumption mode needs to be urgently transformed.

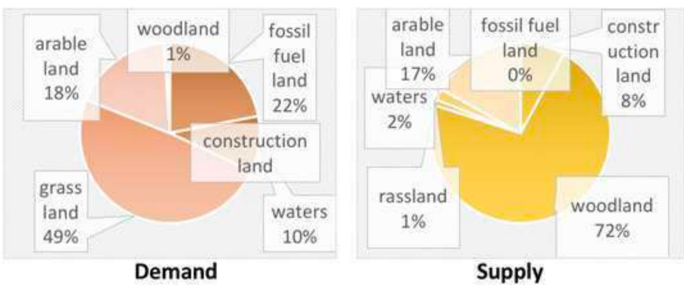

Figure 3: Water Demand and Supplyin the West Beijing Corridor

Source: drawn by the author with data source from Wu&Zhang,2011 & Dong et al., 2013.

1) The Greater Beijing Region in in short supply of water resources. As an important ecological water conservation area, the water resources management problem in the West Beijing Corridor is highlighted, with difficulties to coordinate development between regions. The West Beijing Corridor is the main water supply and the main ecological conservatory in Beijing. However, due to the water utilization mode of the upper stream area is not sustainable, the Guanting Reservoir has stopped the supply for drinking water. As a result, it is difficult to well coordinate the water resources for the Greater Beijing Region.

2) There are contradictions in the construction of Yanghe River conservancy project. It is against the regional sustainable development to carry out the rubber dam projects, or other waterscape projects which harden the riverway and hinder the migration. Slowly-upgraded sewage treatment projects are also considered improper. Located at the juncture of Beijing and Zhangjiangkou, the Guanting Reservoir enjoyed the total volume of 4.16 km3. The water volume has reduced from 1.9 km^3(at the beginning of the construction in 1954) to 0.1 km^3 (in 2015) during the second half of the last century (Zhang, 2008). Nearly 160 km^2 of water surface has been reduced to only 30 km^2 to 40 km^2(Zhang, 2008). The village around the reservoir is densely covered. The retracting lands are mostly turned into farmlands and the original plants have been seriously damaged.

3) Inefficient management of the Greater Beijing Region sand source. The regional coordination strategy requires that anti-sand barriers should be built for the West Beijing Corridor. However, there has been extensive desertification and soil erosion within the region, with the proportion of light desertification being 35% (Wang, 2012).

4) Ecological barrier is faced with soil erosion. The expansion of urban construction lands has become contradictory for the protection of forestry lands and basic farmlands. Smart growth of urban construction lands is still to be explored and the proper layout for farming and forestry land is still to be optimized. The overland runoff is not sufficient, showing serious consumption of underground water and unsustainable of water resource application.

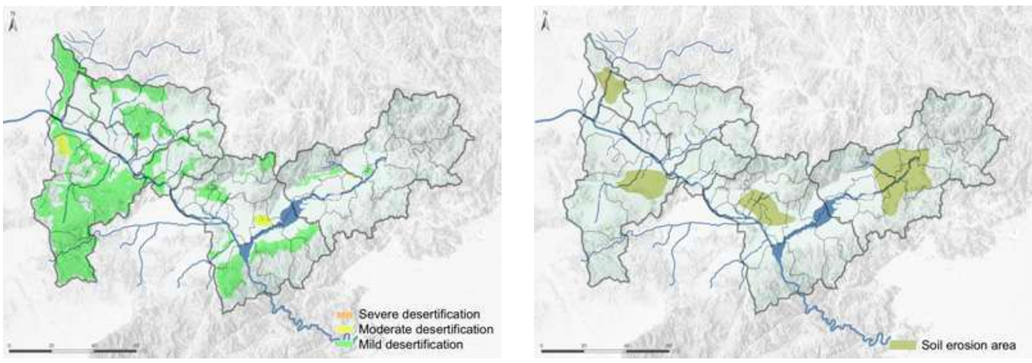

Figure 4: Desertification and Soil Erosion State in the West Beijing Corridor

Source: drawn by the author.

3.2 Imbalance of Urban Development to be Coordinated

There has been an imbalance development of the urban nodes in the West Beijing Corridor, showing a distinct trend for homogeneous development. The exploitation and utilization of resources is not intensive and there lacks communication and coordination between neighboring nodes. The current urban system is scattered, the population agglomeration effect cannot be being achieved well. Most villages are faced with poor geographical conditions and belong to ecological protection areas. Besides, the upper stream of Yanghe River is mostly for agricultural use, while the middle stream for industrial use and the lower stream for both industrial and agricultural use. Most of the industrial and urban life sewage has been discharged to Yanghe River, manifesting the conflict between human activities and the sustainable development of the waters.

1) The limitation of government's rights and obligations due to the administrative borders. The division of administrative units restricts the overall development. It is difficult for the government of these divided units to well communicate with each other and there lack effective ways to solve regional conflicts. the West Beijing Corridor should be considered as a complete district to solve the problems including aging, relatively low labor quality, hollowing villages and population loss, etc.

2) Industrial extensive development consumes much energy and water. The industrial parks which are based on black metals and traditional electricity and chemical support are of high consumption of water and energy but low output value, causing soil and hydrological environmental pollution and the incompatibility with current water resources. The sewage discharge and water resource consumption lead to water quality damage and the water level decline and water area reduction, so there will be a shortage for underground water resources.

3) Low efficiency in agricultural development leads to massive pollution. As the urbanization drive proceeds, there will be increasing pressure asserted by agricultural pollution on the waters of the river. The scattered villages have posed challenges when it comes to the concentrated management of farmlands. The infrastructure processing sewage in the villages and towns is weak. Without proper treatment of swage of life and production, the water resources have been severely polluted.

In conclusion, the traditional mode which considers the administrative units separately ignores the importance of regional interactive development. The separation of administrative units cannot be disconnected geographically. The Yanghe River Watershed is a complete eco-system and the rights and obligations for this area is difficult to be defined for different administrative units.

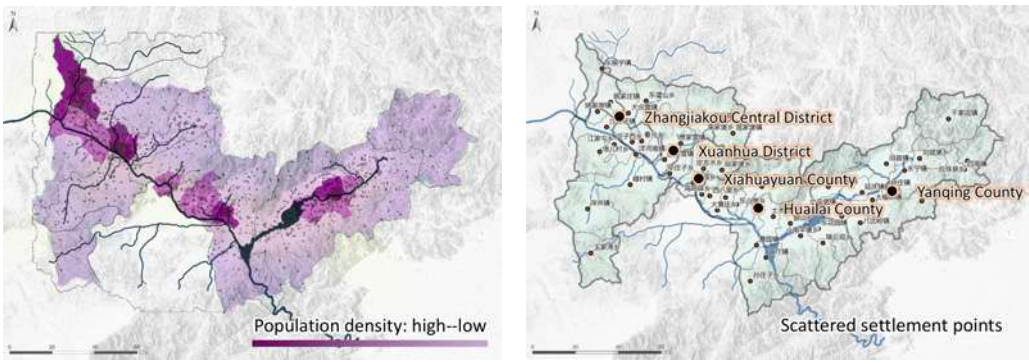

Figure 5: Population Density and the Scattered Settlement Points

Source: drawn by the author.

4. Exploration on the Comprehensive Development of Small Watershed Units

Water-shortage is the core issue of the development of the Yanghe River Watershed. It is of practical significance for disharmony between regions and realizing the coordinated development of river management, industrial layout, agricultural layout and urban construction by breaking through the administrative boundary and coordinate administrative interval cooperation with "small watershed" as a unit.

By applying the theory and method of watershed ecology, the water gathering ground of the river surrounded by the divide line is subdivided into nine watershed units. According to per capita ecological carrying capacity, it is estimated that about 1.725 million people can be carried in the watershed; And now there are 1.888 million people existed in the watershed, in order to ensure the sustainable development, it is necessary to guide and control the population distribution in the watershed properly.

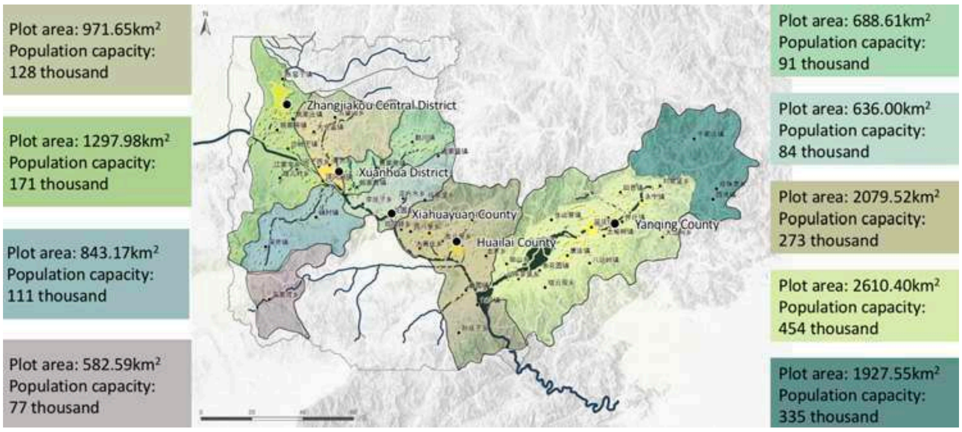

Figure 6: Population Capacity of Each Small Watershed Unit

Source: drawn by the author.

In terms of management strategies in small watershed units, the foregoing mid-term and long-term program in further is divided into two aspects: respectively the management of water environment and the planning of the space. On the management of water environment, practical action plan is supported by administrative system, and space planning based on watershed environment after renovation is fully implemented which involves urban system, cultural tourism resources and the industrial layout etc.

4.1 Water Environment Management

On the management level, in the cross-region comprehensive management of Yanghe River Watershed, the concept of "Watershed Circle" should be established, as well as at the level of Beijing and Zhangjiakou government cross-region comprehensive control department should also be established. Taking the small watershed as a management unit, under the mutual participation of Zhangjiakou and Beijing government, enterprises and the public, in the use of means of administration, market and law, coordinating, systematic, and sustainable management has been applied to well coordinate the resources in the small watershed units, so as to promote the coordinated development in the watershed as a whole.

The policy of "River Leader System" should be implemented, and the main person in charge of the party and government of the main watershed unit should hold the post of “River Leader”, who shall be responsible for the treatment of river pollution. River Leaders should coordinate to deal with the regulation problem of trans-boundary watersheds unit to achieve the division of responsibilities and rights. In addition, the comprehensive management mode of watershed units requires the synchronization of urban river regulation and urban development. Taking the river as a whole system, the management of upstream and downstream, main flow and tributaries are taken into account comprehensively, hence realizing the effective regulation of the whole Yanghe River Watershed.

When it comes to techniques, on the basis of ecological sensitivity factors, the status of towns, villages residential areas, water bodies, nature reserves, and farmland should be combined to obtain the construction suitability evaluation; and by drawing ecological red line, clear define and standardize the range of construction and development. According to land use assessment, on the premise of present distribution situation of towns, village farmlands, reservoir and protection zone, five types of areas are divided, including town construction area, farm area, tourist area, protected area, and key protected area. Also, there will be requirements related to the construction and activities of each area. Among them, protected areas accounted for 68.98%. Through the planning and improvement of agriculture and forestry, changes in land use have increased the area of woodland to achieve the ecological functions of wind prevention, soil fixation and water conservation.

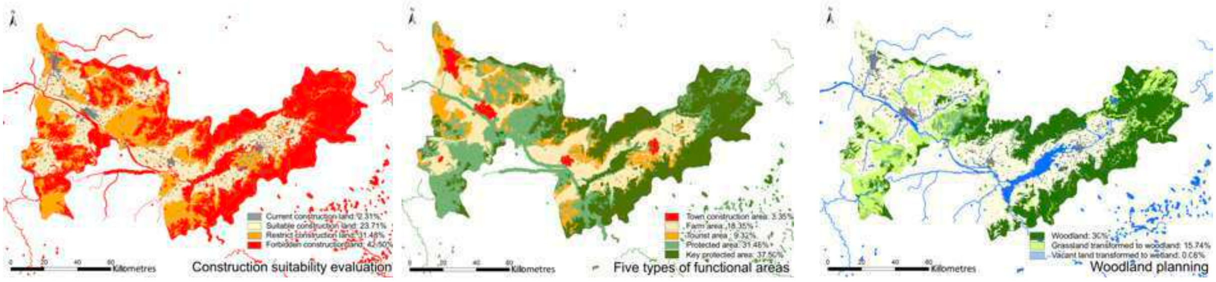

Figure 7: Construction Suitability Evaluation, Five Types 0f Functional Areas and Woodland Planning

Source: drawn by the author.

In terms of rural source pollution control, the technology of sprinkler irrigation, drip irrigation and micro-irrigation should be taken, and make effective utilization of water resources reasonably, choose good, less water-intensive crop varieties, reduce the planting area of high water-intensive crops. At present, settlement points located around the Guanting Reservoir watershed unit generally adopt the old flood irrigation method, which result in the relative serious waste; The reduction potential of pollutants in the corresponding planting industry mainly comes from the scientific and reasonable use of pesticides and fertilizers. Measures should be taken to improve the utilization rate of fertilizers by soil testing and formulated fertilization and changing fertilization methods. Adjust the planting structure to prevent the pollutants flow into the water.

Build a perfect ecological system, improve the effectiveness of protection, protect the diversity of regional species, and form the landscape pattern with characteristics.

4.2 the Layout of Leading Industries

Integrated watershed development needs eliminate high-energy and high-pollution industries such as black metal mining and processing, traditional power supply and chemical products manufacturing in the watershed, optimize and upgrade traditional leading industries such as manufacturing of specialized equipment, food, general equipment and tobacco, and foster new industries such as new energy and automobile manufacturing. The development model is the combination of production, study and research and industrial agglomeration. In this way, the four major industrial agglomeration areas will be formed. Zhangjiakou Central District and Xuanhua District in upstream is focused on manufacturing industry; aerospace equipment and environmental protection industry develop in Huailai District in middlestream; and new energy resources develop in Yanqing District in downstream. Finally, according to the water supply in the watershed, the location and area of the current industrial park in the watershed will be adjusted respectively. The main trend is area reduction.

Moreover, construct multiple and compound ecological leisure roads and provide diversified choices for different types of tourists and residents. Build four travel lines of hundred-mile galleries, Great Wall leisure lines, Beijing-Zhangjiakou railway and the green road along the Yanghe River in the watershed, and form differentiated leisure areas run through by ecological recreation corridor. Differentiated functional status promotes the integrated development of the whole watershed.

4.3 Urban System Planning

Combine urban development potential with the conclusion of the ecological carrying capacity, three types of small watershed units would be divided, respectively the integrated development watershed units, the coordination of urban and rural ecology units and natural ecological conservation units, and on account of three types of small watershed units, respectively the measures of optimizing and improving quality, the coordinated development and ecological protection are proposed.

On the basis of classification, the development function of central settlements inside the watershed units should be further cleared. Yanqing District in downstream as international tourism and leisure area, Huailai District in middlestream as the important transport junction in the west area of Beijing, Xiahuayuan District in middlestream as regional culture tourism city, Xuanhua District in upstream as the famous historical and cultural city, and Zhangjiakou Central District in upstream as the finance and information center in the northwest area of Hebei Province, will be realized. That will achieve differentiated linkage development. Based on the areas mentioned above, the development structure of connecting watershed units is determined by using the landscape system pattern and realize the interconnection and interaction of core nodes, and symbiotic mode of harmonious development of the upstream and downstream watershed units.

The combination model of central-cities +key-towns + general-towns is adopted in the development of watershed units. Efforts are taken to encourage the clustered linkage development of key-towns, as well as to perform appropriate tourism development projects and attract foreign business and investment, motivating the industrial development. In general-towns, the increase of land use should be strictly restricted, promoting environment-friendly recreation and ecological education, and encouraging non-permanent and non-development projects.

In conclusion, the land use pattern should be further optimized in terms of land layout, with emphasis on regional coordination and comprehensive development inside watershed units.

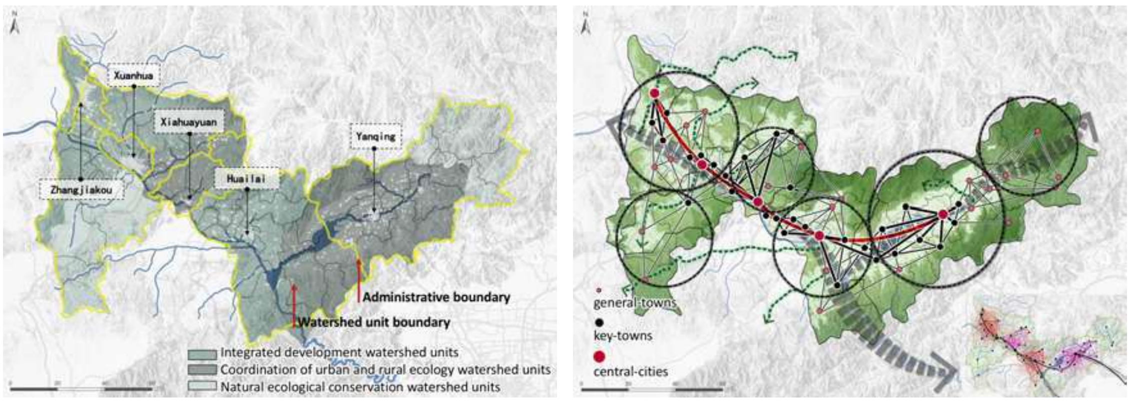

Figure 8: Devided Small Watershed Units and the Guanting Watershed Unit Town Development Mode

Source: drawn by the author.

5. Exploration for Small Watershed Units---Taking the Comprehensive Management of Cross-Border Watershed Around Guanting Reservoir as Example

Guanting Reservoir is an important water source in the capital area. According to the administrative boundary division, 70% of it is in Zhangjiakou and 30% in Beijing. As Guanting Reservoir and its surrounding area are faced with serious water pollution, it's necessary to consider the development within the complete watershed unit. To coordinate the two administrative regions from the perspective of watershed units is of great significance to the protection of water source area and the construction of water source conservation area.

Figure 10: Different Boundaries by Administration and Watershed Unit

Source: drawn by the author.

In the integrated planning of the watershed units, the development of Guanting Reservoir is positioned as a regional ecological leisure area, where the tourism service industry has been mainly developed with many green industry demonstrations. In this watershed unit, the impact of major events brings opportunities. The 2022 Winter Olympics promotes the gathering of ski resort and other tourist service facilities, and the 2019 Garden Expo will accelerate the construction of landscape ecological corridor along the river.

From the perspective of ecological carrying capacity of the watershed unit, the current population in the watershed unit has not reached environmental saturation yet. However, except for the dramatic increase of tourists caused by major events, there is still much less space for growth. In the aspect of ecological development, firstly, it's necessary to form ecological corridor system in the watershed unit based on regional national forest park, forest green land, river ecological green space around Guanting Reservoir, and the urban inside green space, as well as to supply the channel for the migration of wildlife in the watershed unit. Secondly, the management mechanism of the overall watershed unit should be improved by implementing the systematic supervision of the boundary greenbelt, riverbank boundary facilities and sewage treatment at the administrative boundary. The sustainable development of water resources can be realized through integrated management of water pollution from upper stream, middle stream to lower stream. According to different geographical features, the upstream urban development area is the concentrated location of the reservoir, and the sewage is treated in a belt and plane shape; The middle stream urban development area is also the downstream area of the reservoir, which is treated with belt-shaped sewage; The downstream is the non-concentrated area of the township for the treatment of point-shaped sewage.

In the aspect of policy, ecological compensation measures should be perfected. It is recommended that the central committee and the Beijing municipal government should provide compensation to relatively poor cities such as Zhangjiakou to alleviate the limitation of economic development caused by the development of ecology from two aspects: capital and resources. Meantime, the appraisal system should be established to achieve a relatively equitable distribution of benefits.

6. Conclusion

Comprehensive watershed management emphasizes that in the process of developing and utilizing water resources, it is necessary to adhere to the organic combination of two values. On one hand, it must serve the purpose of economic development; On the other hand, it must maintain the basic ecological balance of the watershed. For this purpose, comprehensive watershed management must break through the barriers of administrative divisions. The upper, middle and lower streams of the Yanghe River Watershed should be comprehensively managed based on their different water environment issues to achieve the goal of ecological-production-life integration development from the whole watershed. This can also change the current development model of the government. Comprehensive watershed management is not just a regional master plan. It should also be subdivided into the various urban and rural settlements. The division of small watershed units makes the problems of various parts more detailed, thus realizing the implementation of watershed planning and a sustainable living environment that meets the needs of the Greater Beijing Region.

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Urban New Districts' Toughness Development under The Sponge Infrastructure Project: The case of Jinan, China

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Abstract

In recent years, worldwide extreme weather is constantly appearing. The extensive development and construction of cities had changed the original water system that caused the frequent occurrence of urban water disasters and the worsening of the water environment until the planning and construction of the Sponge cities vigorously promoted in China that the problems with urban water systems were gradually easing in 2014. In this paper, through four points of view are ecological toughness, technical toughness, social toughness and economic toughness that make a scientific top-level design of Sponge city construction. Meanwhile, it points at three key problems as the urban flood control and drainage, regulation of diffuse pollution and utilization of rainwater resources in an urban tenacity development perspective, based on the key points as the simulation technology of urban rain and flood and the LID optimization technique method to discuss the technical methods for supporting the implementation of Sponge cities. According to the Sponge city construction in the new area of pilot cities - The conceptual planning of the sponge city in the extension area of Jixi in Jinan city as the research case; put forward the planning strategies of ecological pattern construction, systematic planning and c onstruction guidance of the sponge city in system, also explores the extended industrial development and the construction of tenacity mechanism of the Sponge city that attempts to provide a new thinking and path for the study of the sponge city planning and construction.

Keywords: Sponge City, New Urban Districts, Toughness Development

1. Background

The promotion of "new normal" accelerates the pace of urban transformation and development, which makes its development demand shift from "scale and quantity" to "efficiency and quality". The construction of the extensive development of the city has changed the original water system of the city, and the problem of water system in the city has become increasingly prominent. Since 2014, China has vigorously promoted the construction of sponge city to solve the problems related to urban water environment, water ecology and water resources. Experts, scholars and relevant administrative departments in the field of urban planning and construction have made many useful attempts and explorations in the planning and research of spongy cities.

In order to enhance the resilience of the city, several pilot projects have been set up in China to carry out the construction. Unfortunately, 19 of the 30 sponge City trials in China appeared water logging in 2016, which led to various controversies in the civil and academic circles. At the same time, it is found that the research scope of the pilot sponge city is limited by the sort out and review of various problems in the process of the planning and construction of the domestic sponge city. It often ignores the top-level design problem of sponge City, especially for the study of water system planning in larger scale regions and cities (Zhao zhiqing, Wu Zhongyang & Wang Zuowei, 2018). Under such circumstances, the construction of sponge city under the guidance of urban resilience thinking is particularly important.

However, most of the research focuses on the planning and construction of spongy cities. They are more inclined to specific municipal engineering measures, and the focus is to solve the problem of urban water logging (Wang C H, Blackmore J M, 2009). Therefore this paper puts forward the top layer design of the construction of the planning strategy of the spongy city by taking Jinan Jixi extension area as the research object, taking the problems arising in the process of the planning and construction of the sponge city as the guidance, and through the methods of urban flood defense and drainage, the control of non-point source pollution and the resource utilization of rainwater (Shao Yiwen, Xu Jiang, 2015).

2. Methodology

2.1 Range of Study

Jinan was selected as the first batch of sponge pilot cities in 2015.It selected the old city area of 39 square kilometers in the central area as the pilot area of sponge city construction (Fig.1). The scope of this plan is to select the JiXi wetland, Emei area and West Railway Station area in the western part of Jinan as the demonstration area for sponge city construction. The conceptual planning is the top-level design of sponge city. It is a commanding plan in the implementation process of the spongy city planning and construction in JiXi extension area, and provides the top level positioning and technical support for the follow-up control detailed planning, construction detailed planning, construction management, acceptance and maintenance work (Zhao zhiqing, 2016).

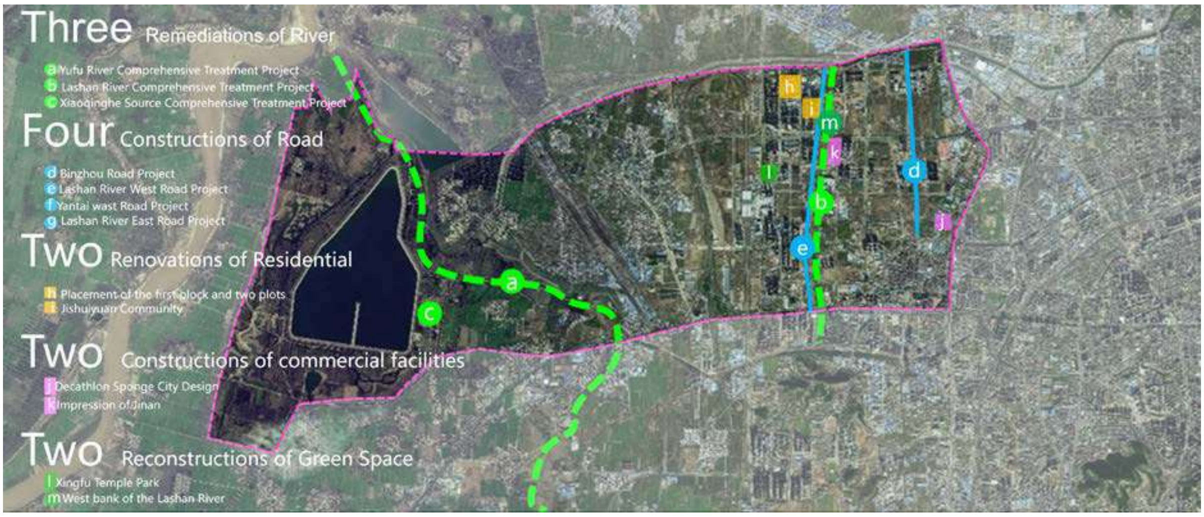

Figure 1: Current status of existing projects
Source: graphing by author

2.2 Situation Questions

(i) The utilization rate of unconventional water resources is low. The regeneration and utilization of sewage has not yet formed a complete system, and the utilization of rainwater resources has just started. There are only rainwater collection and utilization facilities in some housing estates, such as Ji Water Royal Garden District, Forest Landscape Villa district and part of the street.

(ii) There is a hidden danger of water logging in JiXi extension area. The data show that there is no water accumulation point in JiXi extension area, but its rainwater pipeline system is not perfect, the recurrence period is less than 2 years. The poor scheduling of the construction of rainwater pipe network in the west station area and the unsound pipe network in Emei area have hidden dangers of water logging.

(iii) The sewerage network system has not yet been constructed in Emei area. The effect of the direct discharge of sewage and the non-point source pollution result in poor water quality of the Mount Emei River and its downstream Small Thanh Ha. The non-point source pollution of urban water and rainwater surface runoff is more serious.

(iv) The ecological nature of a few river course shoreline is not good. The maintenance of the ecological nature of Small Thanh Ha, La Mountain River and Jade Character River is good. There is no maintenance measure for Mount Emei river bank line, so ecological shoreline restoration is needed.

(v) The risk of flood disaster is low, and the prevention and c ontrol system needs to be improved. On the south side of the Jinxi extension area, there is a flood by-pass of the La Mountain River. It introduced the flood upstream of the Small Thanh Ha into the west to the Yellow River river system and reduced the potential flood hazard. However, the rainstorm in Jinan is characterized by heavy rainfall, high intensity, obvious locality and very concentrated time history distribution. It should strengthen flood control and improve the resistance to flood disasters in the JiXi extension area (Bates S, Angeon V., Ainouche A., 2014).

2.3 Urban Toughness

Resilience thinking can solve various problems in the construction of sponge city with a new research angle, and construct a more stable urban ecological pattern from a macro perspective in order to solve the problem of poor systematic and single research scale (Adger, W. N., 2000). It establishes the overall framework of the sponge city construction system with the ability to deal with the rain and flood risk from the meso scale, and makes the construction of the sponge City collaborate highly with the special planning between the other urban subsystems, which enhance the integrity of the construction project and make it no longer blindly rely on the facilities to solve the water system problem (Bai, X., 2007). It builds the facilities of the sponge city from the micro scale, and at the same time deploys and promotes the implementation and management of the construction of the sponge city, in order to enhance the stability of the economy and control of the sponge city. The following will be di scussed from four perspectives of resilience: ecology, engineering, economy and society (Fig.2).

Tenacity Thinking		Spongy City	Approach	Planning Concept
Ecological toughness	Water system toughness	Water ecology, water environment and water safety planning	Water area control and protection, water pollution control, flood control and drainage facilities planning, "Matrix -- corridor -- plaque" protection strategy	**Dominant recessive combination**——Basin perspective; surface and underground;
	Tenacity of green space system	Construction of urban green space system in sponge City	In the low-lying area of the city, sponge type green space is set up. Retention infiltration green space, Midway transmission type of green space, receiving storing type of green space.	
Technicial toughness	Technical toughness	Planning of municipal rainwater, sewage and water system	Introduce advanced pipe network system and perfect the current system	**General and special combination**——Normal rainfall and extreme climate co-ordination; flood detention, flood diversion and flood discharge co-ordination;
		Revetment improvement and rainwater utilization	Restoration and protection of ecological coastline	
	Measurement toughness	The control index of land use runoff in each block	Quantitative index control	**Micro control and global idea**——The index is refined to the plot, the unit is divided into control thinking, and the promotion area is balanced.
Sociology toughness	Management toughness	Construction management and control	Set up a sponge city management team and set up an expert think tank.	**Resource integration**——Mutual support and interconnection ensure the common operation and rapid response among departments.
	Synergistic toughness	Public participation	Coordination of governments at all levels, neighborhood organizations, community organizations and private sectors	**Cooperative inclusion**——Further develop professional subregional network to achieve the common vision of building resilience cities
Economic toughness	Potential toughness	Planning scheme of extension industry in sponge City	Sponge city culture tourism, sponge City Culture Exhibition	**Layers of progressive**——From building monomer, green space, street to functional area unit, the urban culture and industry will be improved comprehensively.

Figure 2: The Type of Toughness Development
Source: graphing by author

2.4 Data Specification

According to the DEM elevation and landset8 satellite remote sensing image data provided by the local survey service, it has carried out the analysis of the area on the slope, elevation, vegetation cover and heat island, and locked the main aggregation area of the site problem. Local rainfall data are derived from local Yearbook chronicles. In order to ensure consistency of the research foundation, these data sources chose the same year to minimize the possibility of invalid data as far as possible.

2.5 Statistical Analysis

The rainfall pattern in Chicago is composed of the maximum rainfall intensity of different duration under a certain recurrence period. The determination of rain pattern is based on the IDF relation curve at a specific recurrence period. The determination of the rainfall pattern in Chicago includes the determination of the comprehensive rainfall peak position coefficient and the determination of the rainfall graph model in Chicago (Trinh D, Chui T.,2013).

(i) The annual maximum rainfall process samples of the every duration of rainfall were segmented at intervals of 5min to calculate the rainfall peak position coefficient $r_i = t_i / T_i$ (r_i is the peak position coefficient of the rainfall, t_i is the peak value time of the rainfall , and T_i is the duration of rainfall.

(ii) First, it carries on the arithmetic average of the rain peak position coefficient of the annual maximum rainfall process samples of the every duration of rainfall, then weighted average of each diachronic peak position coefficient according to the length of each diachronic time and calculates the comprehensive rainfall peak location coefficient *r*.

(iii) It designs the rainfall recurrence period (*P*) and the duration of rainfall (*t*) based on the comprehensive rain peak position coefficient *r*, and substituting it into the rainfall pattern in Chicago derived from the rainstorm intensity formula to calculate the instantaneous rainfall intensity before and after the rain peak and the average rainfall intensity in each period. Thus, the rainfall pattern in Chicago corresponding to a certain recurrence period and the duration of rainfall is finally determined.

The rainfall pattern in Chicago makes the design of typical rainfall process based on the statistical rainstorm intensity formula. It describe the time when the peak of rainstorm occurs by introducing the rain peak position coefficient *r*, and divides the time series of rainfall duration into two parts: pre peak and post peak. The instantaneous intensity of the pre peak is $i(t_b)$, the corresponding duration is (t_b), and the instantaneous intensity of the post peak is $i(t_a)$. The corresponding duration is (t_a).The instantaneous rainfall intensity before and after the rain peak can be calculated by the following formula：

$$i(t_b) = \frac{A[\frac{(1-n)t_b}{r} + b]}{[(\frac{t_b}{r}) + b]^{n+1}}$$

$$i(t_a) = \frac{A[\frac{(1-n)t_a}{1-r} + b]}{[(\frac{t_a}{1-r}) + b]^{n+1}}$$

3. Results

3.1 Basic Data Analysis

The overall topography of the area shows the South High and North low . The altitude of the south side of the site is mostly between 30-35 meters, while the altitude of the most other areas are mostly between 20-30 meters (Fig.3). The land in JiXi extension area is relatively flat, and most of the slopes are between 0.3-5.0% (Fig.4).The proportion of the whole green space and the underlying surface of the water body can exceed 40%.The JiXi extension area has excellent natural resources and comfortable living environment (Fig.5,6).

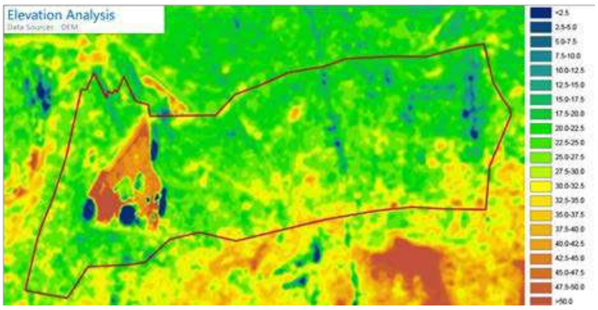

Figure 3: Elevation Analysis

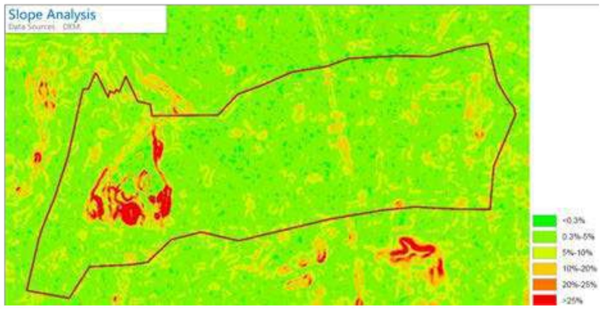

Figure 4: Slope Analysis

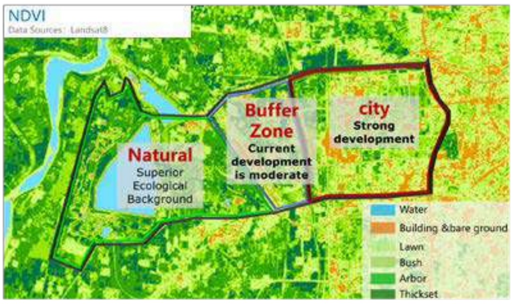

Figure 5: NDVI Analysis

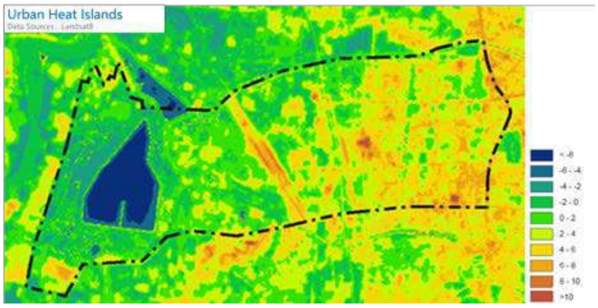

Figure 6: Urban Heat Islands Analysis

Source: graphing by author

According to the statistical data, the local rainfall has the characteristics of uneven distribution of precipitation, large variation of inter annual rainfall, seasonal variation of precipitation, and large annual average water surface evaporation. According to the rainstorm intensity formula before and after the peak, the maximum intensity of Chicago rain pattern at different recurrence periods is shown below the following picture. The maximum intensity of a 2 year rainstorm is 2.656mm/min. The maximum intensity of a 100 year rainstorm is 5.941mm/min, and the composite rain peak coefficient is 0.347 (Fig.7, 8, 9).

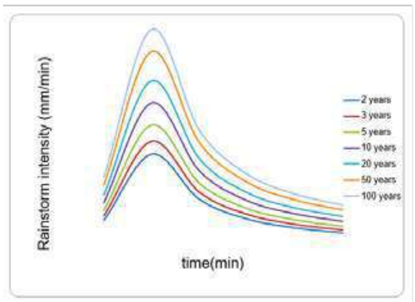

Figure 7: 30min rain pattern

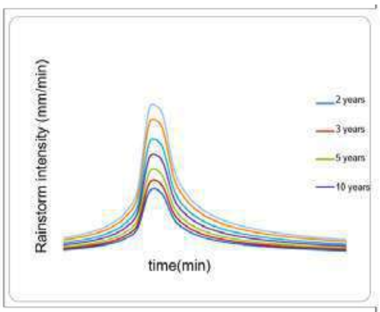

Figure 8: 120min rain pattern

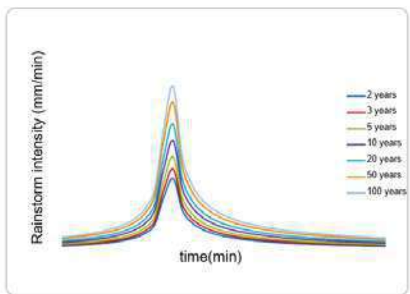

Figure 9: 180min rain pattern

Source: graphing by author

3.2 Flood Control and Drainage

The urban low-lying areas are easy to gather rainwater. Therefore, sponge type green spaces should be set up in the low-lying areas of the city to collect, store and retain rainwater. Depressions type I: water depressions. Protection requirements: coordination of general regulations and regulatory rules must be preserved. Depressions type II: waterless depressions. Protection requirements: according to the actual situation, the depressions should be used as green land, lake or other land, or construct the LID facilities (Fig.10).

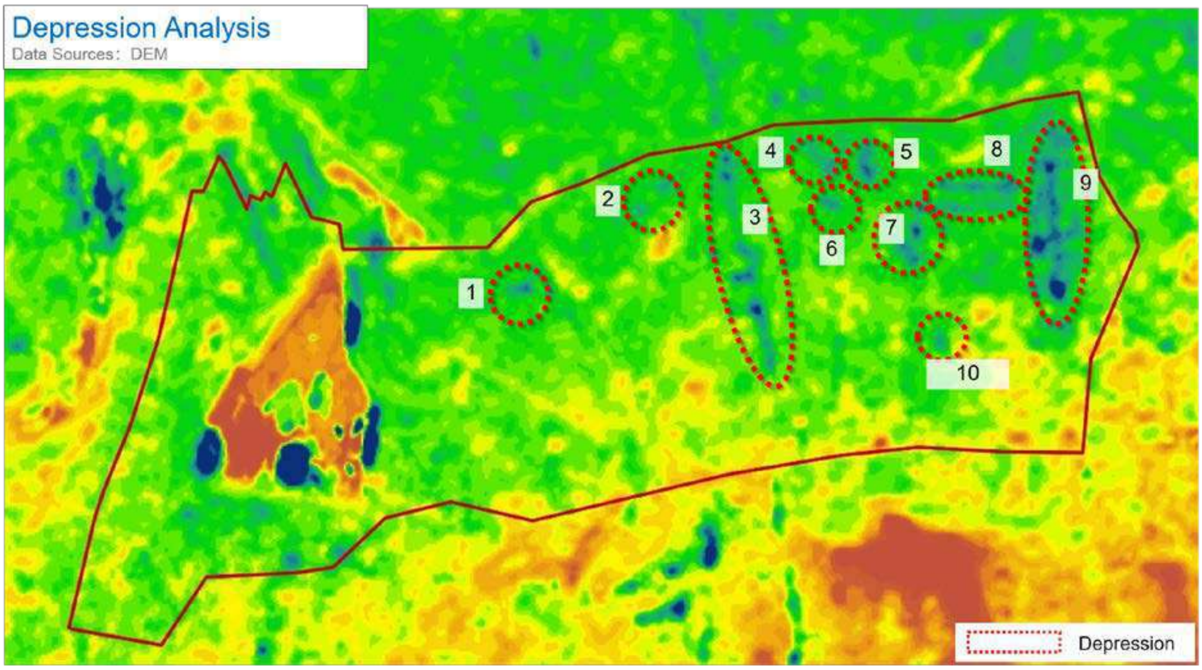

Figure 10: Depression Analysis
Source: graphing by author

3.3 Pollution Control

(i) Increase the ecological purification facilities. Setting up ecological purification facilities in streets and communities, including vegetation buffer zones, grass planting trenches and rainwater gardens, so as to beautify the environment and reduce runoff source pollution.

(ii) Perfect drainage pipe network. The current situation of rainwater network construction is not perfect. There are lots of shanty towns in Mount Emei area, and the density of rainwater and sewer pipe network is low. Part of the road which was not constructed in the West Railway Station area resulted in incomplete pipe network. The pipeline network should be constructed in stages according to the actual situation, so as to reduce non-point source pollution.

(iii) Put up the initial rain discard flow devices. In the rainwater pipeline, the initial rain discard flow device is added, and the initial rainwater is treated and discharged to the river to reduce the pollution of the rain water after washing the pollutants to the river system.

(iv) Sewage interception. Improve the sewage pipe network system, shut off the sewage straight discharge port, discharge all the sewage into the sewage treatment plant, and prevent the sewage from being directly discharged into the river water system (Fig.11).

Figure 11: Classification of Pollution Control
Source: graphing by author

3.4 Runoff Unit

In order to connect the implementation scheme of the spongy city in the JiXi extension area, and to provide support for the implementation of the follow-up construction projects (Fig.12). Facilitating the further deepening of the runoff control indexes in the construction land of the control units, the control units can carry out independent runoff monitoring (Table.1).

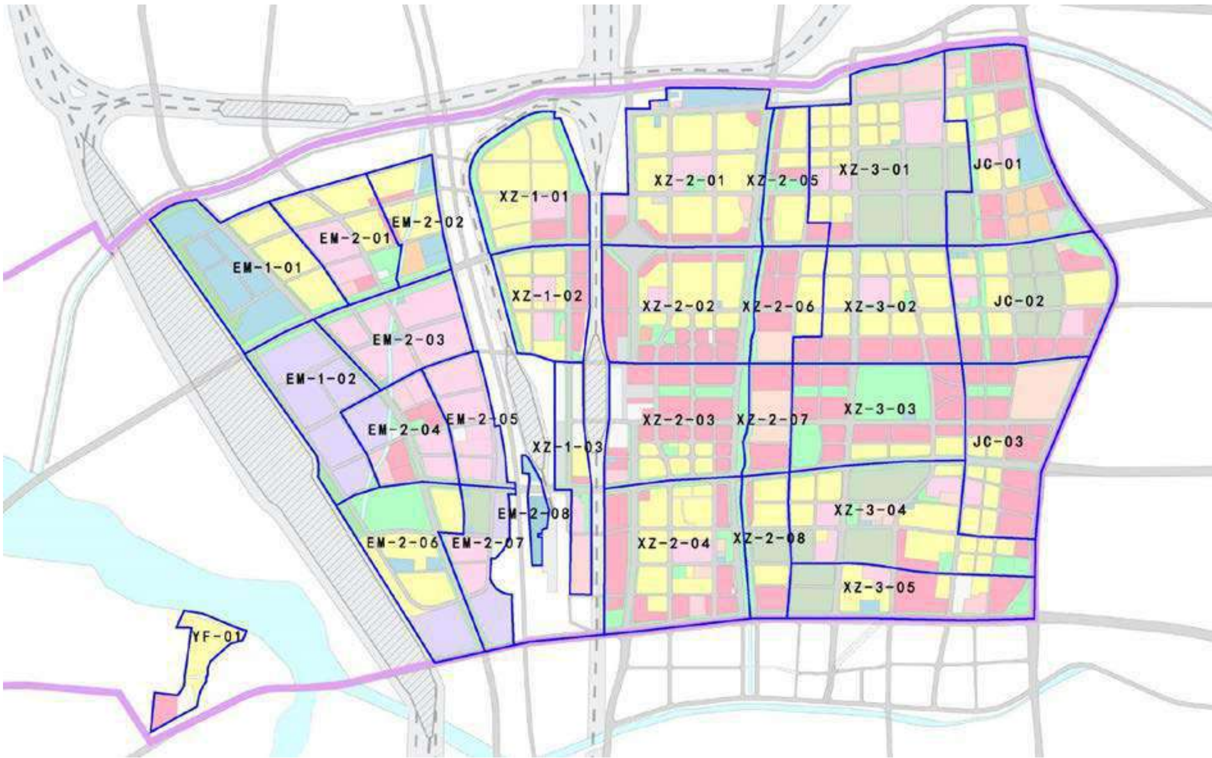

Figure 12: Control Unit of Runoff Rate
Source: graphing by author

Unit	Area(hm^2)	Annual runoff control rate (%)	Rainfall design (mm)
XZ-1-01	94.53	78%	31.2
XZ-1-02	67.00	75%	27.7
XZ-1-03	41.72	64%	19.0
XZ-2-01	161.71	60%	16.7
XZ-2-02	127.90	62%	17.7
XZ-2-03	118.70	60%	16.7
XZ-2-04	148.00	68%	21.7
XZ-2-05	46.32	72%	25.0
XZ-2-06	51.41	64%	19.0
XZ-2-07	34.55	67%	21.0
XZ-2-08	45.15	69%	22.5
XZ-3-01	177.85	68%	21.7
XZ-3-02	117.54	72%	25.0
XZ-3-03	127.95	76%	28.9
XZ-3-04	149.46	67%	21.0
XZ-3-05	88.14	71%	24.0
JC-01	137.57	72%	25.0
JC-02	134.08	71%	24.0
JC-03	117.03	72%	25.0
EM-1-01	118.04	77%	30.0
EM-1-02	86.71	73%	25.9
EM-2-01	71.00	78%	31.2
EM-2-02	43.04	77%	30.0
EM-2-03	75.5111	76%	28.9
EM-2-04	61.5281	75%	27.7
EM-2-05	49.0934	74%	26.8
EM-2-06	101.7757	79%	32.3
EM-2-07	51.7206	73%	25.9
EM-2-08	9.8845	71%	24.0
YF-01	22.93	65%	19.6

Table 1: Runoff Control Indicators of Construction Land
Source: graphing by author

4. Methodology

4.1 Framework of the Resilience Structure

In order to avoid a series of problems, such as poor systematic scheme, single research scale, and fragmentation of construction projects, this plan divides the construction of the spongy city planning system into three levels, which are the ecological pattern planning of the sponge city, the system planning of the sponge city and the planning of the construction of the sponge city (Alexander D E, 2013). In these three levels, it joins the guidance of resilience thinking, and solves the problems in the process of the planning and construction of the traditional sponge city, and makes the construction system of the sponge city more flexible (Fig.13).

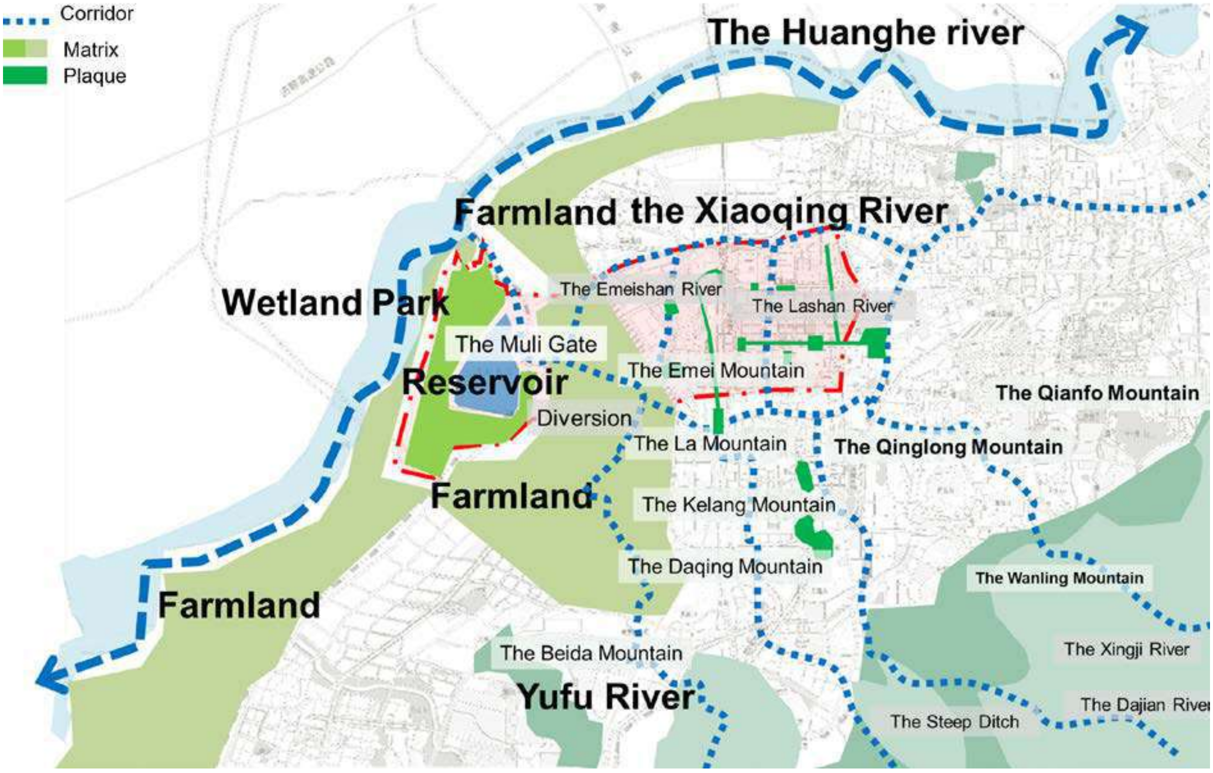

Figure 13: Framework of the Resilience Structure
Source: graphing by author

4.2 Maintenance of Derivative Industry

The development of sponge city extension industry can bring some economic benefits to sponge city construction, and promote diversified industrial development in the promotion area. This plan has utilized the natural resources in the JiXi extension area and the landscape design of the sponge city construction project. At the same time, it combines the six major groups of owners' main group business (including ecotourism, cultural industry, health industry, etc.), and puts forward to develop the two major industries of the cultural tourism and cultural exhibition in spongy city in JiXi (Jabareen Y, 2013).

4.3 Dynamic Supervision and Control

The planning and control system of sponge city construction in JiXi extension area includes three aspects (Huang Xiaojun, Huang Xin, 2015): organization guarantee, technology control and management implementation. The main control phase includes the whole cycle from planning to implementation of the construction .It guarantees that in any stage of the construction of the sponge City, there will be a c lear department responsible, reliable technology to provide security, corresponding regulations, and c an quickly deal with and solve the problem, so as to ensure the stability of the construction system of the sponge city (Fig.14).

Figure 14: Dynamic Supervision and Control
Source: graphing by author

5. Methodology

On the basis of four aspects of urban resilience, through integration analysis of resilience, flood control, pollution source control and runoff unit control, we can conclude: a. the rigidity of sponge facilities is the foundation of urban toughness. b. the implementation of the whole process of resilience is important to the project. c. dynamic supervision and control is the guarantee of urban resilience. In the current practice of sponge City, the new tenacity mechanism and renovation methods are constantly optimized. At the same time, the development of urban and ecological environment system involves many complicated factors, and other types of data should be expanded. The decision making method mentioned in this paper still needs supplementary and practical feedback, which is also needed for further work in the future.

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Track 4

TECHNOLOGY AND INFRASTRUCTURE: Clean, Green, Smart and Resilient

Making Lagos a Cool City: A Study of Transport System and Travel Behaviour

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1. Introduction

Transport plays a pivotal role in the socio-economic and political development of nations all over the world. It is a catalyst which facilitates access to various services and opportunities. Scholars (Alade, 2009, Daramola and Adeniji, 2009, Fadare, 2010, Badejo, 2011 and Filani 2011) have recognized the role of transport in the efficient performance of cities. However, urban transportation systems in most developing cities are far from ideal with congestion being the most visible and frequently mentioned transport problem which results from high level of motorization and other factors such as poor road infrastructure and inefficient traffic management.

According to UNEP (2010), transport is the second largest sector contributing to global carbon dioxide (CO2) emissions from fossil fuel combustion and of the 23 per cent of global CO2 emissions from the transport sector, road transport accounts for 73 per cent, followed by international shipping and international aviation. However, the transport sector is not receiving enough attention in global climate change mitigation efforts, even though, according to UNFCCC (2011) it is the sector where emissions have increased the most (by 14 per cent from 1990-2008) and, in a business-as-usual scenario, are expected to grow by 25.8 per cent by 2020 compared to 1990 levels.

The impact of transport on the environment cannot be underestimated. Mitigating the effects of climate change in the global north has been profound, however, not much has been done in the south. In Lagos, the largest city in West Africa, efforts are ongoing to respond to global action on climate change through investment in transport infrastructure with appropriate measures including policies to encourage more use of public transport and non-motorized transport options. This study examines the transport system and travel behaviour in Lagos and the efforts of the government in promoting environment-friendly transport with a view to using the outcomes to make policy recommendations that will make Lagos a cool city.

2. Literature Review

2.1 Urban Transportation System: An Overview

Transportation can be broadly categorized depending on what is being transported, the mode of transportation, and the governing regulations and other institutional dimensions. In relation to what is being transported, three subsectors in transportation-moving passengers, freight or information- make different demands on transportation systems (Mehrotra et al., 2011). The impact of greenhouse gas emissions as well as measures to mitigate or adapt these emissions can vary widely depending on how passengers, freight and information are transported. Again, transportation in terms of mode of travel can be broadly categorized as occurring by land, air and water. Land-based transportation systems are generally those with the highest utilization in urban centres and can be sub-divided into rail and road-based transportation.

Kahn-Ribeiro et al., (2007) noted that road vehicle accounts for more than three-quarters of the total energy use in transportation and is consequently associated with greenhouse gas emissions. The combination of what (or who) is being transported and mode adopted for transportation is significant because it gives a measure of the amount of greenhouse emissions by modes and types of uses. As a result, the measures of emissions in turn helps to devise adaptation and mitigation strategies. Finally, the type of regulation and management of the urban transport system have a critical role to play in the reduction of vehicular emissions.

2.2 Transportation and Climate Change

The transportation sector accounts for 23% of global energy related greenhouse gas emissions in 2010 and some scholars project that emission levels for this sector could increase by greater than 70% by 2050 (Sims et al., 2014). Transportation, therefore, needs to play a pivotal role in efforts geared towards global climate change mitigation (UN-Habitat, 2009; Voukas and Palmer, 2012; IEA, 2013). However, the importance of the transportation sector goes beyond carbon emissions. Transport networks connect people with employment opportunities, health care and education, shapes communities and provides means of bringing goods and services to the market. In other words, efficient and accessible transport is not just sine qua non to economic growth, but also fundamental to the well-being of humans.

Historical low investment in public transport infrastructure and low capita incomes epitomised by low and middle-income countries in Africa have resulted in dependence on walking, bicycle and motorbike (Oyesiku, 2001; Abduhamoud et al., 2011; Voukas and Palmer, 2012). The implication of the foregoing is that car-centred transport systems require more land, promote urban sprawl, increase congestion, raise expenditure on energy and generate air pollution that causes respiratory illness, particularly among vulnerable groups such as infants, the elderly and physical labourers (Goodwin, 2004; Litman, 2004; UN-Habitat, 2009).

UN-Habitat (2009; 2010b) observed that dependence on private vehicles can also contribute to the development of two-layered transport systems, where those without access to vehicles are forced to depend on non-motorised transport (NMT) modes and informal public transport options, often resulting in greater exposure to air pollution and risk of traffic accidents. This compounds social and environmental inequalities. On the other hand, multi-modal transport networks that include well-connected mass transit infrastructure (buses, trams and trains) and NMT options (pedestrian walkways and cycling lanes) are less energy and emission-intensive, promote more compact forms of urban growth and are socially inclusive (Kenworthy, 2006; Rode et al., 2014). However, these transport networks require substantial upfront capital investment, strategic urban planning and sophisticated technical and management capabilities, which at times are beyond the capacity of governments in low and middle-income countries.

3.0 Materials and Methods

The study is both qualitative and quantitative in approach. The qualitative approach examines the transport system in Lagos by reviewing the Strategic Transport Master Plan and other transport study reports of Lagos Metropolitan Area Transport Authority (LAMATA) to highlight the character and challenges of the city's transport system and government's investment in transport infrastructure that aligns with climate change mitigation. The survey of travel behavior covers 1953 households in 32 neighbourhoods in three contrasting residential density areas using systematic sampling technique. Structured questionnaire was administered on household heads to obtain information on their previous day travel characteristics. Data were analysed descriptively and the results were used to highlight the climate change implication of urban travel in the city.

4.0 Results

4.1 Lagos Transport System

The transport situation in Lagos reflects its megacity status. It is estimated that some 6million passengers' trip are recorded daily within the city. About 70% to 77% of these trips are bus based public transport, while the rest is largely by cars. The rail and water transport accounts for less than 1% of the trips (LAMATA, 2014). Organized public transport services exist in the form of Bus Rapid Transit (BRT), the LAGBUS and the corporate Taxi scheme which were introduced a decade ago as part of government efforts to make Lagos a global and competitive megacity. The BRT was introduced to replace the private sector driven mini-buses known as Danfo and Molue. It was estimated that there are between 75,000 and 90,000 such buses in Lagos metropolitan area.

The BRT Scheme came into operation in 2008. It is expected to operate along eight routes using specially designated BRT lanes running through the city, with the aim of expanding to other routes in the future. The BRT scheme is estimated to transport about 10,000 passengers in each direction per hour during the peak travel times. The Lagos Metropolitan Area Transport Authority (LAMATA) is the government agency established to deal with the multitude of transport problem in the state and oversees the BRT scheme. The LAMATA BRT corridor covers about 22kilometres in length. The system is run by two operators, Nigerian Union of Road Transport Workers (NURTW) Cooperatives and LAGBUS, a Lagos State Government owned Asset Management Company which contributes about 180 high capacity buses for the implementation of the first phase Mile 12 to CMS BRT Lite system.

Motor parks or public transport garages abound all over Lagos Metropolis. These facilities are poorly designed, badly maintained and poorly located. In some cases, bus stops are located too close to interchanges or at a point difficult to access from primary corridors. The bus stops that are commonly utilized are operated inefficiently, because bus drivers maintain no order and there are no pre-designed bus stops serving destinations. This results in large number of bus passengers milling about, searching for buses and the opportunity to board a bus before it has entered the bus stop. The operation of the Lagos State Traffic Management Agency (LASTMA) has impacted positively on traffic situation in Lagos. Total time wasted in traffic is estimated at 3 Billion hours annually. Saving just 20% is equal to 1 Billion USD of economic benefit to Lagos (ROM Transportation Engineering, 2010). Activities of LASTMA has reduced the excessive total travel time on journeys being made on major corridors in Lagos metropolis.

The transport situation in Lagos is expected to get better with the expansion of the BRT scheme and the completion of the light rail transit. The rehabilitation of inland water ways and introduction of private sector ferry services with the new taxi scheme are also efforts directed to enhance urban mobility in Lagos. To consolidate these efforts, some agencies and institutional framework were put in place. These include the establishment of LASTMA, State Traffic Safety Advocacy Programme, Lagos State Drivers Institute and Motor Vehicle Administration.

4.1.1 Lagos Transportation Challenges

Lagos is rapidly expanding and is expected to have a population of over 30 million people by 2030 and overtake Cairo as the biggest city in Africa. Unfortunately, Lagos does not enjoy the privilege of adequate urban and transportation planning it deserved in its initial stage of urbanization. Consequently, the city has experienced proliferation of slums, degradation of urban areas and facilities, and transportation problems affecting all modes manifesting in the form of congestion, poor accessibility and mobility, inadequate road and terminal infrastructure, distressed public transport system, weak traffic management and safety and security challenges among others. Congestion is a major challenge in Lagos megacity and occurs daily along major corridors.

In a report submitted to LAMATA by ALG Transportation & Logistics (2013), it is documented that the public transportation system in Lagos state is inadequately regulated and structured. Besides, the public transport system is highly fragmented comprising many un-regulated routes and dominated by the use mini-buses (Danfos) leading to an inefficient public transport service which compels people to depend on private transport, resulting to a chaotic transportation which aggravates congestion.

It is further noted in the 2013 report that the industrial status of in Nigeria accounts for the growing number of freight vehicles along the main transport corridors in city and the freight vehicles share the existing road infrastructure with passengers. Similarly, the absence of an organised non-motorised transport (NMT) infrastructure, the lack of integration of transport and land use, weak regulatory mechanism among others are factors that worsen the transportation challenges in Lagos. The 2013 report concludes that, there is need for an urgent urban and transport development plan in Lagos, to address the continuous degradation and congestion of the transport system. The report also emphasizes that the results of “No action” will not only lead to the extension of the current congestion levels of Lagos but will also result in the loss of a unique opportunity to develop the Mega-city as the key-economic hub of Africa.

4.1.2 Non-Motorized Transport (NMT)

NMT, especially walking, is the most common form of mobility in Lagos, particularly for low-income households. According to the Lagos STMP (2004), around 30% of Lagos mobility is on foot or by bicycle. The interaction between pedestrian and vehicles in Lagos is unplanned and dangerous. In other to achieve an inclusive and sustainable transportation system in Lagos city, there must be recognition of importance of NMT. This does not seem to be the present situation as there are few segregated traffic facilities for pedestrians (e.g. walkways, zebra crossings, footbridges, underpasses and signs) and no pathways for bicycle riders. As a result, pedestrians are frequently forced to walk on the carriageway sharing roadway with motorised transport, which implies a low level of road safety.

Furthermore, the use of junctions as non-regulated commercial areas has been identified as one of the critical issues of urban mobility in Lagos. The encroachment on the roadway available for pedestrians by commercial activities represent a general challenge in all of Lagos urban core. The inadequacy of space for pedestrians is also a challenge in Lagos public transport system. There is a perceived lack of provision of proper accessibility to bus stops/terminals. Invariably, this results in increased rate of traffic accidents involving pedestrians in relation to unsafe bus stops.

A close examination of Lagos urban transport system also reveals restrictions to pedestrian mobility. For instance, highways and primary roads represent significant obstacles to pedestrian movement due to the absence of proper infrastructure facilitating the crossing of such barriers. The absence of road infrastructure also leads to poor pedestrian mobility. For instance, the present lack of East-West connections within the Mainland Central area isolates neighbourhoods and restricts the efficient movement of people and goods. A close examination of current improvements in road infrastructure shows that provision for NMT in being neglected. The absence of a comprehensive transport policy in favour of NMT may be responsible for this trend.

4.1.3 Vehicular Emissions in Lagos Metropolis

The urban transport system in Lagos metropolis is a significant source of environmental pollution. In terms of industrial activities and economic development, Lagos is one of the fastest growing megacities in the world (Kotin and Cox, 2013). Over 70% of the industries in Nigeria, consisting more than 7,000 medium and large-scale manufacturing industries are located within the city. Lagos is the most industrialized city in the Economic Community of West African States (ECOWAS) sub-region (Komolafe et al., 2014) and is home to about 60% of total non-oil enterprises in Nigeria. Consequent upon the agglomeration of these industrial infrastructure, Lagos city is the highest consumer of energy, which is predominantly fossil-based, thus making it one of the largest contributors to greenhouse gas emissions.

The industrial profile of Lagos is noteworthy in view of the close relationship between industrial activities and transportation, especially freight transportation. Manufactured goods from the industries and raw materials for production are transported to and from industrial complexes through an inefficient road transport system that involves the use of trucks and heavy-duty vehicles. This method of conveyance, largely due to the poor transportation system and lack of credible alternatives to road transportation, has resulted in more vehicles on the road and greater environmental pollution from diesel engines. According to Lagos Air Quality Monitoring Study (2008) vehicular emission is the major source of pollutants in Lagos, contributing approximately 43% of ambient air pollution. This study also recognizes that vehicles in Lagos contribute to over half of the greenhouse gas emission from the transport sector in the country.

In the past ten years (2001-2009), the number of vehicles in Lagos State has increased to 234% (LAMAMTA, 2014) without commensurate increase in roadways which further compounds congestion in the city. The increasing traffic congestion in Lagos also makes driving conditions more polluting. The two main reasons for this growing congestion is the lack of a good network between the hinterland and ports and inadequate transport planning in new areas. The former leads to freight movement within the city and attendant friction with passenger traffic while the latter complicate commuting trips thereby resulting in the adoption of private transport as an alternative in most cases.

According to LAMATA (2009) over 70% of the vehicle fleet in operation within Lagos are 15 years old or more (see figure 1). Most of these vehicles comprising of cars, buses and trucks, are second-hand imported vehicles that do not meet the emission standards of their countries of origin. Furthermore, the general vehicle maintenance culture is often poor and is usually limited to essential maintenance and repairs to keep the vehicle on the road. Inadequate or non-existent vehicle maintenance result in gradual decline in engine performance, leading to less efficient fuel combustion, thereby increasing emissions.

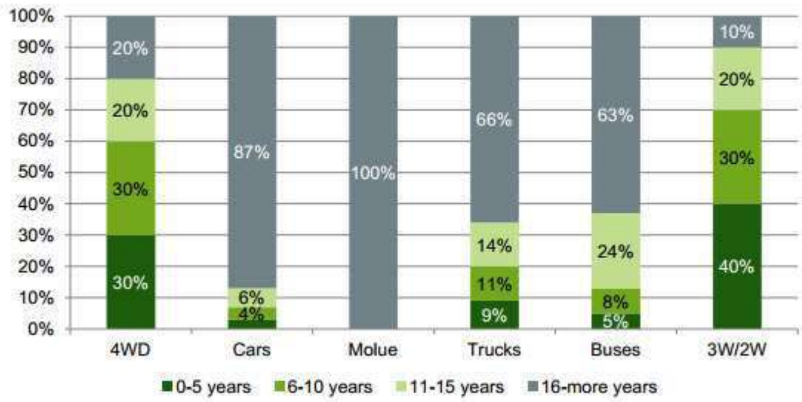

Figure 1: Vehicle classification by age in Lagos
Source: LAMATA, 2009.

These old poorly maintained vehicles are known as "super emitters" which are responsible for about two thirds of the CO_2 emissions in Nigeria coming from transport activity. According to the *Assessment of Emissions from Road Transport (AERT)*, around 85% of the "Lagosian" vehicle fleet works with old engines. A finding of this study is that an average car plying on the roads of Lagos approximately meets the EURO-II emissions standard which was already in place in 1996. EURO-II emissions standard are 3 to 4 times higher than the current standard in the continent.

Vehicle type	Cars		Buses		Euro 2
	New	Used	New	Used	
CO	3.00	14.96	8.07	12.45	3.28
HC	0.006	0.22	0.006	0.17	0.34
NOx	0.07	1.2	0.15	0.36	0.25
CO_2	22.92	165.9	107.9	229.2	130

Table 1: Comparison between emission factors for vehicles using petrol as measured in 2008 and Euro standards (g/km)

4.1.4 Lagos Climate Change Adaptation Strategy

Lagos is not taking the back seat in respect of climate change. The Lagos Climate Change Adaptation Strategy (LAS-CCAS) recognizes multimodal transport - the introduction of mass transport system comprising a combination of bus rapid transit (BRT), rail and water transport services - in Lagos a key measure for climate change mitigation and adaptation (Lagos Strategic Transport Masterplan, 2014).

The rationale for the introduction of multimodal transport is hinged on their larger passenger capacity and lower emission rate than those of private vehicles. As shown in the table below, the private car is the major emitter per passenger-kilometre when compared to other means of transport. The emission levels of motorcycles are close to the Danfos level and more than the BRT, rail transit and bus, the most environmentally efficient modes of transport. The table below further reveals that the BRT is the most efficient of these means of transport, considering emissions per passenger. Private vehicles prove to be high pollutants in comparison with mass transit buses, due to their low occupancy rate. Furthermore, less buses are required to move large populations when compared to private vehicles. Thus, the total emission per passenger in public transport is lower than in private transport.

Additionally, the AERT (2009) proposes that current emission standards are set at Euro 2 (for used vehicles) and Euro 4 (for new vehicle), as well as a series of law enforcement measures concerning inspection, maintenance and certification, including a change in fuel use from diesel/petrol to CNG which will yield substantial environmental benefits from cars and buses. These represent feasible objectives for long-term transport planning in Lagos megacity. AERT recommendations can serve as basis for defining an environmental policy geared towards mitigating environmental impact of transport.

- Transport planning and demand management to implement:
  - Substitution of 20% of cars/SUV (Sports Utility Vehicles with enhanced bus services like BRT.
  - One-way streets
  - Establishment of certification centres for vehicles on emissions
  - Encouragement of Non-Motorized Transport (NMT)
- Promotion of NMT facilities, which could produce a 10% reduction in motorized trips.
- Switching buses to operate with CNG (can reduce the Emission Factor for CO_2 by 28.7%, 30.4% for CO, 0.06% for NO_x and HC and 100% for PM10)
- Limiting the age of second-hand vehicles imported into Nigeria.
- Setting emission standards to EURO-IV to limit emissions from vehicles.

4.2 Travel Behaviour

Five trip characteristics were analysed to present the travel behaviour in Lagos. These include trip frequency, trip purpose, trip mode, trip time and trip length. These are presented to highlight the travel behaviour implication for climate change in Lagos.

4.2.1 Trip Frequency

Analysis of trip frequency in this study covered all purpose trips. Further, “a trip” was defined as a journey made to a destination for a purpose notwithstanding the number of modal interchange. As shown in Table 2, majority of the respondents (97.0%) made at least one trip in a day, while 3.0% made no trip. Those who made just a trip represent just 1.0%. Further, 51.1% of respondents made two trips, 31.3% made three trips, 11.9% made four trips while 2.6% made more than four trips in a day. This implies that apart from the trip originating from homes and home bound trips, respondents usually take an additional trip different from the major trip purpose for the day. Such trips may include shopping, social and religious. The aggregate of all trips made by the respondents was 4565 trips. Thus, the average number of trips made by a respondent per day is 2.6 trips. This is approximately three trips per respondent per day. This figure is like what obtains in other major cities across the world.

Table 2: Trip Frequency

Number of Trips (a)	Frequency (b)	Percentage	Total Trips (a x b)
1	18	1.0	18
2	913	51.1	1826
3	541	30.3	1623
4	213	11.9	852
5	36	2.0	180
6	11	.6	66
No Response	53	3.0	-
Total	1785	100.0	4565

4.2.2 Trip Purpose

Six major trip purposes were identified in this study and they include work, shopping, school, social, religious and others. Others as a trip purpose include those trips made to obtain services like medical, banking, auto repairs and so on. Work and school trips are regarded as non-discretionary trips while others are regarded as discretionary trips. As demonstrated in figure 5.4, 67.0% of respondents made non-discretionary trips (work and school), 30.0% of them made discretionary trips (other types of trips apart from work and school) while only 3.0% of the respondents had no trip purpose since they made neither discretionary nor non-discretionary trips. It is further revealed in figure 6.1 that 56.1% of the respondents made work trips, 7.8% made shopping trips, 10.9% made school trips, 11.4% made social trips, 6.3% made religious trips and 4.4% made other trips. This implies that majority of the respondents made non-discretionary trips than discretionary trips.

4.2.3 Trip Mode

This study reveals that different modes of road transport were used by the respondents for all the trips recorded. Table 3 shows that 97.0% of respondents used one mode or the other for their daily trips while just 3.0% made no trip during this study. Further, the table revealed that car and bus were dominantly used by respondents for their various trips, 44.0% of respondents used car while 33.2% used bus. It is further revealed that 6.7% and 7.7% of respondents used walk and motorcycles/3wheelers respectively for their daily trips. Only 3.9% and 1.5% of the respondents used taxi and the newly introduced bus rapid transit respectively. The use of rail by respondents was low as less than 1.0% used the mode. These results suggest that car and bus are the two major modes of travel in Lagos. The implication of this is that the proportion of respondents who rely on public transport (motorcycles, 3-wheelers, taxi, bus and rail) for their daily trips (46.4%) is almost the same with those who rely on private transport (44.0%). The predominance of low occupancy vehicles (car and bus) and near absence mass transit (bus and rail) in Lagos are pre-conditions for traffic congestion.

Table 3: Trip Mode

Trip Mode	Frequency	Percentage
Walk	119	6.7
Motorcycle/3 wheelers	136	7.7
Car	786	44.0
Taxi	70	3.9
Bus (Danfo/Molue)	593	33.2
Bus Rapid Transit	26	1.5
Rail	1	.1
No Response	53	3.0
Total	1785	100.0

4.2.4 Trip Time

Analysis of trip time of respondents as shown in Table 4 revealed that majority (65.9%) of respondents made trips that were lesser than one hour while 31.2% of respondents made trips of one hour and above. Further, the table 20.0% made trips of between 1 – 2 hours. Respondents whose trip time was above 2 hours represent 11.2%. As earlier observed, 3.0% of respondents had no response. Consequently, the mean trip time for this study was 1.86 hour. This suggests that majority of households in Lagos spend relatively long time in traffic for most of their daily trips. Thus, this becomes a major travel challenge in Lagos and many other large cities where urban travel is undertaken by low occupancy vehicles.

Table 4: Trip Time of Respondents

Trip Time	Frequency	Percentage
<1Hr	1176	65.9
1-2Hrs	357	20.0
2-3Hrs	96	5.4
>3Hrs	103	5.8
No Response	53	3.0
Total	1785	100.0

4.2.5 Trip Length

As shown in Table 5, 47.5% of respondents made trips lesser than 5km. Further, the table revealed that 18.3% made trips of between 5 -10km. Those who covered between 11-20km and above 20km represent 15.7% and 15.6% of respondents respectively. Thus, 49.6% of respondents travel above 5km on daily basis. The mean trip length from this analysis is 3.8km per person per day. This suggests a fairly-short trip length among residents although about 31% travel above 10km per day.

Table 5: Trip Length

Trip Length	**Frequency**	**Percentage**
<5km	847	47.5
5-10km	326	18.3
11-20km	280	15.7
>20km	279	15.6
No Response	53	3.0
Total	**1785**	**100.0**

5.0 Conclusion

This study has examined the character of transport system and travel behaviour in Lagos and concludes that Lagos is still far from being a cool city and may take a relatively long time to become one. This is because the socio-economic development of the rapidly growing city with a current population of about 20 million is driven by road-based transport. Public transport system in the city is dominated by informal services. Organised public transport system is relatively young and very limited in network.

Vehicle population has increased by 234% in the last 10 years and over 70% of the vehicle fleet in operation are 15 years old or more, thus, the transport system in Lagos metropolis is a significant source of environmental pollution. This situation is worsened by the fact that over 70% of the industries in Nigeria are located within the city. Analysis of residents' travel behaviour reveals unsustainable travel pattern as more than 90% of daily trips is road based, average trip time is approximately 2 hours over an average trip length of 10km suggesting a high level of road congestion. Massive transport infrastructure is ongoing, but still largely road based. Development of rail transport is rather slow compared to the travel demand in Lagos.

The government is conscious of the climate change implication of the existing transport system and travel pattern and has made efforts to develop *The Lagos Climate Change Adaptation Strategy (LAS-CCAS)* which recognizes multimodal transport as a key measure for climate change mitigation and adaptation. The multimodal system will be mass transit driven (bus and rail). Other climate change adaptation strategies include setting current emission standards at Euro 2 (for used vehicles) and Euro 4 (for new vehicle), as well as a series of law enforcement measures concerning inspection, maintenance and certification and promotion of NMT. A major concern in all of this is the slow pace of policy and plan implementation. For Lagos to become a cool city, it is important that a workable transport policy is legislated with a strong political will to implement the strategic transport master plan. There is also the need to professionalize the transport sector for capacity building. There is the need to change the transport orientation of the people towards NMT.

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Challenges and Best Practices for the planning of Zero Emission Neighborhoods and Smart Energy Communities – the case of seven Norwegian cities

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Abstract

Designing more sustainable neighborhoods as implemented in the concept of Zero Emission Neighborhoods (ZENs) and Smart Energy Communities (SECs) is a complex challenge and requires a leap from segmented planning approaches to holistic planning. Seven neighborhoods in Norway are currently under planning and development into a ZEN/SEC and used as cases in this paper to extract the significant barriers to the design and implementation process of sustainable development. After presenting the main challenges on a general level, we will focus on stakeholder collaboration as this is pointed out as one of the key challenges in our research. We will show how Norwegian cities cope with challenges within stakeholder collaboration and present best practice solutions from the case cities.

However, the findings show, that the sustainability of the neighborhood requires tools that can encourage also the integration of spatial qualities and sequencing to ensure sustainable behavior as well as an early and ongoing collaboration with stakeholders. A participatory approach with municipalities, utilities and private developers was taken to suggest a solution to this. The paper will end with the presentation of a planning tool, the SEC Planning Wheel with a Core of Community (CofC) Fund mechanism, which aims to be a guideline for city planners to induce stakeholder collaboration and thereby aiming to maximize the emission reduction while ensuring social and economically livable cities.

Key Words

Urban planning, Urban governance, Sustainable Urban Neighborhood, Integrated Planning, Low Carbon Society, Smart Cities, Integrated Project Delivery

1. INTRODUCTION

To develop cities with a lower carbon footprint is a development goal all over the world. The building stock is thereby counting for one third of climate gas emission and 50% of energy consumption. In the last decades in Norway, a strong research evidence and building examples were achieved on the way to reach the ambition of Zero Emission Buildings (ZEB). ZEBs are compensating CO2 emissions with energy generation over their lifetime. Today, the

ZEN[1] concept moves this way of thinking beyond buildings. Successful planning for ZEN needs to consider not only energy and emissions, but also needs to incorporate the interests and ideas of a broad number of "new" stakeholders like e.g. utility companies from the early planning stage. Based on observation and interviews, this paper will present the main challenges identified when planning for Zero Emission Neighborhoods in the seven Norwegian cities and towns Oslo, Bergen, Trondheim, Bodø, Steinkjer, Evenstad and Elverum. Each of these cities is planning for or already developing a ZEN and all of them are partners within the Research Center for ZEN at the Norwegian University of Science and Technology (NTNU)[i].

2. BACKGROUND ABOUT ZEN AND SECS

Historically, ambitious neighborhoods were the art of the architects, building Functional Cities in line with the Athens Charter. Today, the planning of urban neighborhoods depend upon the facilitation of multi-stakeholder processes (Maggioni et al., 2012, Ouhajjou et al., 2017) and negotiation (Monstadt, 2007). Situations of give and take, where researchers, private developers, utility companies, transport administration, municipal planners and citizens have to contribute to make environmentally, socially and economically sustainable living areas.

The Smart Energy Community (SEC) concept was developed as a response to Bergen and Oslo wanting to become pilot cities for the purpose of developing and accessing better tools for the design of emission reducing communities. Two building projects, Zero Village Bergen and Furuset in Oslo, were starting points for this research and the following definition of a SEC was created within the PI-SEC project[2]: While Zero Emission Neighborhoods are still in the development of a concluding definition from NTNU,

'A Smart Energy Community (SEC) is an area of buildings; infrastructure and citizens sharing planned societal services, where environmental targets are reached through the integration of energy aspects into planning and implementation. The Smart Energy Community aims to lower dependency on fossil fuels by becoming highly energy efficient and increasingly powered by renewable and local energy sources. Its spatial planning and localization considers reduction of carbon emissions also through its relationship with the larger region, both through the design of energy systems and by including sustainable mobility aspects of the larger region. It further encourages sustainable behavior through its overall design from building and citizen scale to community scale. The application of open information flow, a large degree of communication between different stakeholders and smart technology are central means to meet these objectives' (Nielsen et al.). The concept of ZEN is widening the definition of SEC by taking not only emissions into consideration which are produced within the operation of the neighborhood, but as well emissions which are produced while planning and constructing the area, as well as embodied emissions (Wiik et al., 2018).

In earlier research, we have identified 10 challenges on the way to ZEN within the seven case areas in Norway (Andresen et al. 2017):

1. Stakeholder collaboration and project management
2. Lack of knowledge
3. Legislation
4. Goal conflicts

[1] The ZEN Research Centre is a research centre for environmentally friendly energy [forskningssenter for miljøvennlig energy]. It was established in 2017 by the Research Council of Norway. The ZEN Research Centre is hosted by the Norwegian University of Science and Technology and organized as a joint NTNU/SINTEF unit. More information in english available on https://fmezen.no/.

[2] The Planning Instruments for Smart Energy Communities (PI-SEC) is a research project funded by the Norwegian Research Council, spanning from 2016 to 2019. See https://www.ntnu.edu/smartcities/pi-sec

5. Time and cost pressure
6. New energy technologies
7. System boundaries
8. Risks and uncertainties
9. Flexibility
10. Transferability

There is a strong believe among stakeholders in the case areas that technological solutions will enable the development of ZEN. But the collaboration of multiple stakeholders within the development process is highlighted as the one of the main challenges as well as enablers for a successful development. Planning for energy and emission reduction and developing ZEN is a multi-stakeholder challenge with new stakeholders on the agenda and the need for new planning and design approaches.

2.3 Challenges related to stakeholder Collaboration

Stakeholders are defined as any individuals, groups or organizations from different disciplines and with different needs, responsibilities, and resources who affect the project, or are affected by it, or exhibit an interest in it.

Designing energy ambitious areas depend upon stakeholder collaboration where all stakeholders need to commit and contribute more than 'business as usual'. While the ambition level is increased by the high environmental commitments following the Paris agreement, (Agreement, 2015, Hulme, 2016), stakeholder collaboration and the relationship between private and public actors are old topics in urban planning(Huxham, 1996, Abdulgader and Aina, 1970). The liberalization of utilities revitalized the need to better governing of private and public stakeholders(Monstadt, 2007), and the emission reduction agenda increased the need for better practices and policies even further. The climate emission reduction depend on the success of integrating energy into urban planning, meaning that collaboration may be the 'win or lose' aspect of the entire vision. (McCormick et al., 2013) The initial reason for the frustration [about stakeholder collaboration] seems to be the separated design and construction, or disintegration of the construction project process in general(Lahdenperä, 2012)" Further, the "low bid syndrome can be recognized as a major determinant behind the customary adversarial behaviour [of stakeholders](Lahdenperä, 2012).

An important aspect is that governance and planning are identified as the key leverage points for transformative change(McCormick et al., 2013), yet neither are simple key points to address and change quickly in the right direction.

In this paper, we contribute to this discussion by looking for cross-sectoral stakeholder-collaboration related challenges in seven real neighborhood cases; finding the most pressing issues that need to be adressed in order to achieve the transformative change in governance and urban planning.

3. CASES

Seven Norwegian neighborhood developments are dedicated to be developed as a ZEN and are participating as pilot projects within the ZEN center at Norwegian University of Science and Technology (NTNU). The cities of Bergen and Oslo are similarly participating within the PI-SEC project. The pilot projects are innovation hubs for co-creation between researchers and building professionals, property developers, municipalities, energy companies, building owners, and users. As urban living labs they shall help to verify, document and optimize the real-life performance of the solutions developed. They will also be lighthouse projects to learn, inspire, and disseminate ZEN-related knowledge.

The seven neighborhood developments varies regarding size, functionalities, time frame and some are green- and brownfield development as others are existing neighborhoods. The most common project owner of the neighborhood developments are the municipalities and only the Zero Village Bergen (ZVB) project has a private developer as project owner. The neighborhood projects in Elverum, Bergen, Bodø, Trondheim and Steinkjer are transforming former brown- or greenfields or areas in use for other purpose as an airport or commercial area into a ZEN. The pilots are developed into multifunctional sub centers in Oslo and Trondheim and to a multifunctional area in Bodø. The pilots in Elverum, Bergen and Steinkjer will be developed as residential areas with public services as schools or kindergartens located within the neighborhood. Evenstad is a university campus and the only pilot which is already in the operational phase, meaning that no further construction is planned within the coming years. The focus in this project is the transformation of the energy system. Figure 1 gives a short overview of the seven case study neighborhoods.

	City population (1.1.16)	Project owner	Area size in m^2	Planned/ Current Function	Construction	Status/Phase
Elverum - Ydalir	14 794	Public (Municipality)	430 000	Residential area with school and kindergarten (planned)	New construction, 1 000 dwellings (ca. 100 000 m^2), a school and a kindergarten	Planning
Oslo - Furuset	652 940	Public (Municipality)	870 000	Multi-functional sub centre with 1 400 dwellings and 3 800 inhabitants, 213 100 m^2 (existing)	Retro-fitting/upgrading and new construction, 1 700 – 2300 dwellings and 2 000 – 3400 work places (up to 160000 m^2)	Planning and Construction
Bergen - ZVB	252 772	Private (Developer)	378 000	Residential area with a kindergarten and additional services (planned)	New construction, 720 dwellings (92 000 m^2), a kindergarten and additional service functions	Planning
Trondheim-Sluppen	177 617	Public (Municipality)	275 000	Multifunctional Neighbourhood (existing)	Retro-fitting and new construction	Planning and Construction
Steinkjer – NRK	12 466	Public (Municipality)	11 113	Kindergarten and dwellings (planned)	Re-use and new construction of 10-12 dwellings	Planning
Evenstad - Campus	2 623 (Municipality)	Public (University)	61 000	University Campus (existing)	Building stock in use: 10 000 m^2, no further construction planned	Operation
Bodø - NyBy	40 209	Public (Municipality)	3 400 000	Multifunctional city centre extension with residential and business areas (planned)	Re-use and new construction, 2 800 dwellings in the first construction stage	Planning

Figure 1: The seven pilot projects within the Zen research center at a glance

4. METHOD

39 interviews were undertaken with stakeholders involved in the neighborhood developments in 7 municipalities during 2016-2018. In addition, we conducted six workshops with a participatory design thinking – approach, with municipalities on certain topics. Participants were from municipal planning offices, climate section, regional governors, national road administration, utility companies, private developers, city architects, energy researchers from the case cities, and also international experts from review groups and two international conferences.

The interviews were transcribed and analyzed while the workshop outcome was photographed and discussed in separate reports and papers (Juhasz-Nagy et al., 2017, Nielsen et al., Nielsen et al., 2017). In the analysis for this study we were first looking for stories indicating challenges related to the stakeholder collaboration aspect of planning and implementation of integrated ZENs, and secondly we looked at the same material for strategies or best practice examples meeting these challenges.

4. FINDINGS

During the analysis, we identified four challenges relating to stakeholder collaboration:

1. Achieving multi-stakeholder concept design and commitment;
2. Private/public relationship and responsibilities;
3. System borders in regional and city planning
4. Balancing social and high environmental goals.

We will present each of the challenge with examples from the various pilot projects in the Norwegian cities. For each of the challenge we will also present Best Practice Examples for attempts to solve these challenges, for other projects to learn from.

(1) Achieving multi-stakeholder concepts and commitment

A significant challenge, seen from the municipal planning side, is to achieve a good process that allow for co-design with all relevant stakeholders. This most commonly includes municipality planners and climate section, private developers, real estate, utility companies, and architects. To aim for a climate gas reduction on a neighborhood level, the commitment and participation of multiple stakeholders – including citizens- within the process is crucial. For the construction industry ZEN requires to go beyond the ambitions of current building act requirements, and requires the collection and provision of data regarding emission in building materials and construction processes. Essential facilitators to gain for energy and climate gas reduction like the building industry or energy utilities are often reluctant to gain for more as asked from regulation and law framework.

The case of ZVB included high influence of one private stakeholder on the project development. After planning and designing the neighborhood the regional governor filed a protest with regard to the location of the planned neighborhood. The project is already on hold for 9 years and still waiting for approval. An integrated co-design or dialogue approach with more stakeholders from public and private sector represented, could have been one of the aspects avoiding this situation.

Best Practice Example 1 The dialogue platform 'Forum Sluppen' in Trondheim

In 2015, a dialogue platform was established between the stakeholders in the Sluppen project in Trondheim, called 'Forum Sluppen'. The Forum Sluppen was established as an experiment in the CityLab approach of Trondheim and has been partly funded by the Norwegian Ministry of Local Development and Modernization within the planning program for Norwegian cities above a certain scale. The goal was to test new forms for collaboration between public and private stakeholders in the area.

Trondheim municipality, Sør-Trøndelag county, the National Road Authority and the biggest private landowner R. Kjeldsberg participated in the Forum Sluppen. The project leader is Trondheim municipality. It was also tried to involve other stakeholders. Siemens as industry stakeholder in Sluppen and Koteng, another private landowner in Sluppen, participated only at an early stage.

In 2017, a feasibility study for Sluppen was conducted as a parallel assignment. The reason for doing this as a parallel assignment was that the participants in the Forum Sluppen wanted an open process with a broad academic discussion. NTNU has assisted the work with the feasibility study. The parallel assignment involved three invited interdisciplinary teams with architects and advisory engineers who were selected by the Forum Sluppen members after an open tender competition with 13 providers.

It was important for the participants of the Forum Sluppen to ensure that the selected teams could share experiences during the process and get input from the Forum Sluppen along the way. In the period from March to June 2017 a start-up seminar, a mid-term seminar and a closing presentation meeting was organized to ensure the possibility for discussion. The final presentation meeting in June was also open to the public and around 55 persons participated. The Forum Sluppen evaluated the three proposals. The results are presented within the evaluation report of the feasibility study (Trondheim Kommune et al., 2017).

Trøndelag County (Trøndelag Fylkeskommune, 2018) evaluates the dialogue within the Forum Sluppen as good and especially useful to find common agreements about the objectives and requirements for the feasibility study. The collaboration is described as an open dialogue, characterized by an understanding for the different positions and agendas of the involved stakeholders. The work with the feasibility study has pointed out the difficulties to find a solution in line with the different demands and requirements. The will for cooperation and compromises is described as crucial for an integrated and long-term solution for land-use in Sluppen, the implementation phase and financing. The cooperation in the Forum Sluppen enabled the participants to understand the demand for compromises and to set the development in Sluppen within a long-term perspective. It also helped to build up a better understanding for each other and the development of common goals.

(2) Private/public relationship and responsibilities

As utilities are privatized, municipalities more often than before play the role as negotiators rather than managers of urban planning. In highly ambitious emission reducing projects, we see a shift from public sector responsibility for social needs at the beginning of a project, and technically advanced dialogues between private stakeholders once the implementation start. This is perhaps nothing new, but the advanced technical innovation taking place is dependent on technical tools such as energy simulations and heat exchange and storage; being both expensive, sector dependent and with little relevance to the citizen involvement taking place at the beginning of the planning process. This makes it seem as if the citizen needs is an accountability issue for private sector, while private sector to a decreasing degree shares this responsibility. Also, public stakeholders see themselves as responsible for "pushing" the environment agenda while project developers in general stick to the minimum standard – which still is perceived as environmentally innovative (TEK 17[3]) by the industry. The private sector on their side believes public sector locally and nationally do not respond to the need for capacity building, both within the building sector and in the municipality.

An argument from several municipalities is that there is a need for a better coordination unit, facilitating innovation in the direction of environment, climate and energy, that can work across the municipal organization. In Furuset, the Futurebuilt programme was one such example,

[3] Regulations on technical requirements for construction works, for English translation: https://dibk.no/byggereglene/Building-Regulations-in-English/

created to develop environmentally ambitious architecture in the Oslo region, has been the coordinating body ensuring stakeholder collaboration particularly within the municipal organization. Despite a thorough citizen-involvement phase and strongly documented citizen needs, the timeline from citizen involvement to implementation has been lengthy. Also, the lack of investment interest in the area has been a significant barrier. The area is seen by public media as 'challenged' with a high immigrant population and low housing prices ((Rosten, 2012, Dyb et al., 2011)). As public sector is spending more than usual on low-emission buildings on municipal land, what the urban planners refer to as "the Core of the Community" (CofC) is difficult to finance. The CofC are in this case the spatial qualities combined with the citizen behavior aspects related to energy use and spatial planning in the Furuset neighborhood. The CofC is to include a public square, the upgrading of a shopping mall and community house, a park, a green axis, all centered around a public transport hub with metro access; also containing charging stations for electric vehicles. This core is seen as key to make sure the inhabitants use the neighborhood in a sustainable way and that they participate in the community; something that again affects the need for safety and security that was identified in the citizen participation at the beginning of the project.

Best Practice Example 2 Masterplan Development in Ydalir, Elverum

One measure approved in the Ydalir project in Elverum to facilitate an early dialogue between stakeholders was the development of a Masterplan for Ydalir in a collaboration between the project owner and the other involved stakeholders. The masterplan of Ydalir provides general goals and requirements for the neighbourhood development regarding design and technical solutions to aim for a ZEN (ETS 2017).

Five workshops over the period of 6 months were held on the key element for stakeholder collaboration in the development of the Masterplan. Each workshop was dedicated to different aspects of the project development. These included different topics such as aims and vision, energy, building and infrastructure, user and quality aspects, and transportation. These workshops were concluded with a summarizing workshop in April 2017 and the results of these workshops influenced the Masterplan for Ydalir, which was completed in 2018. The Masterplan development, including the workshops, were partly funded by Enova – a public owned company providing funding to develop and implement innovative solutions for energy and climate gas reduction in building or neighborhood developments and the energy system - and facilitated by the consultant agency Asplan Viak.

The project owner, the land development agency of Elverum (ETS), stated that they "deliberately invited a bit wide" to the 5 workshops to integrate as many stakeholders as possible in the masterplan development. The interview partners, who participated at the workshops, described the process as fruitful and important to develop a common understanding for the project and the ambitions related to ZEN. The workshops gave the arena to discuss challenges and integrated solutions for the development of ZEN. One challenge discussed at the workshop was e.g. the difficulties to integrate the energy system, the district heating system, into the design of the buildings and install the energy system correctly. As a result of that, a guideline for the implementation of the heating system will be developed under the guidance of the utility company Eidsiva and with the help of researchers from the ZEN center.

Another example of a new collaboration between stakeholders involved in the Ydalir project is the walk- and cycle pathway that will tie Ydalir to the center of Elverum. This will be built in cooperation between the municipality and the utility company Eidsiva, as Eidsiva must nevertheless dig up a channel to offer district heating to the district. The pathway was originally an idea from the local architectural office Plan1, and with the opportunity to gather stakeholders and their good ideas, the way could be realized. Creating an attractive walking and cycling network is part of the core of community concept within the Ydalir project. In this case parts of it were realized as a public-privatepartnership.

(3) System borders in regional and city planning and infrastructure planning

During planning and implementation of concepts that include an integration of mobility, behavior, energy in buildings and attractiveness, design is challenged by the misalignment of decisions on different system level. In the Bergen case, the regional governor stopped the project entirely due to conflict with urban sprawl regulations that came in place after the project had been politically approved by the previous government. In Furuset, the National Road Administration did not agree with the municipality's plan of adding space and attractiveness through a highway lid. The Regional Governor [Fylkesmann] has overturning authority regarding health and environment while the National Road Administration focuses on cost and safety. Large road infrastructure plans are made by the National Road Administration, working on different time schedule but with more authority than local municipalities. Further, national decision makers can make stricter decisions on things like urban sprawl or traffic limiting policies. While private developers mainly involve collaboration with local municipality, maximizing the emission reduction potential of neigbourhoods depend upon the ability to cross traditional system borders.

Best Practice Example 3: Cooperation contract on transport in Bodø

Regarding transportation planning, a cooperation contract 'smart transport' was signed for Bodø in February 2018 between stakeholders from national level (National Road Authority, Norwegian Railway Directorate, Coastal Administration and the aviation company Avinor AS), regional level (Nordland county) and Bodø municipality. This cooperation shall guarantee that national investments in transportation infrastructure in Bodø is aligned with goals for city development on a local level. This agreement will mostly account for the ZEN development of the "New City – New Airport" project, which is the biggest city development project for the coming 80 years and including the construction of a new airport. The alignment is important as the national investments for the airport and road system are made in an early phase of the neighbourhood development, while the urban development with residential and commercial buildings of the vacant land will follow at a later stage.

(4) Balancing social and high environmental goals

When conducting the interviews in the different pilot projects, stakeholders involved could be divided into two groups. One group, enthusiastic to reach for high environmental goals and seeing this as chance for innovation and better performance of their own organization and the other group being more reluctant and skeptical. Among stakeholders from this group, a ZEN development is often perceived as implementing an additional burden, by making the development more expensive and time consuming as well as being not congruent to social development goals. In this context interview partners often mention that first of all - and before ZEN - they want to develop "a good place to live" Steinkjer. The Steinkjer case has showed how resistant the future users of the ZEN development are against the concept of ZEN. ZEN was perceived as an additional burden to an already delayed and difficult project development. Future user resistance against the re-use of existing buildings – a main concept within ZEN – stopped the further development of the neighborhood as ZEN pilot project.

On the other hand, the "enthusiastic" group also pointed out this problem but emphasized the importance to develop the neighborhood in balance with environmental and social development goals. The idea "You have to give something while you take something" (give an take-concept) was mentioned from several interview partners, meaning to develop an understanding for where to cut down perceived comfort while improving services and usability at another part. The above-mentioned example of the cycle pathway in Ydalir as god example for that. While cutting down parking spaces within the Ydalir neighborhood, the cycle network and connectivity to surrounding areas will be improved.

Best Practice Example 4: Branding strategy in Ydalir

To develop a vision for the neighborhood based on future citizens demands and ideas, a branding strategy was developed at the beginning of the planning phase in Ydalir. A workshop was conducted with participants from ETS, local politicians, members of the administration of the municipality, and participants of the focused inhabitant groups of Ydalir.

The aim was to identify needs and values of the potential inhabitants regarding the neighborhood development. Representatives from different potential user groups participated at the workshop: citizens who have just moved to Elverum, former citizens of Elverum, which are living abroad and considering moving back as well as older residents living in Elverum. Three values are especially important for the potential inhabitants: close, constant and real. Each of these values was filled with a bundle of ideas how the everyday life shall be in Ydalir.

The values and ideas developed at the workshop were used to develop Ydalir as a brand with an own logo and a marketing strategy. The aim is to promote Ydalir as a sustainable neighborhood which incorporates the future way of living. While creating a positive image and pictures of the future, citizens shall have an affirmative attitude to Ydalir and its ZEN ambitions. They shall get an idea "what they get", instead of focusing on what they could lose. Figure 2 shows example pictures from the branding strategy. People displayed at the marketing pictures are residents from Elverum.

Figure 2. Examples of the logo and marketing visualisations for the Ydalir project, Source: ETS

5. DISCUSSION AND RESULTING TOOL

The previous chapter presented the challenges in the field of stakeholder collaboration within sustainable neighborhood projects. We pointed out- that in the worst case – processes stopped due to objections from individual stakeholder groups as in the Steinkjer and Bergen case. Most of the challenges could be addressed by creating stakeholder collaboration platforms – meeting places - where different stakeholders meet and get the chance to develop a common understanding, goals and solutions for the fulfillment of the high environmental goals of the neighborhood development.

On the other hand, we see that in thematic areas, the integration of social sustainability and spatial planning is the threatened aspects in neighborhoods with high environmental and energy ambitions. This is perceived as a 'goal conflict' among interview partners and thereby not only creates tension between citizens, urban planners, politicians and private developers but most significantly may lead to not intended results as poor living conditions and gentrification . The concept of "give and take" and the 'Core of Community' as a holistic and citizen-centered development concept are responses to this challenge.

But how to deal with these challenges and the good examples we can learn from?

Within several workshops, participants from the Bergen and Oslo case designed a new solution to this imbalance between spatial quality and social sustainability and smart energy communities. They proposed a more stakeholder led version of the planning process, very similar to the integrated project delivery contracts (Lahdenperä, 2012). The Smart Energy Community Planning Wheel (SEC Planning Wheel) was designed through collaborative efforts matched with needs identified in the interviews; and is presented in figure 3.

Figure 3. SEC Planning Wheel, Nielsen et al. 2017

The Smart Energy Community Planning Wheel describes a process in which stakeholder collaboration and citizen inclusion run as parallel priorities from the first step (Step 1 SEC Agreement). This is before a collective agreement is made for the public and private stakeholders to commit to finance the Core of Community as early as possible (Step 2 Core of

Community fund). The idea is that obligation to finance the central elements of the neighborhood development will prevent delays in the implementation. It will lower risk and avoid the situation where "everyone waits for everyone" as happened in Furuset, and overarchingly to increase the sustainability of the neighborhood or community. Ideally, the involved stakeholders suggested that contributing to this fund should lead to a set of incentives (Step 3). Further, participants explained that this would only work when the municipalities would not let other private developers or projects to compete directly with the planned neighborhood development (No Go policy), but prioritize the ones contributing to the CofC. Finally, the learning element particularly needed in the municipal organization, is represented through the need for an evaluation (Step 5).

6. CONCLUSION

Development of neighborhoods with high environmental goals do face a lot of challenges. Some of them are common challenges and could be found in nearly every neighborhood project, as some are distinctive for ZEN and SEC developments. Stakeholder collaboration is one important challenge but meanwhile an enabler for solving challenges in other thematic fields as solving the perceived "goal conflict" by aligning the neighborhood projects with both environmental and social goals.

As these challenges are influential in keeping the silos that we need to think outside to achieve sustainable behavior coupled with technological optimization, we have proposed with the SEC planning wheel a solution in terms of an integrated delivery (Ghassemi and Becerik-Gerber, 2011) orientation. In the planning wheel combining the core of spatial quality and sustainable behavior design with the conceptual development of low-carbon neighborhoods, we place accountability not only for the delivery of buildings, but also for the "Core of Community" – the very aspects that the citizens believe are key to keep the attractiveness of the area.

The SEC wheel is providing an understanding for the planning of neighborhoods with high environmental goals in 5 phases. The presented examples for stakeholder collaboration from the various pilots will be helpful as best practice examples and tools to integrate in the SEC planning wheel. Our future work will therefore focus on the evaluation of the stakeholder collaboration in the pilot projects with special focus on the individual and local context of each pilot project. We do not only need good examples to learn from, but as well an understanding under which circumstances and which context these examples are replicable and a frame to set these best practice cases and tools in a context to each other - the SEC planning wheel.

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Windows of Opportunity for Smart City Solutions in the Urban Fabric

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Abstract

This paper focuses on the development of a methodology for identifying the windows of opportunity for smart city solutions within the current urban fabric. Advanced ICT and the wealth of urban data offer unprecedented opportunities nowadays for smart urban (re)design, smart operations of urban infrastructures as energy and transport, and for smart interaction with citizens. However, most successful examples of application of smart city solutions come from greenfield developments or comparable situations such as redevelopment locations of substantial size, where the legacy of the past in the form of building characteristics and specific choices for supply of mobility and energy, do not hinder full-scale application of smart city solutions. It is not common practice yet for cities to identify systemically where smart city solutions could be applied within the current urban fabric while planning its management and maintenance. This is a missed opportunity, as the financial flows in management and maintenance programs in the built environment are far larger than investments available for use of innovative solutions in experimental situations of limited size, such as pilots and living labs. Therefore a methodology is needed which identifies local windows of opportunity from spatial and economical perspective. Prospected outcomes of this methodology are citywide hotspot maps and generic business cases at district level. This paper outlines the proposed methodology and describes the next steps in its development.

1 Dynamics in the urban fabric

Each city has to address its current and future challenges being equipped with an urban morphology and with infrastructures designed for the past. In Europe, most cities are defined by a core from medieval or industrialisation time. They have developed subsequently in rings or sectors around this core, depending upon specific physical constraints to construction, transport options, culture, housing and business preferences, social requirements and planning principles. Wegener et al. (1986) describe the temporal characteristics of dominant urban change processes in terms of a stimulus-response scheme, shown in Table 1.

It demonstrates that changes affecting the physical stock of the city have the longest response time and the most long lasting impacts, with small, almost irreversible changes, usually in the range of 1-2% replacements of the existing stock per year (Wegener et al. 1986). What is more, an increasing demand is often fulfilled by adaptation of existing buildings instead of demolition and rebuilding (Grover and Grover, 2013).

Frequently the building stock and urban infrastructures even outlive their economic value for a variety of reasons, such as aesthetical, social or operational motives, which reduce the perceived need for development and substitution, see for instance Zhu and Bostic (2009). Altogether, even in areas with demographic and economic growth where urban change and expansion are significant, overall the pace of change in the urban fabric is often surprisingly low.

Because low or zero energy neighbourhoods and advanced ICT are essential elements in many smart city plans of European origin, critical infrastructures for energy supply, production and distribution, and for ICT should be added to the overview composed by Wegener et al. (1986). Key features to be included in Table 1 describe change process, stock affected, response time, response duration, response level and reversibility of these infrastructures. Most of these infrastructures are characterised by the same slow level of dynamics as buildings and the transport system. For instance, the average lifespan of electricity grids is approximately 45 years, distribution networks for natural gas are used for more than 50 years, heating and cooling networks for 40 to 80 years, and ICT networks 10-25 years.

Level	Change Process	Stock Affected	Response Time (years)	Response Duration (years)	Response Level	Reversibility
1 Slow	industrial construction	industrial buildings	3-5	50-100	low	very low
	residential construction	residential buildings	2-3	60-80	low	low
	transport construction	transport system	5-10	>100	low	nearly irreversible
2 Medium Speed	economic change	employment/ unemployment	2-5	10-20	medium	reversible
	demographic change	population/ households	0-70	0-70	low/high	partly reversible
	technological change	transport equipment	3-5	10-15	medium	very low
3 Fast	labour mobility	workplace occupancy	<1	5-10	high	reversible
	residential mobility	housing occupancy	<1	5-10	high	reversible
	daily mobility	traffic	<1	2-5	high	reversible

Table 1: Urban change processes. Source: Wegener et al. (1986), p. 4

This means that the larger part of the urban building stock, utilities and infrastructures have not been designed for current contexts, lifestyles and technologies, are more often than not, unable to meet current performance standards, for instance in the field of energy savings and production of clean energy.

Therefore, cities are ill equipped to respond to current or future challenges, such as adaptation to and mitigation of climate change, the ever-increasing demand for transportation and the on-going digitisation of our society. While building stock, energy and transport infrastructures, play a dominant role in emission of greenhouse gasses (GHG), the abundance of legacy systems in urban morphology and infrastructures may hamper the transition towards smart and sustainable cities. Thus, in order to meet the Europe wide objectives of at least 20% respectively 40% GHG reduction, a share of more than 20”% respectively 27% of renewable energy sources in energy consumption, and of 20% respectively 27% energy savings compared to 1990 by 2020 and 2030, both building stock and physical infrastructures need to be deeply renovated, adjusted or operated in a fundamentally different way.

Given the slow pace of urban dynamics discussed above, this is not an easy task. For instance, Hajer (2016) describes how, despite the vital role of urban infrastructures in improving resource efficiency, governance of their alteration is highly complex because long periods of cumulative investments have made them static and make changes very costly, not to mention the consequences of interrupted daily use during refurbishment. For that reason, he expects more from using urban infrastructures in a more sustainable way through smart technologies. In the light of the EU's energy roadmap's eventual aim of an 80 to 95% reduction of GHG emissions by 2050, it can be said that the desired transition to a low-carbon economy with low-carbon cities, will take an enormous effort.

This research will focus predominantly on those physical entities in the built environment, which are relevant to implementation of smart city solutions and subject to low levels of change, as shown in the first row in Table 1. For that reason, this table will be complemented with additional information on these objects, for instance energy and ICT infrastructures.

2 Focus on energy efficiency and renewable energy in cities

This paper departs from the EU's perspective on smart cities, where the reduction of GHG emissions in the built environment by application of smart, in particular ICT-based, technologies, plays a dominant role (see section 3). For that reason, it will not go into the wide range of other application domains of smart city technologies, for instance health, environmental quality, inclusiveness and parity of access, and economic competitiveness. While their importance from a societal perspective is clear, this research wants to stay closely aligned to the EU interpretation of the smart cities concept.

Many authors have demonstrated that investments in energy savings and renewable energy systems (RES) can very well have viable business cases, especially when they offer substantial co-benefits; see for instance Gouldson et al. (2018). However, the slow pace of change in the built environment and the lack of a widespread transition to smart sustainable cities (EC Directorate-general for Internal Policies 2014, Loorbach et al. 2016), indicate that the business cases might not yet attractive enough compared to regular investments. This in spite of the prospected size of this market (Gouldson et al., 2015, McKinsey Global Institute, 2018) and the significant potential to reduce GHG emissions. For instance, Hoornweg and Freire (2013) calculated that wide scale deployment of smart city technologies could reduce CO_2 emission by 7.8 gigatonnes, nearly 20% of global emission in that year.

It is clear the local governments can at best only partially bear the full costs of investments of a transition to smart and sustainable cities. This means that for the realisation of their aims, local governments have to rely on strategic allies and co-initiators of plans for smart sustainable cities, such as housing associations, energy suppliers and energy network operators, transport providers, local businesses, tenants and owner-occupiers in housing. Besides, a different governance philosophy is needed where civil society and private parties actively contribute to the realisation of public goods as sustainability (Hajer 2011). So far, urban stakeholders are often insufficiently involved in decision-making, while implementation cannot be forced upon them, and knowledge and creativity of non- governmental parties is insufficiently used. Only by exploiting the potential of an «energetic society» of articulate, creative citizens and by acknowledgement of society's learning abilities, can governments realise public objectives as sustainability (Hajer, 2011).

3 Definition of the Smart Cities concept

There is a wide range of different definitions of smart cities, and thoughts about what constitutes them and makes them smart, see for instance excellent overviews of definitions and concepts by Albino et al. (2015) and Mora et al. (2018). Generally spoken, the smart city concept assumes the emergence of a new layer of urban data and advanced, interoperable, ICT's on top of the traditional physical elements in the built environment, opening up new possibilities for (re)design, operation and use of the built environment, and for interaction

between citizens, or between government and citizens, what can lead to new or better services and new business opportunities.
However, despite increasing popularity of the term smart cities in science and practice, there is no agreement yet on a common accepted definition. Albino et al. (2015) attribute this to the fact that the term smart cities has been applied to both the “hard” domain of urban morphology and its infrastructures, where ICT fundamentally influences the functions of systems, and the “soft” domain of education, social inclusion, culture, innovation and administration, where ICT application is less decisive. Nevertheless, common features of smart cities can be defined, such as a citywide, networked infrastructure enabling political efficiency and social and cultural development, room for business and creativity-led urban development, attention for social aspects of urban development, and the natural environment as key strategic component (Albino et al., 2015).

In their bibliometric analysis of the smart city research field, Mora et al. (2018) found specific thematic clusters, each related to a specific understanding and conceptualisation of smart cities, which is reflected in a particular strategic perspective for smart city development. They observe a distinct European path, where ICT’s are seen as a key factor in improving energy efficiency in the built environment. Thus, smart cities are defined as cities that create the conditions for market acceleration and widespread uptake of energy-efficiency technologies in cities, eventually leading to a transformation of the currently unsustainable energy system (EC, 2009). Contrary to the Ubiquitous, Experimental, Corporate, and Holistic Paths, the European Path does not embrace as many domains as possible, but focuses on the deployment of low-carbon technologies in transport, buildings and energy distribution networks (Mora et al., 2018).

4 Smart cities in Europe

In EC policy, smart city policies are anchored in a number of directives and agreements. At first the Strategic Energy Technology (SET) plan (EC, 2017) and the climate and energy policy objectives for 2020, 2030 and 2050 (EC, 2010a, 2012, 2016b). At second, smart city policies are linked to the Digital Agenda for Europe (EC, 2010b). Lastly, ambitions for low emission mobility and logistics as laid down (EC, 2016a).

Experiences from successful earlier programs, such as CONCERTO and CIVITAS, have been very important for further articulation of EU smart city policies. CONCERTO has proved in 53 pilots that a district-based approach to deep refurbishment and clean energy can deliver more than 50% reduction in energy consumption and GHG emission with a viable business case (EC, 2014). CIVITAS has amply demonstrated the feasibility of sustainable transport solutions. Subsequently, more integrated, cross-domain smart city projects have been part of Framework Program (FP) 9 and Horizon2020 SCC-01. The first generations of these lighthouse projects as Triangulum, SmarterTogether and REMOURBAN, have now successfully implemented plans integrating smart transport, smart buildings and smart infrastructures, usually in a specific district. Common ingredients of most Horizon2020 SCC-01 plans are installation of smart meters, smart thermal and/or power grids, and RES in combination with thermal insulation and deep retrofitting, smart lighting, introduction or extension of car sharing systems, promotion of private and public electric vehicles, Intelligent Transport Systems (ITS) and instalment of urban platforms. The urban platforms connect the different domain subsystems through interoperable ICT and provide new services to both citizen and government, or support co-design and co-creation of solutions to urban challenges (Borsboom-van Beurden et al., *forthcoming*, 2018).

A host of excellent projects, programmes, initiatives and networks has worked on low energy districts and smart cities in the EU, not only the aforementioned CONCERTO, CIVITAS, FP9 and Horizon 2020 projects and programmes, but also networks as C40, ICLEI, Covenant of

Mayors, 100 Resilient Cities, and European Innovation Partnership on Smart Cities and Communities. A learning environment has been created, where knowledge, best practices, and lessons learnt are shared and jointly brought to the next level. Nevertheless, the pace of adoption of new methods and technologies is still too slow to achieve EU goals on energy savings, renewable energy and emission of GHG's for 2030 and particularly for 2050 (EEA, 2015). Not only should new policies be implemented earlier, also should the supply of energy, food, transport and housing be restructured, substantial investments made in RES, smart meters and energy saving appliances be used more widely, high standards set for energy performance of buildings, and alternative fuel vehicles, public and slow modes of transport promoted (EEA, 2015).

While many European cities are embracing the smart city concept, developing smart city strategies and implementing smart city projects, a widespread breakthrough seems not yet to be taking place ((EC Directorate-general for Internal Policies, 2014, McKinsey Global Institute, 2018). A couple of persistent barriers and obstacles result in lengthy planning and implementation phases, or sometimes even in cancellation of smart city and low energy district projects. These barriers and obstacles have been analysed, for instance for CONCERTO programme by Mosannenzadeh et al. (2017), and for smart city projects by consultants as PWC et al. (2016) and McKinsey (2018), and by the Action Cluster Integrated Planning/Policy and Regulations of the European Innovation Partnership on Smart Cities and Communities (Borsboom-van Beurden et al., *forthcoming,* 2018).

The most common barriers are 1) high initial and operational costs of smart city solutions, 2) lack of financing and appropriate business models, 3) siloed governments, 4) lack of technical skills in staff, 5) risk aversion by financial organisations, 6) split incentives, 7) inconsistent government policies, 8) prohibitive legislative frameworks, for instance for pre-commercial procurement, 9) lack of proven solutions and validated examples, and 10) difficulties with engagement of local stakeholders. The latter can be in particular a problem in highly privatised European countries. The multitude of interdependencies existing between urban actors makes it even more complicated to align interests and create a common operational picture, especially when concessions are granted to best-value-for money without sustainability criteria.

What is more, the direct impact of implemented smart city projects can be limited due to their usual "pilot-like" character: more or less singular, tailored to a specific context and situation, with a limited scope, subsidy-dependent, quite small and sometimes lacking a truly holistic perspective. While these complex projects provide invaluable information and lessons learned, and are quintessential for building a learning community, market acceleration of successful technologies, products and methods is lagging behind. A pattern of "islands of smartness" seems to prevail, as Snøhetta director Kjetil Trædal Thorsen labelled it during a panel discussion at Nordic Edge 2017 conference.

5 The need for a systemic citywide scan of windows of opportunities

A couple of reasons have inspired this research to focus on upcoming changes and adjustments in the urban fabric and the investments involved. At first, local governments have insufficient resources to finance full-scale transformation of the built environment and its infrastructures to a smart and sustainable state. At second, the volume of investments by local governments, owners and operators into maintenance and management of buildings and infrastructures, is a multitude of the volume of so-called innovation pilots, and they will happen anyway, so why not make maintenance and management measure vehicles for smart and low energy solutions? At third, lengthy preparation phases can be shortened and success rates of implementation improved if possibilities for smart city solutions are included earlier in policy and decision making processes, for instance because relevant stakeholder are identified and engaged earlier. At fourth, by making pilots part of a larger systematic approach to smart cities and low energy districts, the potential for replication within a municipality's jurisdiction increases. Currently, pilot projects are often more or less incidentally chosen, often more on political than on strategic grounds. By selecting those areas that are highly representative for the city's building stock and urban infrastructures, most in need of adjustment and having the largest potential for improvement, future replication can be fostered.

However, more mundane reasons for transitions to smart and low-carbon cities not taking off could also be in play. Current policy and decision-making processes by key stakeholders in the city might simply overlook possibilities for such investments, especially in very early phases of policy and decision making processes, because they are recognised too late. As these phases contain the seeds of future change, the question is whether smart city solutions would be implemented more widely, if rudimentary information on the potential of smart city solutions would be available during these very early phases. These considerations have led this research to focus explicitly on the pre-phase of actual planning and decision-making, and on the role of information on viable business cases and models for smart city solutions in this pre-phase. It aims to identify which dynamics and changes can be expected in the urban fabric, which stakeholders are involved, and how the opportunities that urban dynamics and changes offer for useful application of smart sustainable city solutions, can be seized by identifying them at a very early stage. In that way, such investments can be made part of novel practices in planning, real estate development and exploitation, and lastly maintenance and management of building stock and urban infrastructures during its lifecycle.

The following sections discuss the different building blocks that could compose a systemic citywide scan of the windows-of-opportunities for introduction of smart city solutions.

6 Potential windows of opportunity made explicit

The term «window of opportunity» is stemming from political sciences, as part of the Multiple Streams Framework (MSF), or Multiple Streams Analysis (MSA), which explains policy changes under multi-actor and multi-level conditions (Kingdon, 1995; Zahariadis, 1999). Three more or less independent streams, that is, a problem stream identifying problems, a policy stream containing ideas about possible solutions, and a politics stream reflecting the "national mood", produce these policy changes together. When there is simultaneously high attention for the problem, a viable solution available and a policymaker motivated and able to select it, a window of opportunity is open for major policy change (Zahariadis, 1999; Cairney and Zahariadis, 2016).

The MSF has been applied at many different scale levels and in other situations than national government agenda-setting studies, with varying degrees of success (see Cairney and Zahriadis, 2016). It is obvious that the multi-actor, multi-sectorial and often multi-level policy and decision-making required to create a smart and sustainable built environment, is endlessly more complicated, and maybe even too complicated, to apply the MSF. Nevertheless, the concept "window of opportunity" offers a powerful metaphor for the unique opportunities, both in space and in time, now and in the future, where policy and decision-making in cities can bent towards more effective sustainable and smart options. Exactly for its metaphorical power, the MSF concept of a "window of opportunity" has been chosen here as point of departure for a systemic, citywide analysis of spatial and temporal possibilities to incorporate smart and sustainable methods and technologies in joint policy and decision-making processes.

As follows from the MSF, one of the conditions for a window of opportunity is the existence of a viable solution, which is known to the initiator of the policy change. One of the reasons for not being on track for the 2030 and 2050 GHG emissions, energy savings and share of renewable energy, might be that strategic windows of opportunities for the introduction of sustainable and smart city solutions are missed, and that business as usual prevails often in practice. Given the incredible slow pace of change regarding vital urban objects as buildings and infrastructures, this is a missed chance. For that reason, it is of paramount importance that viable solutions are known at the very moment that a window of opportunity arises, and preferably even before.

A comprehensive overview of expected dynamics and adjustments at object level in building stock and urban infrastructures reflecting stakeholder’s agenda’s, combined with an overview of relevant smart and sustainable solutions, and a generic business case and exploitation model, will provide policy and decision makers with an evidence base when windows of opportunity are popping up in future.

7 Main changes in the urban fabric identified

Altogether changes in demography, lifestyles, and economy, translate into continuous development and adjustment of urban morphology and urban structures, often quite gradually. Spatial planning puts preconditions to these developments and channels it. It can be expected that the dynamics in cities as described in section 1, will offer many possibilities for implementation of smart low-carbon technologies in cities, by local governments, and strategic allies such as citizens, energy suppliers and transport network operators, and for enablers such as investors. Policy processes might be for instance the implementation of the mandatory Sustainable Urban Mobility Plans (SUMP’s) or the Strategic Energy (and Climate) Action Plans, where local governments commit themselves to in the Covenant of Mayors.

Section 8 summarises the usual actors in integrated planning and management of smart city projects. In order to be able to define the windows of opportunity now and in the future more precisely, this paper distinguishes the main processes of change in the urban morphology and urban infrastructures, and in their operation, which might open up new possibilities for introduction of smart city solutions. Table 2 is a first attempt to make an overview of typical smart city solutions applied in Europe. Table 3 summarises the main processes of change from a holistic perspective, and relates these to specific objects in the built environment and potential windows of opportunity. These tables will be validated and completed later.

Objects	Typical smart city solutions
Residential, buildings; Commercial, social, educational, medical buildings; Industry buildings and installations	Low-, zero- and positive energy construction and refurbishment technologies, installations and appliances, e.g. thermal insulation, passive houses, heat recovery from ventilation; Integration with renewable energy production; Making buildings more intelligent through sensors, actuators and interoperable ICT, smart meters; Creating uni- or bi-directional charging infrastructures for electric vehicles as cars and bikes; Providing collective solutions for energy supply, such as solar plants, geothermal or district heating; Make operation and use of the building smarter, e.g. through sensorised smart lighting; Using clean mobility and logistics solutions to provide transport, e.g. electric vehicles, smart parking, clean “lastymile”yinylogistics,y Applying principles or smart (re)design, integrated planning and implementation at district level, e.g. based on holistic energy and transport designs which have been co-designed with stakeholders; Smart process technology in industry, e.g. allowing re-use of excess heat and by-products as hydro
Infrastructures	Enable smart operation and use of the infrastructures with sensors and actuators, other urban data and ICT, i.e. intelligent transport systems; Make thermal and electric grids smart(er) so they can respond real-time; Enable exchanges, conversion and co-production of energy, e.g. with data centres, or using combined heat power (CHP); Adding sensors and actuators to the physical infrastructures; Organise interoperability between physical infrastructures and buildings through protocols, standards, e.g. Internet of Things, Internet of Everything; Organise smart operations, smart (re)design and improved/novel services to citizens through urban platforms

Table 2: Typical smart city solutions applied to urban morphology and urban infrastructures

At this stage of the research, specific windows of opportunity are not yet linked to specific smart city solutions, appropriate for that situation. These linkages will be made explicit later.

Change processes	**Objects**	**Potential windows of opportunity** if decisions are taken on:
Construction: large scale development *of* new objects on greenfields or comparable tabula rasa, e.g. obsolete harbour areas, or large scale demolition and substitution by similar object(s) with similar function at district level		
Development or substitution of housing and social, educational and medical facilities Development or substitution of offices and business parks Development or substitution of industrial buildings	Residential buildings; Commercial, social, educational, medical buildings; Industry buildings including installations	Densities, land use, form, mobility and logistics; Design of buildings (i.e. building envelope, use of materials, construction technologies, design of installations and choice for appliances, energy performance of the building, (re-)use of resources and circularity) Design of energy supply for electricity, heating and cooling to buildings and district (individual and/or collective systems, central or decentral solutions, exchange of energy between buildings and electric vehicles, use of excess heat and cold, recovery of heat and electricity) Design of provision of other utilities to buildings and districts ((hot)water, sewage and waste treatment and collection, ICT connectivity), process technology Business cases; use and operation, contracting future maintenance and management, facilities and asset management
Construction of new roads; new (light)rail; new utilities such as sewage; new energy networks and distributions grids; ICT connectivity	Infrastructures for transport, energy supply and distribution, utilities, ICT	Selection of design and construction technologies; Standards regarding (re-)use and circularity of resources, e.g. waste treatment; Desired level of energy performance, i.e. of lighting, of equipment and installations Operation of the infrastructures and business cases Desired level of intelligence in infrastructure Integration of infrastructures through ICT
Upgrading, updating and periodical maintenance: original objects adjusted and upgraded to meet new needs and standards		
Refurbishment, upgrading and adjustment of existing buildings and their installations (thermal insulation, , different degrees: can be minor or major adjustments	Residential, commercial, social, educational, medical buildings	25-30 year deep refurbishment cycles and updating to current living standards Proposed changes to building envelope, i.e. thermal insulation Renovation, replacement and upgrading of installations and appliances to up-to-date technical and legal standards, i.e. energy saving solar boilers or smart meters and sensors, or new EPBD Improvement of energy efficiency of building and district, e.g. through recovery or exchange of heat Extensions of the building Transformation into other, more profitable or useful functions, e.g. redundant office space to housing
Renovation, upgrading and adjustment of networks and utilities; also major and minor adjustments	Infrastructures for transport, energy supply and distribution, utilities, ICT	Improvement and rationalisation of management by adding sensors and actuators to the infrastructure; Improving the performance and robustness of infrastructures, e.g. upgrading district heating networks to multi-commodity grids Development of new services and business opportunities on urban platforms connecting and integrating information on infrastructures and buildings;
Demolition, out phasing and possibly replacement of redundant buildings and infrastructures after the end of their life-cycle, often substitution by newly constructed object(s), probably with another function,		
Stepwise, small-scale replacement and redevelopment of buildings in the urban fabric	Residential, commercial, social, educational, medical buildings	Legal requirements and fulfilment of policy obligations, aiming to improve liveability, sustainability, health, comfort, or affordability for residents Problems in use and operation of the building due to outdated installations and appliances, e.g. sick building syndrome Building(s) no longer in demand, changed preferences or needs of customers Economic and financial reasons, profitability of substitution and redevelopment
Phasing out and replacement of existing infrastructures,	Infrastructures for transport, energy supply and distribution, utilities, ICT	Legal changes, e.g. motivated by sustainability, safety or affordability reasons, which induce exploration of alternatives, e.g. for instance substitution of natural gas networks by all-electric or going off-grid by decentral energy supply Economic and financial reasons, profitability of substitution and redevelopment Changes in procurement and licenses to operate Infrastructures no longer in demand, e.g. due to new technologies or lifestyles, e.g. promotion of walking and cycling, or public car sharing replacing own car

Table 3: Overview of main changes in urban fabric in relation to windows-of-opportunity

8 Relevant actors

Nearly all smart city projects are founded upon collaboration in the triple or quadruple helix of local administrations, knowledge institutes, industry and citizens. This means involvement of relevant stakeholders and governance play a dominant role in the successful implementation of any smart city project. The complexity of most smart city projects means that many stakeholders need to be involved, and the fact that many interdependencies exist between these stakeholders, implies that a large variety of interests have to be aligned (Nijman, 2014). Figure 1 depicts a non-exhaustive overview of common stakeholders.

Figure 1: Overview of stakeholders in planning and implementation of smart city solutions
Source: Borsboom-van Beurden et al. (forthcoming, 2018)

9 Contours of a methodology

The key objective of this research is to develop a methodology for identifying the windows of opportunity in districts and cities for the most common smart city solutions on a systemic and long-term basis, inclusive financial aspects, which deliver best value for money and can be easily coupled to investments that are planned anyway. Such a systemic scan during very early, explorative phases of policy and decision-making, will enable local governments, their strategic allies and their enablers, to better exploit specific dynamics and developments as vehicles for bringing about an urban transition towards smart and sustainable cities. The proposed methodology combines elements derived from four methods:

- *Geo-ICT and geodesign*: central to the proposed methodology are spatial data representing the building stock and urban infrastructures. With geo-ICT possible windows of opportunity in future are made spatially explicit, for instance by creating maps of hotspots. In addition, current representation, collaboration and visualization features of Geo-ICT can support transition management by providing detailed information on buildings and infrastructures, by showing interests and positions of different actors and owners, and by showing the possible impact of specific solutions. Geodesign, "*an iterative design and planning method whereby an emerging solution is influenced by (scientific) geospatial knowledge*,… *integrates the exploration of ideas with direct evaluation in the same moment, generating an advanced design solution"* (Lee et al., 2014), will be used as a method during stakeholder workshops.

- *Transition management:* this governance approach is increasingly applied in cities and aims at "*1) Bringing together frontrunners from policy, science, business, and society to develop shared understandings of complex transition challenges; 2) developing collective transition visions and strategies; and 3) experimentally implementing strategic social innovations"* (Wittmayer and Loorbach, 2016). Elements from the transition framework will be borrowed and used in an adjusted form to create a joint appreciation and understanding of urban challenges, and to develop a joint strategy how to address these challenges.
- *Impact assessment:* standard methods and protocols for impact assessment, for example from Societal Cost-Benefit-Analysis, will be applied to analyse not only the spatial impact of expected dynamics on building stock and infrastructures, but also the impact of smart city solutions at GHG emission, share of renewable energy, energy savings, reduced use of fossil fuels and potential co-benefits.
- *Value chains*: standards methods for value capturing will be applied for drafting business cases and value propositions at district level for technically feasible smart city solutions. See for instance Brouwer (2017) for methods to assess the financial aspects of future-resilient and sustainable urban development.

The methodology will eventually support the following stages:

Snapshot	• Define area (street, neighbourhood, district, village or city) • Collect spatial data on objects in the urban fabric (land, buildings, infrastructures for energy, transport, utilities and ICT, other relevant physical objects) • Collect attribute data on ownership, operational and legal responsibilities, and use per object
Dynamics & investments	• Draft list of transport and urban planning interventions by local/regional authorities • Draft list of regular and foreseen refurbishments and adjustments by owners and operators of physical objects as buildings and urban infrastructures • Make timeline of interventions, and expected refurbishments and adjustments • Chart spatial impact of this on physical objects and map corresponding stakeholders (owners, operators, users) • Estimate the value of planned and expected investments per object • Visualise dynamics and investments in GIS «Dynamics» and «Investments» layers • Draft timeline for urban dynamics and investments • Identify hotspots where robust opportunities occur in future, rank these • Validate hotspots and ranking with experts and strategic allies, which most-promising?
Windows of opportunity	• Draft list of applicable smart city solutions given foreseen dynamics and ajustments • Assess suitability, technical and economic feasibility and potential impact of smart city solutions for objects, select most-promising options with owners, operators, users • Visualise high-feasibility, high-impact solutions in GIS in «Feasibility» and «Impact» layers • Create combination map by overlaying «Dynamics», «Investments», «Feasibility» and «Impact» layers, flag objects with high scores • Map these «spatialised» upcoming windows of opportunity on the timeline
Negotiations and financing	• Share outcomes with strategic allies and key enablers, select most-promising solutions • Develop roadmap for integrated planning and implementation • Engage stakeholders, analyse appropriate financial schemes, PPP's, start negotiations

Figure 2: Proposed methodology for a systemic, city-wide scan of windows of opportunities for smart city solutions

Not all stakeholders included in Figure 1 will be end-users of the envisaged systemic, citywide scan. Nevertheless, it is possible to identify some key actors as potential end-users:

- Those who have specific responsibilities in the built environment as *municipalities and regional authorities, r*esponsible for public goods as accessibility, and environmental and spatial quality. They give permission for changes to buildings and infrastructures. Municipality-owned housing associations also belong to this category;
- Stakeholders that are responsible for *operation, management and maintenance of urban buildings and infrastructures*, such as local energy producers, transport operators, non-municipal road authorities, and utility providers. These stakeholders might be public or private, as provision of basic needs as water and electricity to inhabitants and local businesses is organised very differently per country;
- *Owners of land, buildings and urban infrastructures*. Not only can they initiate planning and implementation of smart city solutions themselves, they have to agree on the plans when proposed by others, and possibly share the financial burden of implementation. This category is very heterogeneous, depending upon planning system and culture, and can range from pension funds owning rental housing to housing cooperatives and farmers still owning plots of land in the city. Residential owner-occupiers can be a difficult category to convince if the plan does not fit their own interests and ambitions, or just does not suit their timeline.
- *Users of the built environment*, who come in many forms, making the “citizens” a difficult group to define: tenants, who often are required by law to approve of plans, local businesses and their staff, commuters, visitors and tourists.
- Those who have ensured *financing*, such as investors, banks who gave loans, private equity, and want to secure the profitability of their current and future investments.

10 Conclusions and next steps

Transitions to low-carbon cities are hampered and delayed by costs, uncertainties and risks, sunken costs, path dependencies and legacies, and non-aligned stakeholders. The possibilities to smartify cities by making investments in a different way through alignment with planned and upcoming adjustments and interventions is enormous. This paper proposes a geodesign based methodology, which scans the possibilities for deployment of smart city solutions at a very early stage. This helps to take better decisions far in advance. Further development of the methodology will take place with the following steps:

1. Desk research on expected dynamics and adjustments to the urban fabric during the lifecycle of its physical objects in the case study areas;
2. Interviews with the aim of collecting more information on how are decision making is prepared in different change processes by local governments and their strategic allies, in particular during very early phases. In addition, interviewees will be asked to reflect on the design of the methodology and potential end-users. This input will be used to extend Wegener’s table with buildings and infrastructures relevant for smart city solutions and to adjust the proposed methodology;
3. Selection of three to four cases across Europe, representing different geographies, planning cultures, city sizes, governance models, and local challenges;
4. Working out the methodology as depicted in Figure 2 for every case;
5. Testing of the methodology in workshops with stakeholders in the case study areas;
6. Evaluation of the outcomes together with local governments and key stakeholders and refinement of the methodology.

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Planning issues of wind farms siting in Russian Federation

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1. Introduction

Russia as a country with the largest territory in the world and one of the longest coastlines has enough suitable locations for siting onshore, nearshore and off-shore wind farms. Wind power potential of Russia is estimated at 16'500 TW.h/year [1]. Although these opportunities do exist, the Russian Federation is strongly bound to fossil fuels both in the internal economic development and in import-export balances.
Despite huge wind resources and governmental support, national plans for wind energy are modest. Based on the National Energy Strategy of Russia till 2035 and current trends, the International Renewable Energy Agency (IRENA) [2] predicts up to 5% of total energy demand to be covered by renewable sources, the installed capacity of solar power plants by 2030 – to be only 2.7 GW, and wind power stations – 5 GW. For comparison, US government reports estimate wind power to contribute up to 20% of national electricity supply by 2030 [3]. WindEurope's Central Scenario assumes to get a 30% share of EU's power demand from wind power [4].
At the same time, the Russian Federation is considered to be one of the world's leaders in carbon dioxide emission with 5% share in 2014 [5]. Even so, Paris agreements, calling for 25% to 30% emission reductions below 1990 levels by 2030, were not ratified by Russia [6].
This article discusses the constraints on the way to provide better conditions for wind farms' construction, looking for necessary improvements in Russian national policy, planning system and land use operational mechanism.

2. National context

2.1 Wind resources

Starkov et al. (2000) developed Russian Wind Atlas, where wind energy resources are studied.

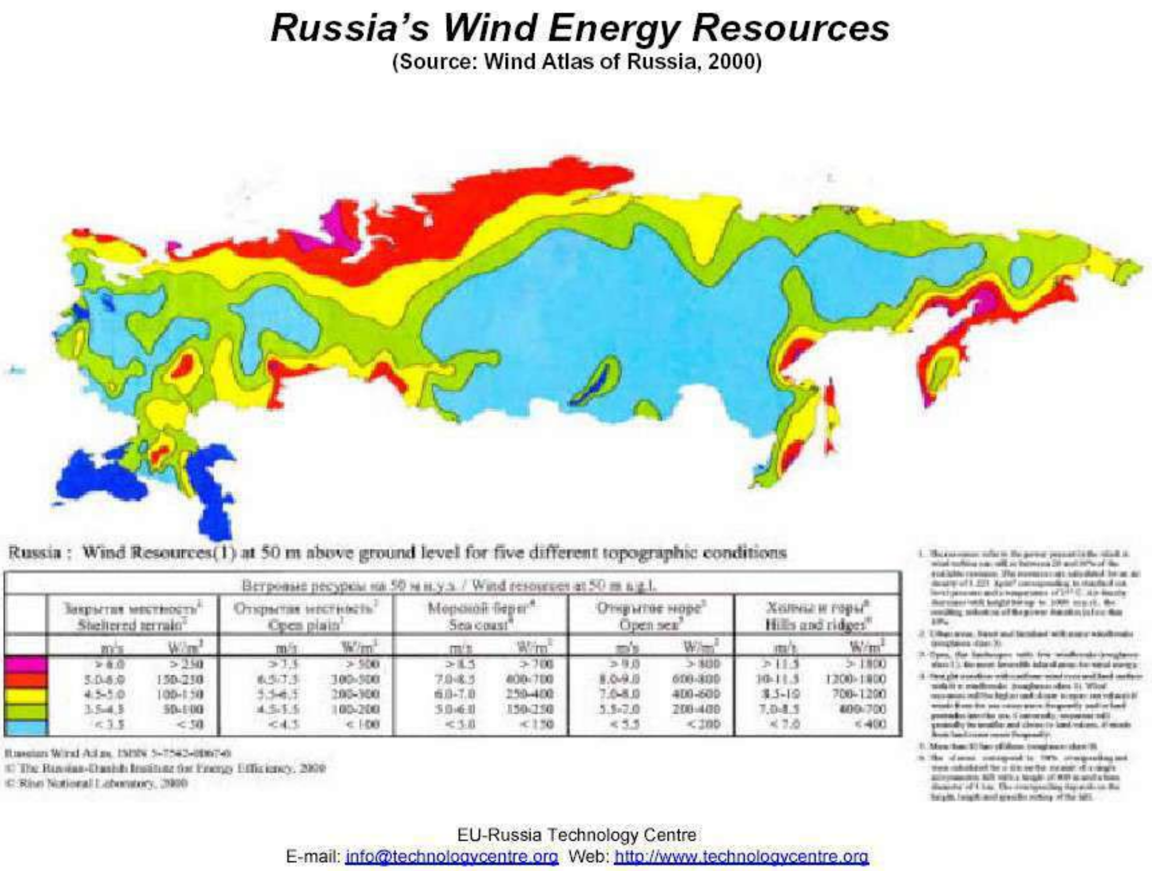

Figure 1 : Russia's wind resource map (source: Russian Wind Atlas)

The areas of greatest wind resource are the regions where the population density is less than 1 person per km2 [7] The coastal areas of the Pacific and Arctic Oceans, the vast steppes and the mountains are the areas of highest potential. Recent estimates suggest that the European part of Russia has a gross wind energy resource of 29 600 TWh/yr (37%) and the Siberian and Far East part, 50 400 TWh/yr (63%). The technical resource for each is reported to be 2'308 and 3'910 TWh/yr, respectively.

It has been suggested that large-scale wind energy systems might be applied in areas where the resource is particularly favourable and there is an existing power infrastructure and major industrial consumers. These would include various locations in Siberia and the Far East (east of Sakhalin Island, the extreme south of Kamchatka, the Chukotka Peninsula in the Magadan region, Vladivostok), the steppes along the Volga river, the northern Caucasus steppes and mountains and the Kola Peninsula. Additionally, offshore wind parks could be considered in some of these areas, especially in the Magadan region and in the Kola Peninsula where existing hydropower stations could be used to compensate for the intermittent wind power.

The Russian Association of Wind Industry (RAWI) has stated that as at March 2010, 4'134 MW of wind capacity sites had been identified.

Breyer et al. [8] created a computer model, which considers the energy costs of various types of renewable sources, and marked the optimal kind of renewable source according to its regional potential. This strategic choice was offered for a long-term path to a completely renewable energy power supply.

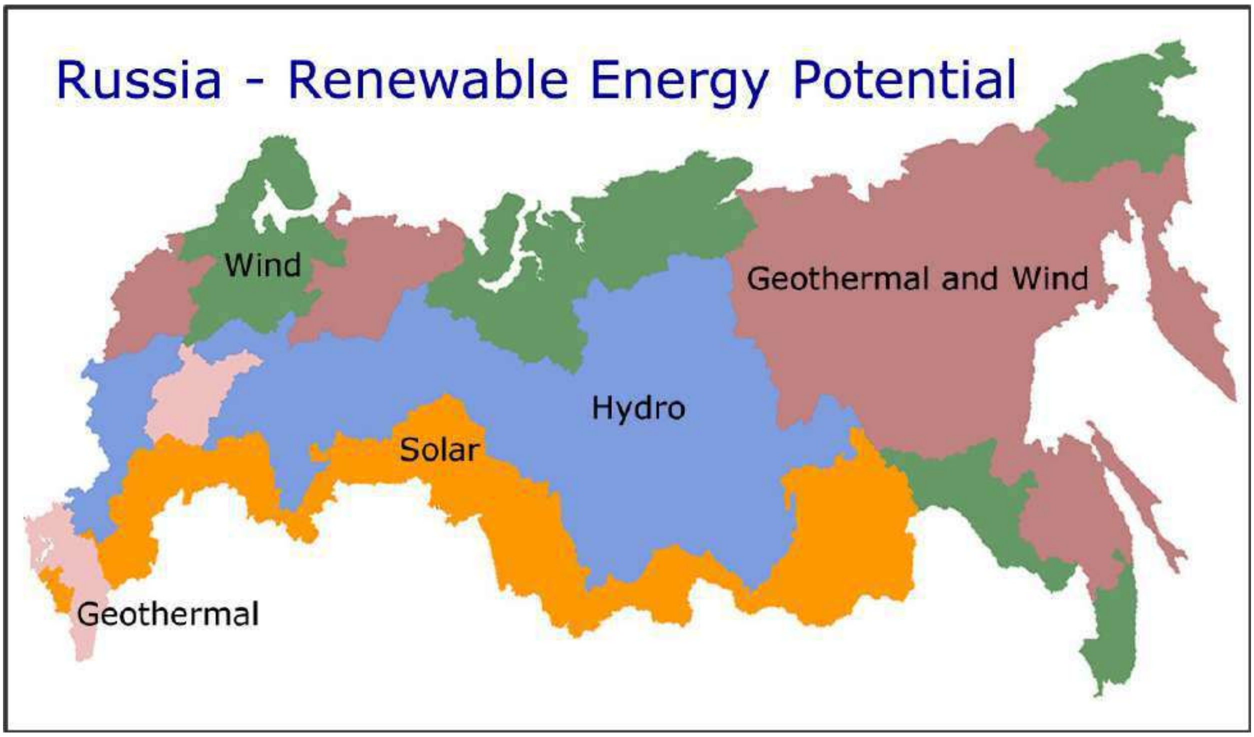

Figure 2 : Russian renewable energy potential (source: Bogdanov, D., Breyer, C. [9])

2.2 Current power production

The total power capacity in Russia currently equals 239.8 GW, while wind power annually produces 96.71 MW, which is less than 0.05%. The Unified Energy System of Russia includes 748 power plants with a capacity of over 5 MW and generates about one trillion kWh of electricity per annum.

Table 1 : Power output and consumption in Russia (2017) (source: System operator of the Unified energy system http://so-ups.ru/)

№	Parameter	millions kW h	%
1	Output	1053861,5	100,00%
a	- thermal power plants	611341,5	58,01%
b	- hydroelectric power stations	178901,6	16,98%
c	- nuclear power plants	202642,4	19,23%
d	- others	60976	5,79%
2	Consumption	1039879,9	98,67%

Energy deficit regions are mostly located in the southern part of Russia (deep in the Eurasia continent), what makes land-based wind farm more relevant (see Fig. 3).

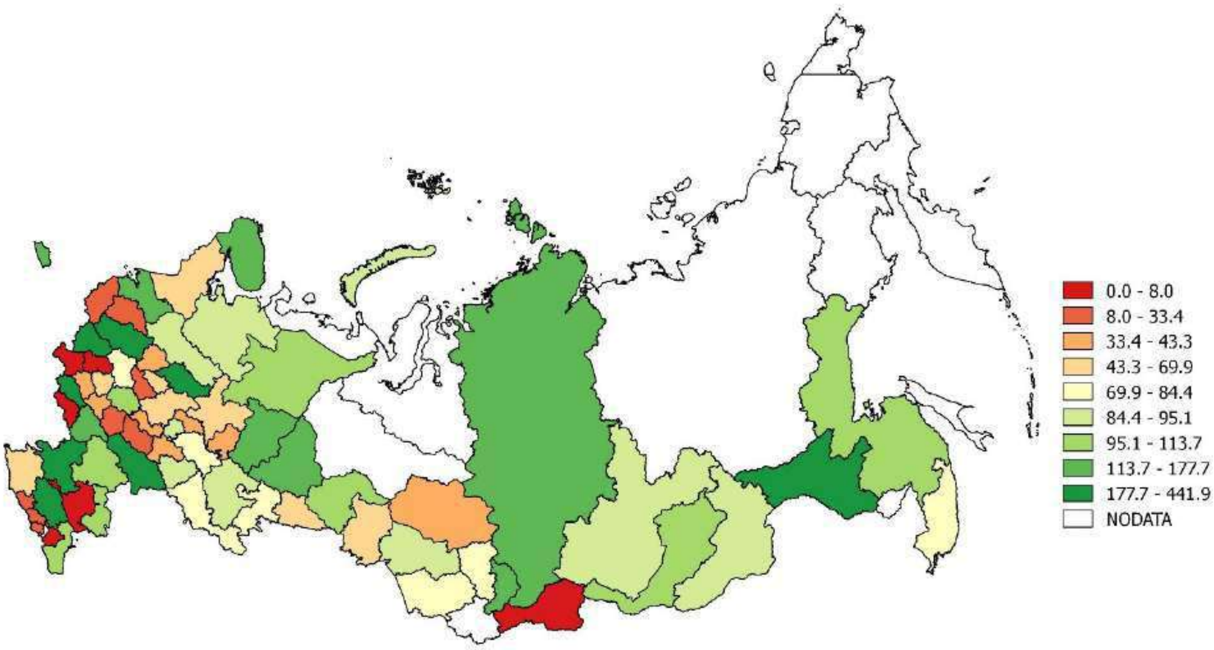

Figure 3 : Map of power production divided by power consumption (per cent) for each region in Russia (2017). Green regions are «power donors», red regions are «power recipients». (source: made by author)

Wind power stations and projects of planned wind farm construction are distributed unevenly (see Fig. 4).

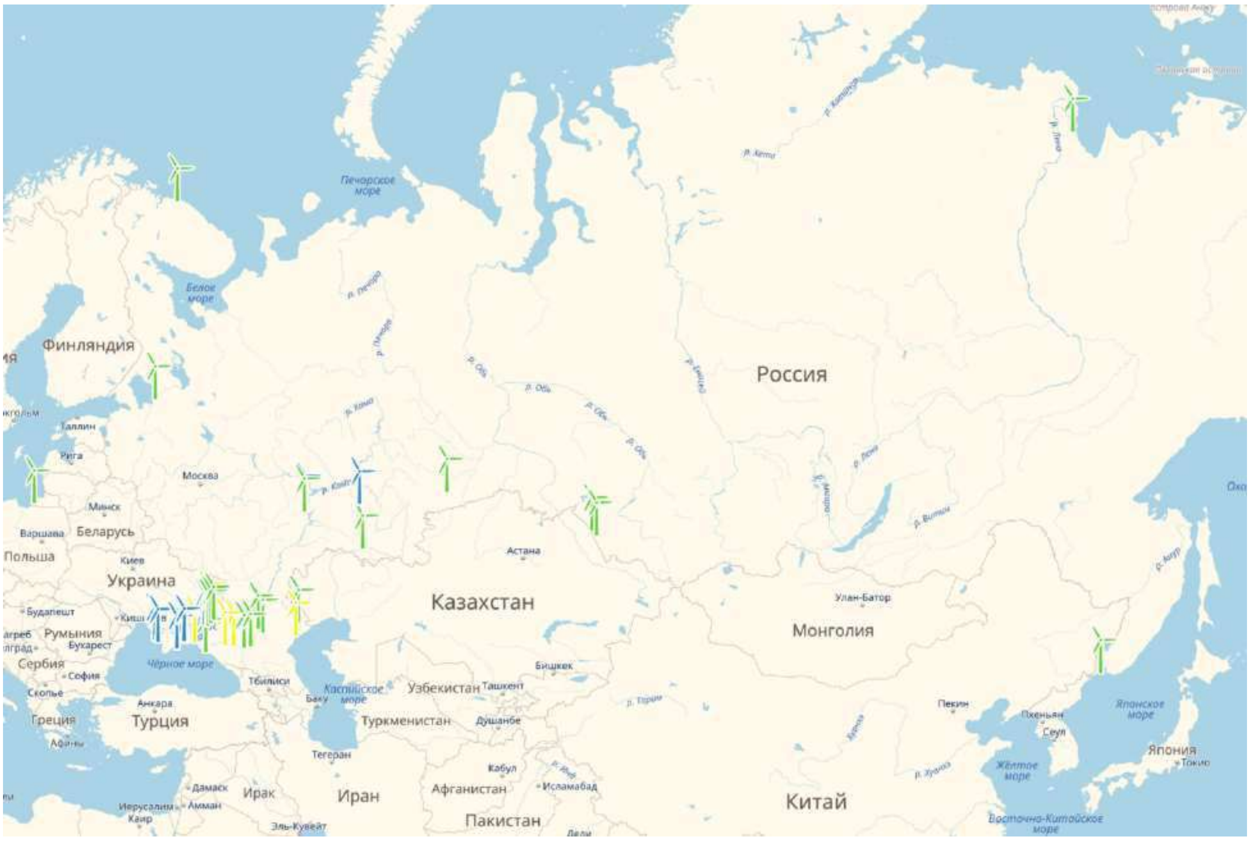

Figure 4 : Map of wind energy projects in Russia. Yellow – wind monitoring stage, Green – design stage, Blue – exploitation stage. (source: Russian Association of Wind Industry, RAWI https://rawi.ru/ru/map18/)

According to the RAWI data, there are 8 existing wind farms in Russia.

Table 2 : Wind power stations in Russia (source: Russian Association of Wind Industry, RAWI)

№	Name of the wind farm	Region	Installed capacity, MW	Year of completion
1	Ulyanovsk wind farm	Ulyanovsk region	35	2018
2	Tyupkildy wind farm	Republic of Bashkiria	1,65	2001
3	Presnovodnenskaya wind farm	Republic of Crimea	7,39	2006
4	East Crimean wind farm	Republic of Crimea	2,81	2009
5	Sudak wind farm	Republic of Crimea	3,76	2001
6	Sakskaya wind farm	Republic of Crimea	20,82	1998
7	Donuzlav wind farm	Republic of Crimea	6,78	1992
8	Tarkhankut wind farm	Republic of Crimea	18,5	2001

Total installed capacity of wind farms in the Republic of Crimea is about 64 MW, but all of them were commissioned before 2014, when the Russian Federation began to consider Crimea to be a part of its territory.
The energy infrastructure of isolated regions is based on a stand-alone power supply ("off-grid") mainly consisting of diesel power plants with one or more diesel generators. The number of diesel generators in these isolated areas is about 900; diesel power plants produce about 2.5 billion kWh, which equals the consumption of approximately 1 million tons of diesel fuel per year (to substitute diesel power completely with wind power would require a wind capacity of 1000-2000 MW plus storage, depending on the specific sites.) There are cross-subsidization in these regions and procedures how to cover the difference between the real generation costs (up to 2.5 $/kWh) and the actual rate for the customers (3-4 cent/kWh) have not been worked out yet [Elistratov et al., 7].

Table 3 : List of stand-alone wind-diesel hybrid energy systems in Russia (source: Elistratov et al.)

Location	Wind	Diesel
The Bering Island (Kamchatka)	550 kW (2 Vergnet GEV-C with unit capacity of 275 kW)	1168 kW
The Ust-Kamchatsk village (Kamchatka)	first stage: 1 Vergnet GEV-C (capacity of 275 kW in the version for cold climates); second stage: 3 wind turbines Komai KWT 300 (unit capacity of 300 kW)	8 MW
The Novikovo village (Sakhalin region)	450 kW (2 turbine with unit capacity of 225 kW)	N/a
The Republic of Tatarstan	Ghrepower FD 12-30/11 (30 kW)	N/a

The Amderma village (Nenets Autonomous Okrug)	200 kW (4 arctic version turbines Ghrepower-50 with unit capacity of 50 kW)	800 kW

2.3 Legislation

Russian government made first steps to support the development of wind and renewable energy, codified in the amendments of 4.11.2007 in the Federal Law of 26.03.2003 № 35-FZ “On Electric Power Industry”1 . Based on that Law, the Non-profit Partnership “Council for Organizing Efficient System of Trading at Wholesale and Retail Electricity and Capacity Market” (“NP Market Council”) was established. This organization, on a membership basis, brings together electricity sellers and buyers that are wholesale market entities (including renewable energy and wind power) taking part in the circulation of electric power on the wholesale market. It also pairs up companies operating the commercial as well as technological infrastructure of the wholesale market and other companies of the electric power industry.
The Government Decree of 28.05.2013 Nr. 449 “On the mechanism of promoting the use of renewable energies in the wholesale electricity market and power” was approved as another important step: A requirement for mechanisms was introduced to work with renewable energy projects in the wholesale electricity market, including regulations to develop renewable energy until 2020.
The development of renewable energy in the retail market of Russia is carried out in accordance with the programs of the energy efficiency in these regions, and the local authorities are taking over the role of the “NP Market Council”, e.g. by organizing tenders. The main documents in the retail market are the Government Resolution of 04.05.2012 Nr. 442 (ed. on 10.11.2016) “The rules of functioning of retail electricity markets” and the Federal Law of 23.11.2009 Nr. 261 “The improvements on energy saving and energy efficiency in the retail market” (energy service contracts). In addition, there are local energy efficiency laws in some isolated regions.

2.4 Support from the government

Wind energy like other renewable energy sources is legislatively supported in Russia since the May of 2013. The goal of support is not a replacement of traditional generation (based on natural gas, oil, coal, etc.) with renewable sources, but the development of new power generation technologies. The support is provided both in the wholesale and retail energy markets.
Legislative support of renewable energy sources includes following privileges:
- power produced by wind farms over 25 MW is totally purchased during 15 years at a fixed price plus 12% profit for investor;
- the fixed price takes into account fluctuations in the exchange rate, the actual value of the project's capital expenditures, other parameters.

According to the Government Decree №449, 3.35 GW of installed capacity will be installed by 2024 – 4.5 GW in 2030.

Table 4 : Installed capacity of the wind farms to be supported according to the current program for each year (source: the Government Decree №449)

Year	2017	2018	2019	2020	2021	2022	2023	2024
Capacity, MW	200	400	500	500	500	500	500	150

Main conditions for obtaining the support are:

- the maximum of capital expenditures (CAPEX) for wind power projects is determined (for example, in 2016 it was 152'000 roubles for 1 kW);
- localization principle - wind farms built in Russia should use equipment and services, produced in Russia. If a wind farm is commissioned after 2019, then localization rate has to be 65% or more.

Energy projects based on renewable energy sources are being held for a contract for the supply of capacity (CSC) as a legal form of the support mechanism. The selection of wind farm projects is held every year for the upcoming 4 years. The CAPEX is the main criterion: the smaller the CAPEX is, the more likely to win.

Table 5 : Wind power projects selected for the wind energy supply since 2013 till 2016 (source: https://www.atsenergo.ru/vie/proresults)

№	Year of the selection	Name of the wind farm	Region	Installed capacity, MW	Date of completion (plan)	Date of completion (fact)
1	2013	Aksaray wind farm, Funtovo wind farm,	Astrakhan Region	15 + 15 =30	2016, 2017	uncompleted
2	2013	Airport wind farm, Novosergievskaya wind farm	Orenburg region	15 + 15 = 30	2017	uncompleted
3	2013	Karsun, Isheevka, Novaya Maina wind farms	Ulyanovsk region	15 x 3 = 45	2017	uncompleted
4	2014	Priyutnenskaya wind farm, 1 stage	Republic of Kalmykia	51	01.12.2015	uncompleted
5	2015	Ulyanovsk wind farm	Ulyanovsk region	35	01.12.2016	01.2018
6	2016	Pilot wind farms	Krasnodar region	20 MW x 23 = 460	10 in 12.2019 13 in 12.2020	is being implemented
7	2016	Shovgenovskaya wind farm	Republic of Adygea	48 + 70 + 32 = 150	01.12.2018	is being implemented

Thus, only one of the 9 wind farms, which should have been completed by today, is really built. But even it was built 2 years later.

Speaking about projects, the implementation period of which is known, but has not yet come, in 2017, projects with a total capacity of 1.65 GW were selected, including 924 MW in the southern regions. And in 2018, projects with a total capacity of 853 MW were selected, including 588 MW in the southern regions. This distribution follows the energetic deficit in southern part of Russia, which was described earlier.

2.5 National planning

At the same time, Scheme of territorial planning of the Russian Federation at the field of power engineering, STP RF PE (national level planning document) plans 15 wind power plants to be sited in different regions till 2030 with total installed capacity over 4500 MW.

Table 6 : Wind farms planned for construction until 2030 (source: STP RF PE)

№	Region	Installed capacity, MW
1	Kaliningrad region	200
2	Leningrad region	300
3	Murmansk region	300
4	Murmansk region	100
5	Nizhny Novgorod region	350
6	Orenburg region	150
7	Saratov region	1000
8	Astrakhan region	100
9	Republic of Kalmykiya	150
10	Krasnodar region	1000
11	Republic of Adygeiya	195
12	Republic of Adygeiya	102
13	Republic of Adygeiya	144
14	Karachay-Cherkess Republic	300
15	Omsk region	110
	Total	4501

The most ambitious wind power projects (1 GW each) are planned in Saratov region and in Krasnodar region. As it was shown earlier, Krasnodar is the second most energy deficit region in Russia after Moscow, so the decision seems reasonable. But Saratov is the biggest energy donor in the country, which generates three times more then uses for internal needs. It makes the distribution of future wind farms questionable.

3. Challenges and constraints of wind power development

Most common constraints of wind power projects discussed by researchers in different countries are:
- environmental impact;
- territorial requirements:
- amount of land;
- configuration of parcels;
- landscape conditions;
- temporary and permanent land uses;
- distance to residential zones;
- complications for agriculture;
- volatile power supply by wind farms and the necessity of storage infrastructure;
- social acceptance;
- lack of properly adjusted law.

Based on stakeholders' interviews Gsänger and Denisov [10] outline main barriers for the Russian wind power industry:
- a general lack of investments and investors which is primarily related to an insufficient and intransparent remuneration scheme and the small market volume but also to the macroeconomic situation in the country.

- a significant number of weaknesses in the regulatory framework, including land use issues, standards etc.
- challenges with grid connection.

In a sense, all of the above constraints can be connected to the planning process, that's why we will study them more.

3.1 Environmental impact

Although wind power is considered to be one of the cheapest renewable energy sources (by levelized cost of energy – LCOE [11]), it doesn't mean that energy production became completely harmless for the natural environment. To avoid these risks a relevant site-specific research should be conducted before siting a wind farm.
Often this impact is shown through the bird migration processes [12, 13]. Wind turbines' sweep of the blades can reach up to 200 meters, what can potentially be catastrophic for birds' population.
Wind turbines are also criticised for its noise. Latest studies show that noise level of modern wind power plants is usually 35-40 dB(A) [14], what people still find annoying. Prescribed minimum sanitation distances from a wind turbine to residential zones and houses can make a certain difference for planning practice and controls over the urban sprawl.

3.2 Territorial requirements

As wind turbines are most effective in a certain distance one from another, wind farms in total need many hectares of land. Land (on average 34 ha/MW of total project area - according to Denholm et al., 2009) is needed for permanent and temporary use and the required area depends mostly on the number of turbines, their installed power and their configuration in space.
Configuration of wind plant for land use planning purposes was divided by National Renewable Energy Laboratory (NREL) [15] into four general categories: Single String, Multiple Strings, Parallel Strings, and Clusters. Taking configuration into account NREL estimates for US wind farms that 70% of the permanent area is being used for roads. So there is a big reserve for the land use optimization while siting wind power turbines, electric grid and roads at the local level.
Wind farm should be sited in a place, where the land cover is as smooth as possible, because any roughness brings to decrease of wind speed. That is why strongest winds blow over the sea, what usually allows off-shore wind power plants produce more energy from each turbine. As land for wind farm is almost always can't be provided inside the inhabitable locality, most of appropriate places are related to agricultural land category. Wind farms also bring more energy when they are located far enough from wind breaking forests and mountains and use natural advantages of the landscape and wind microclimate.
When a wind farm is constructed it takes not much territory to use. But it's necessary to have roads to do technical maintenance several times a year. Wind turbines one with another are connected with power lines that can be put under the ground, but there is still a protection zone for each line. These two types of lines create a net of restrictions, which are seen to be barriers for use of the agricultural land around the towers. Though some part of the land is still free from these restrictions, the effective use of agricultural machines requires open ways forward and back to cover all the land. So taking agricultural farm land for wind farms is often necessary, but the matter of balance is to organize complementary use of land.

3.3 Social acceptance

Matter of social acceptance of wind farms sometimes falls out of planner's sight. People protesting aspect [16, 17] is often being seen as NIMBYism. However, when meeting the resistance of the local community in the construction of wind farms, one should look back

and consider whose interests are given the highest priority in the implemented policy. Is this the private sector or certain community groups?
Therefore, it is important to try, on the one hand, to engage the community to the development of renewable energy, overcoming the widespread misconceptions and spreading knowledge, and on the other hand, to critically evaluate concrete projects to find out the root causes of social contradictions.

3.4 Lack of properly adjusted law

Based on our analysis of Federal laws in the Russian Federation, two main features ignoring wind power specificity were found.
When there is still no design decision where each turbine should be built, wind farms need big plots of land, is almost always can't be provided inside the inhabitable locality, most of appropriate places are related to agricultural land category and forest land category, where any construction is forbidden (Land Use Code). General plan is the necessary step to change the category of land, usually to industrial land category. The procedure of change empowers regional administrations for agricultural land category and federal government for forest land category.
Construction of wind measuring towers according to the federal law (Urban Planning Code) because of their height is considered to be a kind of structure that needs a permit to build. Also Rules of land use and building (so called "PZZ", zoning) should envisage that this permit will be asked to allow it. And general plan needs to be a basis for zoning (PZZ) to work together or PZZ can be cancelled by court. That is why general plan should reflect future wind measuring towers or the building permit can't be legally provided.
In this sense technical algorithm to be realized in legislative aspect needs to implement into general plan not just the wind power plant, but also wind measuring towers. As it's impossible to design the wind farm without data about wind resources, general plan needs to be changed two times: first to get a proper category of land and a building permit for wind measuring tower, and second to get the same for the wind power plant itself.
Based on the particular qualities of wind power projects, these two points (land use category and urban planning decision making) need to be changed at the national level. These legal issues can increase the project duration by one year at least, even if there is no controversy in local community.
As it was shown in this chapter most of wind energy challenges can be responded by planning system as a part of national legislation and by certain planning technics at the local level.

4. Method

The method used for further analysis is to assess the decision making process in parallel with formal planning documents' preparation using data on the first functioning wind farm in Russia, located in Ulyanovsk. We use contradictions identified earlier in this paper as a framework for this study.

5. Case study: Ulyanovsk Wind Farm

In Krasny Yar village in Ulyanovsk region in January 2018 the first wind farm in Russia was put into operation [18]. The 35 MW power plant was built by Finnish company Fortum and has 14 Dong Fang wind turbines [19].
Now we apply the assessment framework considered above to analyze this case against all the contradictions.

5.1 Environmental impact

According to official statements of the Fortum company, the necessary work towards reducing the negative impact on the environment was done.
First, the closest wind turbine to houses is located 900 meters far from them. Besides, new models with no mechanical transmission are installed, what makes the vibration and noise indistinguishable at a distance of 300 meters.
Second, the project of the wind farm construction contains sections on the environment protection and passed the state expertise and received a positive conclusion.
Third, since the wind farm is located next to Volga river, where bird migration routes pass by, dangerous events for birds can take place. For this reason, each wind turbine is equipped with ultrasonic bird repeller to keep them at a distance.
As wind farm has less then a year of operation, it's difficult to make a certain conclusion about its environmental impact, but certain necessary measures have been definitely undertaken.

5.2 Territorial requirements

First part of the Ulyanovsk wind farm, which is in operation now, was planned by the General plan of Krasny Yar municipality (located next to Ulyanovsk) (see Fig. 2). According to the State register of the real estate, current land area is 59,4 hectares.

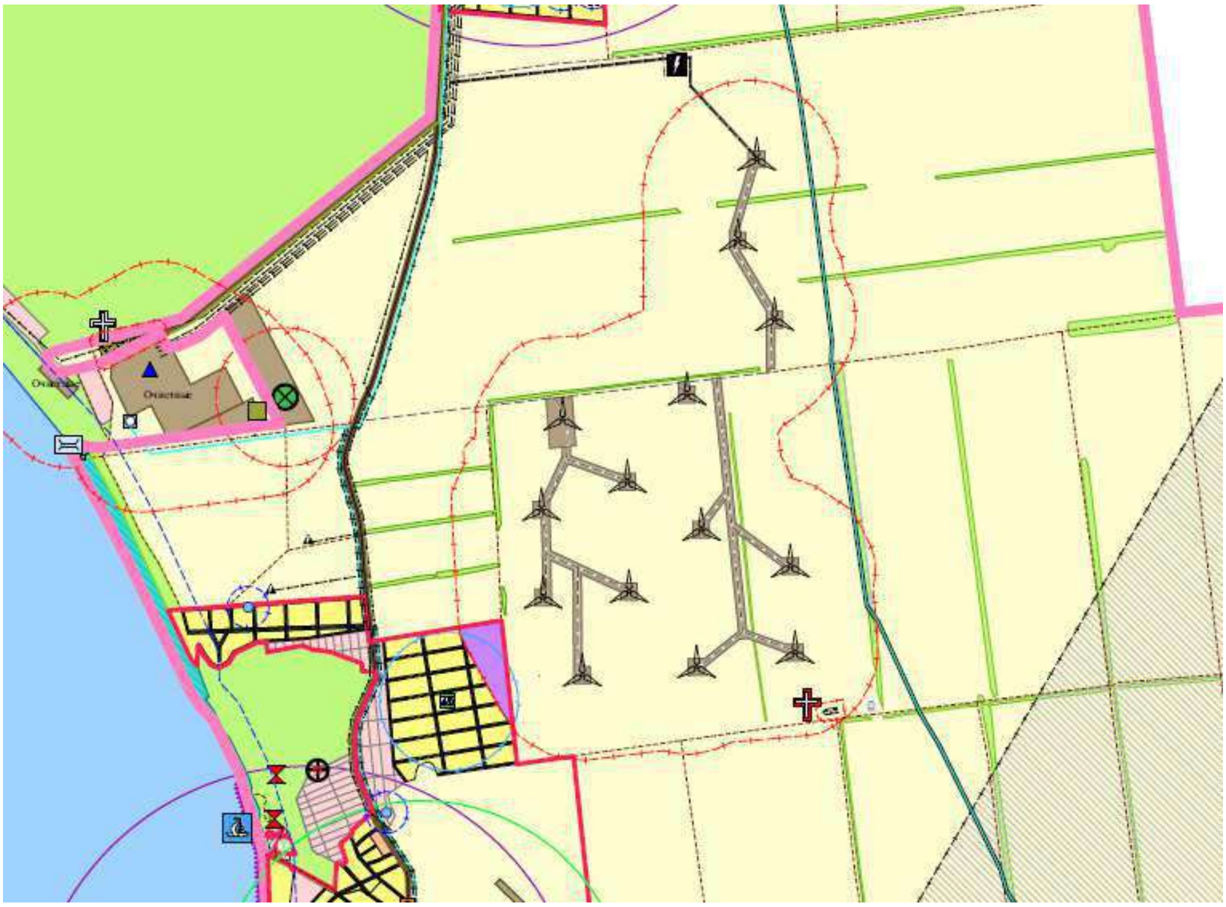

Figure 5 : Fragment of the general plan showing wind turbines and power lines (source: Federal state information system of territorial planning, https://fgistp.economy.gov.ru/)

Second part of the wind farm is announced to be built with installed capacity 50MW. Future development of the wind farm hasn't been reflected in the General plan yet, but a couple of land parcels, intended for this purpose, can be found in the same source – of 16,5 hectares in the northwest, and of 21,5 hectares in the north (see Fig. 3). Wind turbines can be recognized as small squares, connected with each other with roads and power lines.

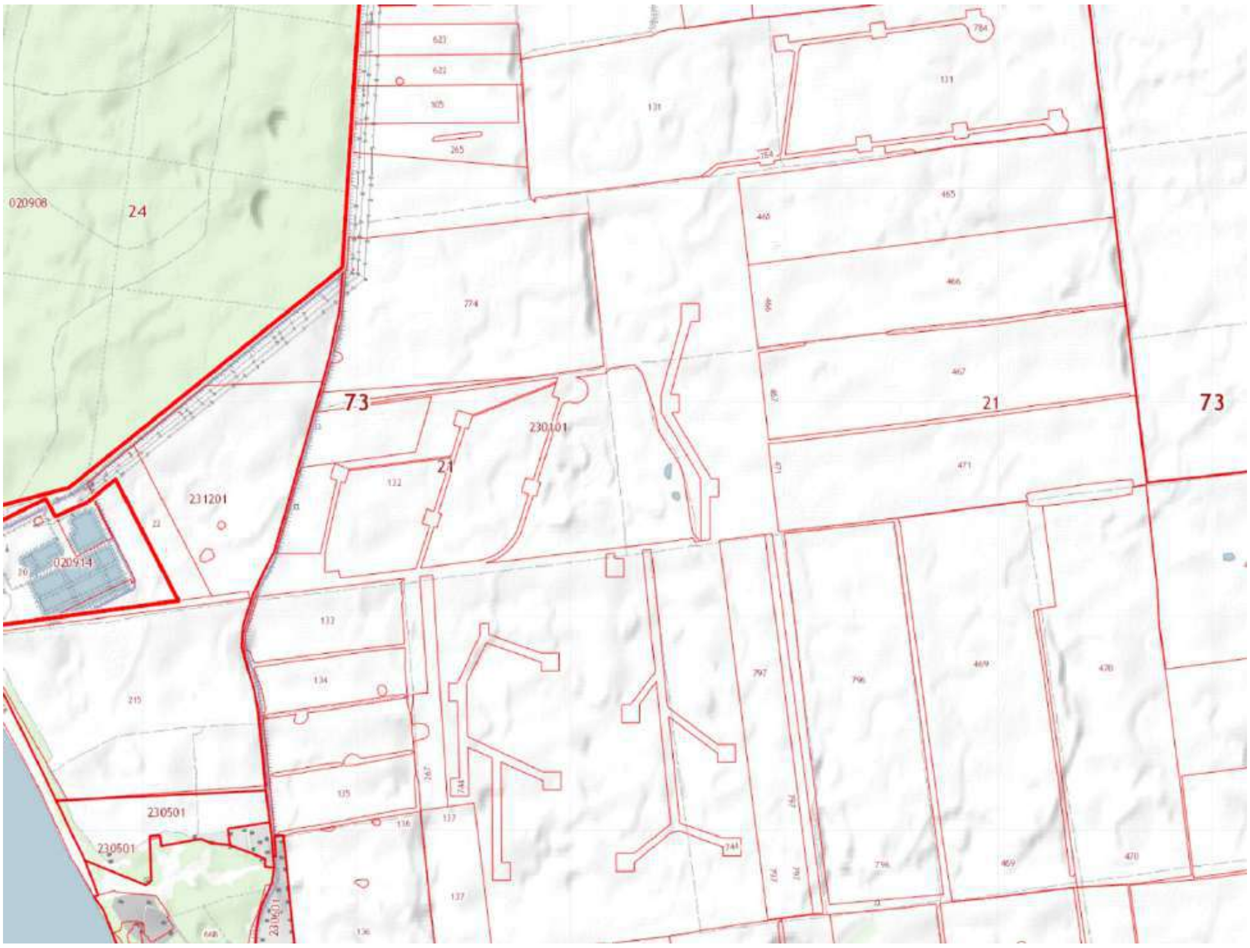

Figure 6 – Fragment of the public cadastral map (source: http://pkk5.rosreestr.ru)

As shown in the figures 2 and 3, the wind turbines are placed along the cluster scheme, which uses compact land plots. However, the use of surrounding agricultural land, especially soil tillage by machines, becomes impossible due to the presence of wind towers and their security zones. It means the actual area taken by wind farm is around 860 hectares in the central part and around 480 hectares in the north part. As each wind turbine has installed capacity of 2.5 MW, and 26 locations for wind turbines that can be distinguished now, the area for production of 1 MW equals 20,6 hectares. In comparison with NREL study and US average area of 34 ha/MW, Ulyanovsk wind farm uses land effectively.

5.3 Social acceptance

Analysis of the materials of Ulyanovsk media did not provide an opportunity to assert about the existence of a social conflict over the construction of the wind farm. However, there have been several publications of ornithologists concerned about the possible death of birds and journalists on corruption and violations during construction.
However, it seems that private sector and regional administration interests were drivers for this investment project while community interests are not formulated.

5.4 Lack of properly adjusted law

It was a long journey from the national tender for wind power company won in June 2015 (and the early preparations made to participate) to the end of the construction phase it took 2,5 years.
To force the realization of the Ulyanovsk wind project several administrative steps were taken.
1) Wind farm is being developed as a part of the long term strategy to create a technological valley to create conditions for increasing the investment attractiveness of the region. So wind power production becomes an answer for the needs of new consumers and especially for residents of Zavolzhye industrial park of 706 ha. Industrial zones development program in Ulyanovsk region started in 2007. It received financial support from the national government from 2008. In the industrial park over 30 investment projects are realized, and the number of residents is growing.
2) From the strategic perspective Ulyanovsk region and the regional capital have mentions of the technological valley, industrial park, wind power and other connected objects in their socio-economic strategies. But strategies are more declarative and reflect decisions that already were made. The effect of this on the development is limited.
3) To coordinate the future development of industrial park its territory was included to the Ulyanovsk municipality. It was done to have more taxes for Ulyanovsk and to have a single center for coordination. The regional decision on changing borders of municipalities was approved at the end of 2014. As the Ulyanovsk wind farm is located outside the new borders after the extension, wind power producing company pays prescribed taxes to Krasnoyarskoe rural settlement. And the future technological valley will develop in several neighbor municipalities.
4) To have the necessary information on wind resources of the site, proper measurement were made. It is an internationally accepted practice to build high structures with the equipment on top to collect data for a year. There is no detailed information about building permits for the construction of wind measuring towers. But the land parcel for the first part of the Ulyanovsk wind farm was formed for the exact configuration of the wind turbines before the General plan of Krasny Yar was changed to show where the wind farm is to be built. It means that wind measurements and wind farm design were ready earlier.
5) General plans of municipalities reflect comprehensive plans for energy and industrial development now. General plan of Krasny Yar was changed to adjust to the new requirements when decisions on the place and the configuration of the wind farm were already known. Technical parameters, which were accepted in general plans, earlier were detailed in territorial design projects. New version of Ulyanovsk general plan was presented in 2017. That is why the general plan for Krasny Yar shows the exact parcel for each wind tower.
6) German company (Assmann Beraten + Planen) developed a territorial design project for the Zavolzhye industrial park in 2011, and the territorial design project for the Ulyanovsk wind farm was developed by local specialists according to the data of Fortum.
7) Land readjustment for the wind farm territory was done to change the configuration of parcels and the allowed land uses according to general plan and zoning. Then with proper building permits and construction project developed, wind turbines were raised and power lines constructed.

6. Discussion of results

New wind farm in Ulyanovsk became a breakthrough and opened most of systematic and administrative inconveniences connected to national planning system and technological features of wind farms themselves.
Siting of wind farms on the national and regional level should be determined based on an analysis of energy needs and available wind resources. We assume that these sites can be detailed more. But the exact parameters for the power station shouldn’t be designed at this stage.

The wind industry functions as a market, despite state regulation and the participation of state-owned companies. In such circumstances, decisions on the location of wind parks, including their comprehensive justification, are taken within the framework of the strategies and business plans of the companies. Public territorial planning, linked to such procedures as the transfer of land from one category to another, the provision of land plots from state and municipal property for construction, participation in federal and regional programs of investment development, becomes the mapping of the planned, not always required by the business entity.
The uncertainty about necessity of building permits for wind measurement towers we propose to clear by establishing a special order of getting permits for this type of structures. This order shouldn't include changing planning documents of strategic level such as general plans.
Land ownership played a visible role on siting the Ulyanovsk wind farm. Based on the configuration, it is likely that the land parcels for the wind farm were provided from the state and municipal property. As it's easier to provide land this way, it can be seen as a plus. But it restricts from making a wind farm from perspective of optimal siting to get more power in given natural conditions. To overcome ownership constraints, legislation needs to be completed by mechanisms of public private partnership in land ownership aspect.
Landscape has been out of sight during all the Ulyanovsk wind farm siting and design. We propose to take surrounding agricultural land into consideration when making a structure of power lines and siting each turbine. Changing the optimal siting scheme of turbines' allocation can help important qualities of agricultural land use to be kept.

7. Conclusions

The main findings of this paper include common international features and specific Russian planning issues, that should be taken in account.
Planning issues of the international importance include:
- wind farm siting as a specific aspect of providing building permits, designing power network, land use management, taken in account in planning system;
- transmission technology of strategic decisions for network development to land use planning while siting wind farms; interaction of public and private plans;
- standards and rules for environmental studies in wind farm projects;
- support mechanism of bottom up initiatives for community driven wind farm projects;
- partnership framework for land owners and farmers to optimize land use patterns and to make wind farms work within the existing agricultural landscape.

Russian planning issues of wind farm siting represent a simplified version of common world issues. To eliminate existing barriers and stimulate the renewable power production in Russia, the planning process for wind farm siting needs to be improved. It is more likely that these changes lie in the legislative field. Experience of planning and construction of the Ulyanovsk wind farm can already become a basis for simplification of existing procedures and strengthening of the planning expertise in Russia.

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CLIMATE ADAPTATION: TRANSIT ORIENTED DEVELOPMENT AS A STRATEGY FOR ASIAN CITIES

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Synopsis

Increasing climate vulnerability has made adaptation a critical matter for Asian cities. Several urban adaptation strategies, such as engineering solutions or climate resilient planning and land use regulations, have been largely tested. Climate adaptation contribution of a Transit Oriented Development (TOD) has however hardly been assessed, highlighted and tapped into. Yet, the advantage of a TOD approach lies in its capacity to come as a co-benefit to other major urban improvements: containing urban sprawl, reducing air pollution, GHG emissions and the urban heat island effect, mainstreaming mixed land use and generating public spaces, boosting the economy and improving the overall quality of life. With the same investments, TOD significantly contributes to climate adaptation in terms of both managing and preventing disaster risks.

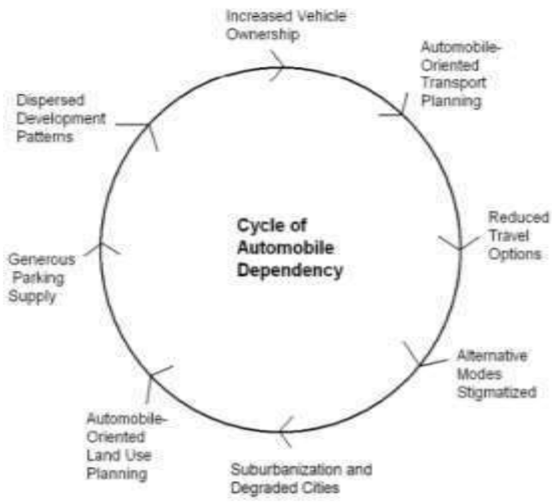
This paper builds the case of TOD as a climate adaptation strategy for Asian cities. It outlines major features of TOD and demonstrates how these are relevant to strengthening climate adaptation. Learnings from successful TOD implementation models such as Hong Kong, Seoul Copenhagen and Singapore are examined.

Compact development model facilitates Asian cities' climate adaptation

Asia has been rapidly urbanising from 0,3 billion urban dwellers in late 1950s, the region moved to 2,1 billion in 2015, which is projected to reach 3,3 billion by 2050 (Worldometers, 2018). Over 60% of world megacities are likely to be located in the region by 2025 (UN, 2018). The rapid infrastructure development accompanying this trend came **at the cost of significant vulnerabilities**. Over 40% of South Asian urban population lives in slums (UN Habitat). Basic infrastructure and housing needs are tremendous: ADB estimates that between 2010 and 2020 over USD 8 trillion need to be invested into infrastructure in Asia (ADB, 2009).

Climate change and increasingly intense and frequent extreme weather events exacerbate the already high urban vulnerabilities and create a major threat in the region: 6 out of 10 most climate change affected nations are located in Asia-Pacific; 410 million urban dwellers in Asia will be at risk of coastal floods by 2025 and South Asia alone is projected to annually lose 1.8% of GDP by 2050 due to natural disasters. Climate change adaptation is hence a critical and urgent matter for Asian cities.

The urban sprawl urban development model, largely dominating in Asia, is however not up to the challenge. Urban sprawl is commonly defined as a dispersed, segregated land use and automobile-oriented urban-fringe development (NCE Cities, 2015, p. 10). Urban dwellers in sprawling cities depend on motorised vehicles for most activities: work, education, health, grocery, access to recreation areas, etc. Increasing purchasing capacity in Asian cities, more affordable car ownership and fuel subsidies in some countries further nourish the model. Between 2000 and 2010, Manila's urban area grew from 1,800 km2 to 2,300 km2. Most of the expansions occurred in neighbouring provinces rather than Manila itself. The core municipality attracted only 10-20% of the urban growth between 1950 and 1980 and virtually 2% of the growth from 1980-2010. As per the 2010 data (Cox, 2011), over 50% of Manila's urban population lives in the inner suburbs and 40% in the outer suburbs. The satellite imagery below shows how this development pattern reflected upon green and blue spaces. After 50% of the city was flooded in 2012, experts referred to an unplanned city expansion, extreme pressure on existing resources and mismanagement of natural resources as reasons for the disaster to occur (de Leon, 2012).



1: self-reinforcing cycle of increased automobile dependency and sprawl. Source: (NCE Cities, 2015, p. 16)

2: Manila 1988 and 2014. Source: (NASA, 2015)

In addition to a well-known harmful pollution, GHG emissions, congestion, economic and overall liveability impact, **urban sprawl hence significantly compromises urban climate adaptation.** Indeed, car oriented cities require vast spaces for parking and roads, which encroach upon valuable natural urban ecosystems such as agricultural lands, wetlands, parks and forests. For example, in the Los Angeles central business district, parking areas (including large multi-storey parking garages) equal to 81% of the total land area (Zhao, et al., 2016, p. 5). Sprawl typically increases per capita land consumption by 60-80% and motor vehicle travel by 20-60% (NCE Cities, 2015). Resulting encroachments upon lakes, rivers, streams, wetlands and coastal areas severely **damage urban areas' flood and heat control capacities and reduce ground water tables**. The scale, intensity and duration of floods have increased in Asian cities while these face severe water scarcity. Bangalore, India, once a city of 2,500 lakes, has tripled its size over the last 4 decades, with only 80 lakes remaining in 1993 (Murali, 2016) (Seth, 2012). As a consequence, 78% of the city surface is impervious to water (Nagar, 2018) and the city faces severe floods regularly since 2000 (IISC, 2017), while it is expected to run out of ground water by 2020 (NITI Aayog, 2018). Similarly, urban sprawl is associated with **increased surface temperatures** in cities and intensity of heat waves. Bangalore's average temperature has risen by 2° to 2.5°C between 1995 and today (Vidal, 2017).

3: Los Angeles 1964 from the Griffith Observatory. Source: (Murphy, 2017)

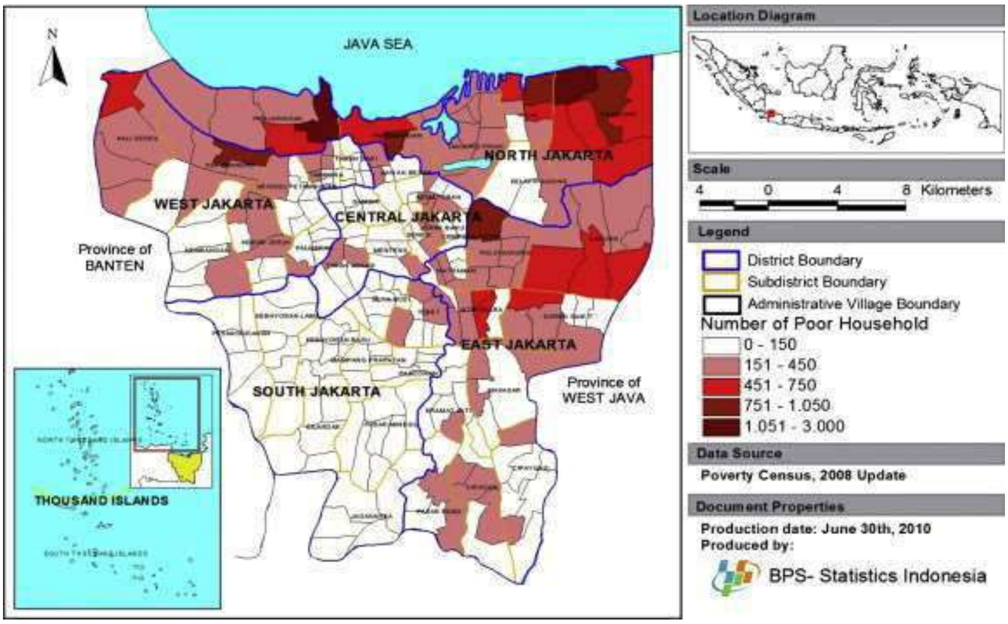
Largely criticised and gradually abandoned in the West starting from the 1960s, the model prevails in the Asian region (Zhao, et al., 2016). Night lights data analysis shows that South Asia's urban areas have annually expanded by 5% between 1999 and 2010. This despite the population only grew by 2.5% a year. Therefore, cities' territories grew twice as fast as their population, which is a clear indicator of urban sprawl (Ellis & Roberts, 2016, p. 3).

Urban policies have largely contributed to urban sprawl development and automobile dependency directly or indirectly. Examples of such policies include master plans that favoured urban expansion over increasing core densities, restrictions on building density and heights, minimum parking space and setback requirements, transport planning that favoured automobile commute, utility pricing and tax rates that failed to reflect higher costs of providing public services in sprawled locations (NCE Cities, 2015). For example, Thailand used tax rebates on car purchase, which has encouraged settlements in the outskirts of Bangkok and increased road congestion (Saengpassa , 2013). As a result, Bangkok grew by 30% between 2000 and 2010 and its suburban provinces grew by 66%. Much of this new development has been townhouses and detached housing in areas accessible only by cars, typical of the sprawl model (Cox, 2012).

Such policies reduced housing and transport options in the core city while they increased economic and environmental costs. Urban sprawl costs the American economy over USD 1 trillion annually: greater spending on basic services such as water supply and sewage pipelines, solid waste management facilities or roads. Americans living in sprawled communities hence directly bear an astonishing USD 625 billion extra costs (NCE Cities, 2015).

Finally, urban sprawl poses a major social equity concern:

- The **urban poor are at a loss in car dependent cities** because a significant share of public investments goes to automobile-related facilities while these are used by a small share of the population (NCE Cities, 2015), taking resources away from activities that could benefit the majority of citizens.
- **Informal settlements tend to crop up in environmentally vulnerable areas**: river or lake banks, steep slopes or low lying coastal zones as in Jakarta (map below).
- Disaster related costs for the urban poor are tremendous because these citizens **lack health and property insurance.** The quality of their housing is the poorest and least resistant to extreme weather events (Feiden, 2011)**.**



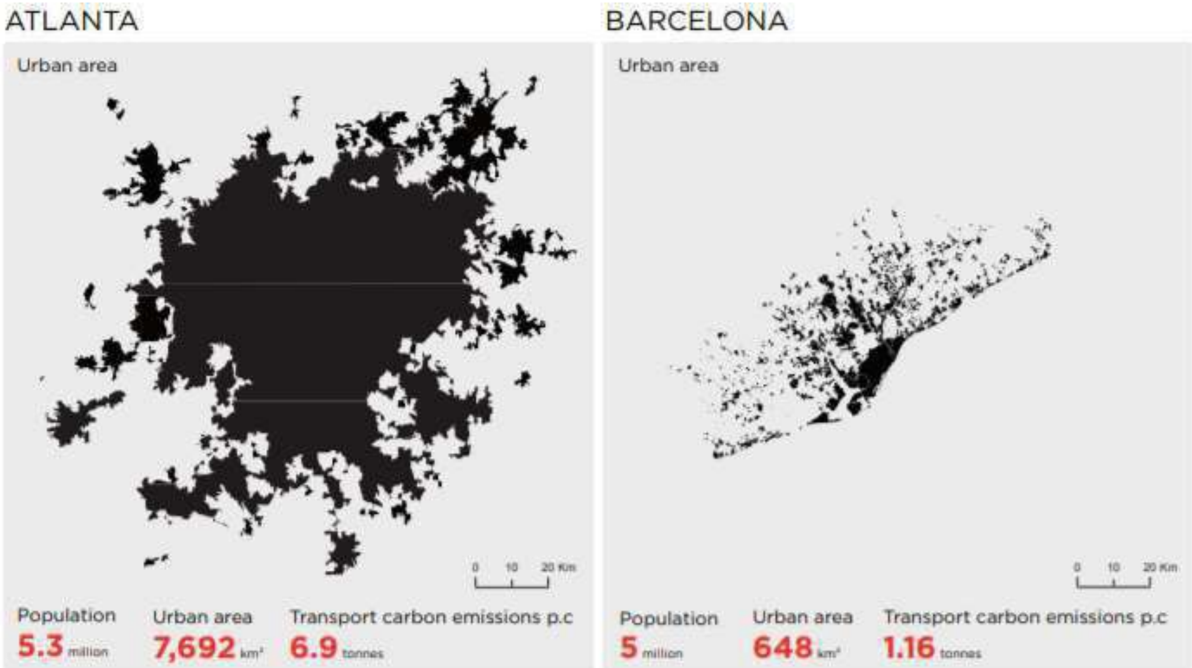
4: Potential climate-change related vulnerabilities in Jakarta: Challenges and current status. Source: (Firman, T. et al. 2011)

Climate resilience and climate adaptation advantages of the compact urban development model over the urban sprawl model have largely been demonstrated. A compact urban development model is commonly defined as a dense development pattern, well linked by mass transit systems and maintaining an easy accessibility to local services and jobs. Compact development usually reduces the impact of development on the environment by limiting urban expansion (OECD, 2012). Compact cities are viewed as resource-efficient and less dependent on the use of private cars (UN-HABITAT, 2013). **Transit Oriented Development (TOD)** is a form of a compact development model built around existing or planned transit stops, hubs and corridors supporting light rail, train, or bus ridership. Hong Kong has supported compact transit oriented development since 1960s, which allowed the city to host a population of over 7 million by building on only 24% of its total land area, reaching an average population density of 7,000 people per sq.km and yet maintaining an overall high quality of life (LEGCO, 2016).

Compact city policies promote investments in mass transit and integrate active mobility (such as walking and biking) to make the transport system comprehensive. Such policies hence provide the urban poor with a better access to job opportunities and services promoting equity and inclusiveness. In parallel, such policies reduce the share of required impervious land in urban and peri-urban areas which, combined with adequate land use regulations, helps preserve natural ecosystems to divert and absorb flood water, replenish ground water tables and reduce heat. Through compact development, Hong Kong has been able to maintain 76% of its land as natural ecosystems, comprising of grasslands, woodlands, farmlands, wetlands and water bodies (LEGCO, 2016).

All major internationally adopted guidelines highlight climate advantages of the compact development model versus the sprawl model. The *New Urban Agenda* highlights the benefits of integrated planning and compact development in paragraphs 51, 52, 69 and 98, making an emphasis on transit oriented development (TOD) and integrated mobility in paragraphs 114 (b) and 118. Sustainable Development Goal 11 highlights that by 2020 countries must substantially increase the number of cities that adopt and implement integrated policies towards climate change adaptation in line with the Sendai Framework for Disaster Risk reduction 2015-2030. "The role of transit in sustainable urban development is increasingly being recognized and promoted as a way to moderate climate change and increase the mobility of the poor" (Suzuki, et al., 2013, p. 25).

Let us compare an example of an urban sprawl versus a compact city model. With a similar population of about 5 million, Barcelona has a significantly lower spatial coverage and carbon footprint than Atlanta: 7,692 versus 648 km2 and 1,2 versus 6,9 tonnes per capita respectively. Over 20% of trips made by Barcelona citizens are walked (UN-HABITAT, 2013). This is a result of a longstanding commitment to planning and designing transit oriented compact, mixed-use walkable neighbourhoods.



5: Sprawl vs. compact transit oriented development for same population figures. Source: LSE Cities 2014

Transit Oriented Development as a strategy for urban climate adaptation

Based on considerations above, identified while the author assisted a number of Asian cities with strengthening climate adaptation, the present paper initiated exploring direct and indirect linkages between TOD and climate adaptation. The objective of this exploration is to help vulnerable Asian cities obtain significant socio-economic, environmental and climate co-benefits through optimising their scarce territorial, natural, economic, human and financial resources. The topic revealed hardly explored by academic and policy literature, which is both the value and the limitation of the present paper, in particular when it comes to quantifying climate adaptation benefits of adopted TOD strategies. While direct author's experience of working with cities feeds considerations and conclusions of the research, specific city related data often cannot be publicly disclosed. The paper hence presents results of an on-going research, which will lead to further data collection and analysis.

Transit-oriented development (TOD) is commonly defined as an urban planning model that promotes compact, high-density, mixed use development within a walking distance (one kilometre) to transit stations and high quality public transit services (BRT systems, trams, underground trains). A TOD block consists of a mixture of housing, offices, retail and/or other amenities organized in a **compact walkable neighbourhood** (Suzuki, et al., 2013). Key components include:

- Mixed use neighbourhoods minimize the necessity to use motorized transportation by placing all key daily activities within a walking/cycling distance: housing, office spaces, schools, shops, green and recreational spaces. Major components of mixed land use neighbourhood development are mixed functions buildings, vibrant ground floors, open public spaces, dedicated pedestrian and cycling paths, limited car speed, limited roads and parking spaces.
- The neighbourhood is dotted with pedestrianized public spaces, designed in a way to create a public realm and provide ample interaction opportunities. The overall quality of life is uplifted by increasing free usage spaces. These make individual residential spaces' size somehow less critical and help creating compact areas.
- While walking and cycling is encouraged at the neighbourhood scale, rapid inter-neighbourhood transit is provided between neighbourhoods. This transit consists of rapid efficient public transportation and transit nodes located at a walking distance in all major points, which encourages citizens to shift from cars to public transport. Often, private car usage is additionally discouraged at policy and infrastructure levels: reduced parking lots and increased parking cost, city entrance fee, congestion charges/ taxes. This combination favours a gradual **shift to non-motorized and public transport mobility.**

A number of the above-listed TOD features directly contribute to climate adaptation, although not often viewed as such. While reducing traffic loads, creating recreational green areas and public spaces, they seamlessly adapt the city to climate change and extreme weather events. These features preserve and strengthen natural urban and peri-urban ecosystems, which is a key element of climate adaptation in the long run; enhance urban food security; locate densely populated areas in safest zones of the city; improve accessibility and evacuation networks; and de facto often benefit to the urban poor and vulnerable populations. These components can be examined on the example of a few successful Asian cities' cases (Hong Kong, Singapore, Seoul) and selected Western cities' models (Copenhagen, Stockholm, Houston).

- ***TOD preserves and strengthens natural urban and peri-urban ecosystems.***

Containing urban sprawl and reducing road space through TOD frees up urban and peri-urban land areas for green and blue spaces (parks, forest, agricultural land, water bodies, etc.) that act as buffers during extreme weather events (floods, heat waves, climate change resulting potable water stresses). Compact development can indeed save up to 1/3 of land development and infrastructure costs (Gar-on Yeh, 2002).

Hong Kong opted for a highly compact development and prioritized regeneration and reclamation of existing urbanized territories while developing TOD rather than expanding into green-field areas. Over 45% of Hong Kong's land is legally protected as a country-park since the 1970s, (the Mass Transit Railway Corporation ordinance leading to TOD planning was passed in 1975) while another 30% remain undeveloped and subject to various degrees of protection under a hierarchy of preserved areas (Salat & Ollivier, 2017). Interestingly, such a development mode did not affect but rather, on the contrary, enhanced real estate development opportunities. Through its R+P (Rail plus Property) TOD model: developers have been allotted suitable land and FAR rights that have been demarcated in the overall land use planning by the MTR and other planning bodies. For example, revenues from R+P developments around stations along the MTR's Tseung Kwan O line financed the extension of that line to serve a new town, which has since grown to a population of 380,000 (Yifan, 2017). MTR makes sure that all new developments adhere to guidelines for urban design, pedestrian circulation and public amenities. Today, **the city's resilience and quality of life index rank amongst the top 5 in Asia**. Hong Kong promotes knowledge and experiences across government departments as well as private sector to maximise opportunities that create sustainable urban ecosystems and make Hong Kong more climate-ready.

Urban green and blue spaces cool the air and provide shade limiting the urban heat island and heat waves effects. This is of a particular importance to low income communities, which can hardly afford artificial cooling. TOD principles includes providing green areas next to high density major transportation nodes, which make important natural buffers in high density zones. Learning from Singapore, cities with large footprint buildings can adopt block policies to provide well landscaped and ventilated pedestrian and bike routes, permeable pavements and green intermediary spaces that mitigate UHI (Urban Heat Island). Studies in Singapore have demonstrated that green areas reduced the average air temperature by 1.3°C (Aflaki, et al., 2016).

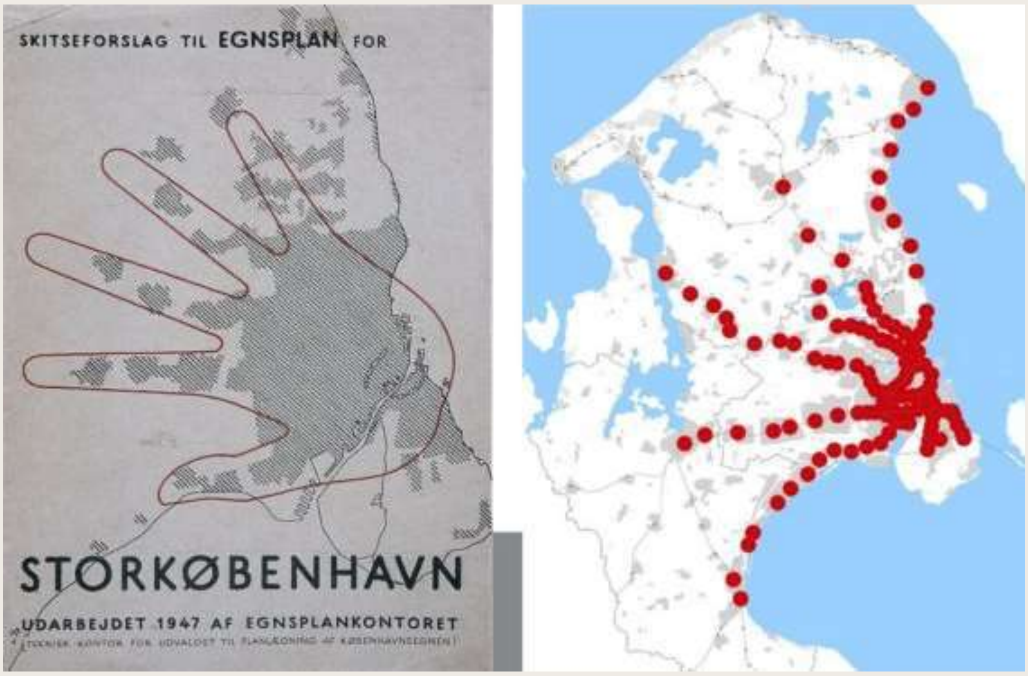
Natural ecosystems also play an important role in reducing flood risks by retaining flood waters and allowing water absorption thereby recharging ground water tables and increasing the fresh water quantity, quality, and reliability (Erwin, 2018). At Singapore's Bishan Park, a 2,7 km straight concrete drainage channel was restored into a sinuous, 3,2 km long natural river in 2012, which meanders through the park. After redevelopment, the naturalised river's carrying capacity increased by 40%. The river system now accommodates fluctuating water levels and protects surrounding built up areas from flooding during heavy precipitations (Zheng, 2017). As part of its Sponge Cities program, China increasingly focuses on revitalising natural ecosystems to collect and manage storm water: restored wetlands, rain gardens or bio swales, permeable pavements and subsurface detention systems all facilitate the natural movement of water, and help runoff and infiltration into the ground (Gallego-Lizón, 2017).

Pioneering TOD interventions in Europe, the celebrated 'Finger Plan' of Copenhagen and the 'Planetary Cluster Plan' of Stockholm, both defined corridors for channelling overspill growth

Copenhagen TOD policies for long term sustainable urban development

An example of **long-range planning visions shaping TOD**, which in turn shaped urban growth, comes from Copenhagen, with its celebrated "finger plan" that was proposed as early as 1947. Planners identified corridors for channelling overspill growth from the urban centres. Rail infrastructure was built, often in advance of demand, to steer growth along desired growth axes. Copenhagen has adopted a **3/3 mobility policy**: at least 1/3 of trips are to be made by public transport, at least 1/3 by bike, and at most 1/3 by car (Als, n.d.).

More importantly, **designated greenbelt lands were set aside** as agricultural preserves, open spaces, and natural habitats and accordingly major infrastructure was directed away from these districts (Curtis, et al., 2009). Copenhagen takes full advantage of its forests, farmlands and open green spaces by limiting development along transit corridors, thereby maintaining a favourable ecological urban environment and mitigating urban sprawl. Integrating transit and land use and discouraging private car use has been an important step in land-constrained, low-lying Denmark that is vulnerable to the rising sea levels because of climate change (Suzuki, et al., 2013, p. 189). After the 2011 '100 year cloudburst' that caused damage totalling more than DKK 6 billion, **a long term Cloudburst Management Plan 2012 has been devised to be fully adaptive with the TOD and other infrastructure initiatives** such as new roads, bridges, or public spaces as well as green and blue climate initiatives, to ensure a common plan can be implemented (Climate-Adapt EEA, 2016).



6: Finger Plan 1947-2007. Source: (Als, n.d.)

from the urban centres early in the planning process, and rail infrastructure was built in advance of the demand to steer growth along desired growth axes.

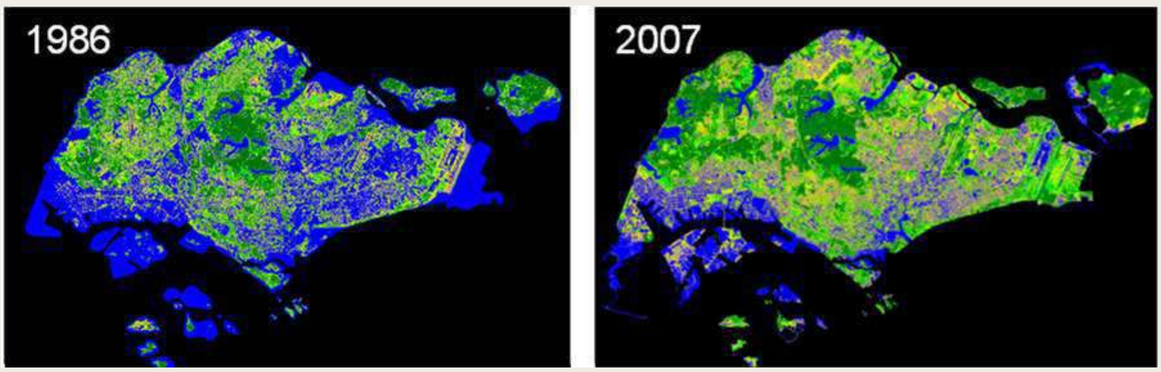
Natural ecosystems preserved through TOD planning - Singapore

In Singapore, the **Concept Plan** is a strategic, long-term integrated land use and transportation plan that guides the city development for 40 to 50 years, reviewed every 10 years. The Concept Plan holistically maps out Singapore's urban development: it determines locations for major infrastructure projects (e.g. the MRT Network, reservoirs), future housing, commercial and industrial clusters. Green and blue spaces (e.g. nature reserves, parks and open spaces) are safeguarded as part of the Concept Plan (Bin, 2013). The first Concept Plan was prepared in 1971 and the MRT network opened in 1987. Subsequently, the task of revising the Concept Plan and taking up further TOD development was placed under a single authority founded in 1989: the Urban Redevelopment Authority.

TOD allowed Singapore to preserve its natural ecosystems while directing development to low risk zones. Green cover increased by 1/3 between 1986 and 2007 (NParks , 2016). This approach helped Singapore reduce its flood prone area from 3,178 ha in 1970s to only 34 ha in 2013 (IWRM, 2014). The ND Gain index, which ranks countries on their ability to leverage investments and convert them to climate adaptation actions, places Singapore on the top of the list (ND-GAIN, 2018).

1: Flood prone map of Singapore in 1970s and 2013.

7: Flood prone zones in Singapore 1970 and 2013. Source: (Hill, 2013)



8: Remote Sensing Images of Greenery Cover in Singapore. Source: (NParks , 2016)

- ***TOD ensures better food security***

Compact development measures contribute to preserving urban agriculture. In the Chinese Pearl River Delta, massive agricultural land was consumed by urban development in the early 1990s. For example, 'paddy production in Dongguan in the Pearl River Delta in Southern China dropped by 63% in 1979-94'. Nearly 25% of the total area of Dongguan had undergone changes in 1988-93. In contrast, only 3.2% land use change occurred in transit oriented compact development Hong Kong between 1987-95 (Gar-on Yeh, 2002). Hong Kong used 10% of its total area to produce 45% of fresh vegetables, 15% of pigs, and 68% of chicken consumed by its population in the 1990s. Singapore grew 25% of the vegetables consumed by its population, in the same period (Yeung, 1988). As a co-benefit, urban agriculture contributes to disaster risk reduction and climate adaptation by reducing water runoff, keeping flood plains free from impervious built surfaces, reducing urban temperatures, capturing dust and CO2. This comes along with a major mitigation benefit: growing fresh food close to consumers reduces energy spent on freight, cooling, processing and packaging, whilst potentially reusing urban organic waste and wastewater productively (RUAF Foundation, 2018).

- ***TOD helps locate major transportation nodes, high density areas and critical infrastructure in less vulnerable areas***

A TOD design requires a thorough holistic assessment of the city: not only densities, mobility patterns, activity hubs but also topography, hydrology, climate and related potential vulnerabilities. Since TOD calls for major investments, present and future vulnerabilities are thoroughly taken into consideration when laying out transportation nodes and roads. This approach leads a number of climate adaptation benefits: high population densities can divert to less hazard exposed areas and these can provide refuge to more exposed citizens or, if required, people located in highly connected zones can, on the contrary, shift to a safer location faster (Salat & Ollivier, 2017).

- ***TOD improves accessibility and evacuation networks***

Accessibility may prove critical when a disaster hits the city. As demonstrated above, **major transit routes are usually located in safer city areas** and are efficiently linked to more remote neighbourhoods. This structural set up can be very effectively complemented with non-structural components. For example, transit control rooms for metro networks or bus traffic monitoring systems can be linked to emergency operations centres so that they circulate real-time information on the movements of both passenger vehicles and buses, and identify chokepoints during disasters.

Houston’s transportation authority, METRO, has set up an agreement with the neighbouring island town of Galveston stating that in the event of a hurricane, METRO will help evacuate Galveston residents located in vulnerable storm surge zones. During hurricane Rita (2005), METRO evacuated individuals from Galveston and Houston, arranged for supplementary rail services using other regional passenger rail agencies Amtrak and Trinity’s (Dallas commuter rail) railroad facilities for evacuations, provided support to stranded motorists on freeways, and offered shelter and basic amenities to METRO’s affected employees and their families. METRO used 500 buses and 500 other vehicles to transport 20,000 individuals to safe areas in 4,500 trips. (TRB, 2008, p. 85).

To take an Asian example, residents of R+P developments in Hong Kong value the fact that they can commute without getting wet during typhoons and storms (Leong, 2016). Given high typhoon vulnerability of several coastal cities in Asia, TOD developments that address evacuation processes and emergency relief can notably minimise damages for its vulnerable populations.

- ***TOD investments are de facto pro-poor and pro-vulnerable populations’ investments***.

Housing infrastructure through TOD investments mitigates climate vulnerability of poor urban dwellers who often choose to be located in vulnerable areas in order to remain within an easy access to job opportunities. Indeed, high land value does not allow poor and informal settlers to rent accommodation in well protected areas, however often these areas are surrounded with low land value vulnerable areas. The matter is worsened by the use of cheap and non-adapted to climate hazards construction materials. In Bangkok’s Khlong Toei slum, 100,000 poor urban dwellers live in makeshift tin shack houses just minutes away from luxurious malls, expat bars, high-end hotels, parks and its Stock Exchange that provide them livelihood opportunities. Khlong Toei is extremely susceptible to floods due to its location in a low lying port area, inadequate storm water drainage and substandard living conditions (Sapsuwan, 2014). As a result, the poor pay the highest part of the burden related to extreme weather event damages. In the Philippines, poor urban households suffered 90% of the USD 4.3 billion damages caused by Typhoon Ketsana in 2009. Similarly, during the 2011 floods, a third of Bangkok’s population was directly affected, but this included two-thirds of the city’s poor (UN-HABITAT, 2014).

TOD connects low income populations to jobs by providing an efficient, rapid and affordable transportation on one side and through **creating more equitable socially mixed neighbourhoods** on the other side. The Housing and Development Board (HDB) website reports that over 80% of Singapore’s population reside in publicly governed and developed housing. These residential complexes are part of planned transit oriented districts (IBI Group, 2014). In addition, developers are provided incentives such as density bonus, parking space reduction or higher FARs to include mixed income housing.

- ***Climate adaptation through TOD carries a large number of co-benefits***

Climate adaptation through **TOD comes with valuable co-benefits**, such as optimisation of local spendings, climate mitigation, reduction of air pollution and congestion, improved health, placemaking and wellbeing.

Creating networks of dense, walkable communities greatly **reduces the energy consumption** in cities. A family moving from a drivable suburban house to a walkable urban place can reduce its energy usage and GHG emissions by 50-80% (Leinberger, 2012).

TOD helps local governments **optimise scarce municipal funds** by saving on building roads, flyovers and parking spaces, and even helps generate additional revenues. For example, land value capture in Hong Kong brought in about HKD140 billion revenues between 1980 and 2005, and unlocked land for 600,000 public housing units (Salat & Ollivier, 2017). Cities that introduced TOD tend to increase and concentrate real estate values in the best-connected areas and are more competitive than other cities, as a result of agglomeration effects. At the city level, transit investment can have twice the economic benefit than a highway investment. A double-track light rail system occupies 50 times **less urban space** than highways and parking needs for cars. (Newman & Kenworthy, 1996). At the household level, **disposable incomes saved** on buying a car can be channelized towards household level adaptation and mitigation measures such as rain water harvesting systems or solar panels. This approach works even better when incentivised by government support, such as subsidies or tax incentives.

Mixed land use coupled with a continuous passenger flow near transit stations allow for a range of daytime and night-time amenities, creating **active streets** throughout the day. This means ‘more eyes’ on the street, making cities safer for women and children. Community amenities such as shops, cafes, groceries and open spaces on the ground floor of residential buildings mean greater convenience for those living around, along with more opportunities for neighbours to meet and interact with one another adding to the urban social fabric. These are only some co-benefits that TOD brings to urban environments. As a result, planners and urbanists have been worldwide recognised TOD as a viable development model for cities in developing cities.

Conclusion

As demonstrated above, TOD interventions have a number of features that directly contribute to strengthening climate adaptation. Investments made into TOD are investments made into an overall socio-economic environmentally sustainable development, which is an essential priority for developing Asian cities. These are hence synergized investments, which makes it easier to address the funding challenge. Looking at TOD as a climate adaptation strategy may therefore be considered as a pragmatic and achievable model.

Successful TOD implementation requires strong management and governance, co-ordination between stakeholders and significant financial investments over time. These pose political, fiscal and operational challenges in low and middle income Asian nations that may face difficulties with the above due to complex inter-governmental structures, political economy, weak leadership and a narrow access to funding. These challenges and potential solutions are examined in more details in the up-coming related paper. Meanwhile, learning and strategizing based on successful TOD business and operating models while targeting climate adaptation can be adopted in association with private investors and international development institutions.

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Do High-Speed Trains improve the urban economy? Evidence from the Yangtze River Delta

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Abstract:

High-Speed Trains vastly improve traffic connections among cities and have significant impact on the regional spatial structure. On the one hand, high-speed trains bring new opportunity for urban economic development; on the other, for cities less competitive, high-speed rail may exacerbate the resources flow and become a new challenge for municipal development.
China pays attention to high-speed railway construction since the 21st century and soon plays a leading role in the world. In this essay, the Yangtze river delta is chosen as the research object to examine whether high-speed trains improve the urban economy or not.
The quantitative model is modified from CD production function. The dependent variable is GDP in every city in each year. Three basic variables are: fixed asset investment, labor, and the proportion of tertiary industry. This study includes two observation variables: railway passenger flow and whether there is HST this year (dumb variable). Based on data from 24 cities from 2009 to 2016, I use a regression model to analyze the economic impact of HST in YRD. As a result, the overall construction of HST has a positive impact on urban economic development, but this effect is not significant for non-first-tier cities.

1. Introduction

High-Speed Trains (in short, HSTs) vastly improve traffic connections among cities and have significant impact on the regional spatial structure. It has become a hot topic in the field of economic geography for a long time that whether the high-speed trains improve urban economy or not. In China, the first HST line, Beijing-Tianjing HST line was open to traffic in 2008, which signals a revolution in the regional transit system.
Passed by HST line means that the city has been incorporated into a more efficient economic network, and thus it has become an important strategic resource in the competition among major cities. But on the other hand, many scholars mention that the construction of HST has adverse effects, that aggravates the outflow of resources for some cities. The effect of high-speed trains on the economic growth of cities along the lines becomes a heated topic. I will examine this effect by observing the Yangtze River Delta area and base on panel data from 2006 to 2016.

2. Literature review

2.1 high speed trains construction in China

"High speed" is a relative concept compared to the speed of ordinary railways. The definition of high speed railways varies in different countries. The State Railway Administration of China defines the High-Speed Train as: trains designed to 250km/h (including the upgraded ones) and more EMU trains, and the initial operation speed is not less than 200 km/h.
The construction of HST in the world started in Japan. In 1964, Tokyo-Osaka's Shinkansen was the first HST line with a speed of 210km/h, making a day trip possible between Tokyo and Osaka. In 1981, the first TGV high-speed train line opened in France, connecting Paris with Lyon and running at 270km/h. Subsequently, the HST lines in Germany, Spain and other countries have been opened, including not only the newly built HST lines, but also the

upgraded lines based on the original railways. The HST has become the core issue attracting global attention in the second half of the twentieth Century, bringing the second railway age.
In twenty-first Century, China began to focus on high-speed and large volume railway construction and put it into practice quickly. The State Council of China depicted "four vertical and four horizontal" passenger HST lines in the Medium and Long Term Railway Network Plan, released in 2004. In 2009, Wuhan-Guangzhou HST marked the High-Speed Train Era in China with the speed of 394km/h. A global report by the world bank compared the construction of HST all over the world, as showed in the figure 1 and 2. HST construction of China quickly surpassing the developed countries in Europe and the United States. China becomes the country with the longest mileage of HST in the world.

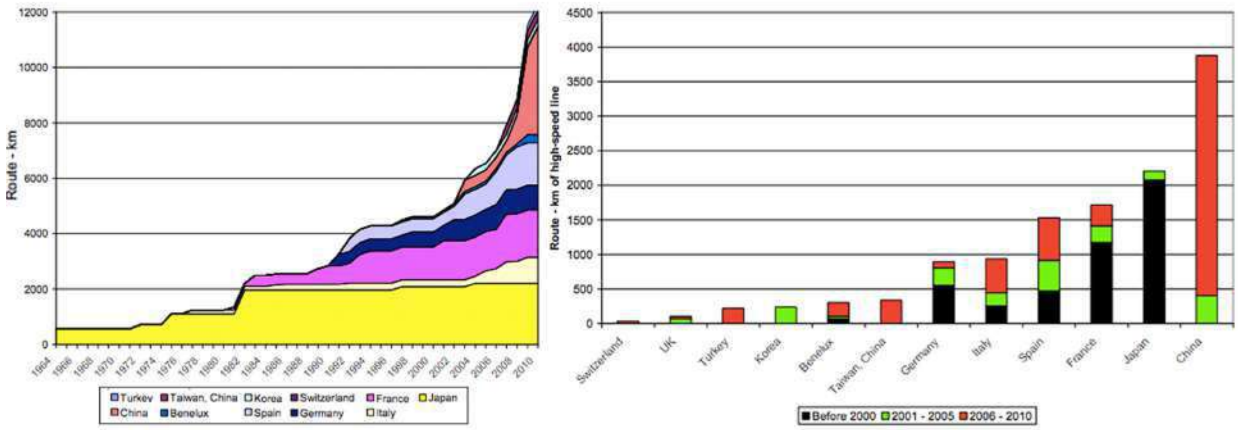

Figure 1-2: The world's HST mileage 1964-2010; HST mileage increasement 2001-2010 (source: the World Bank report)

However, after ten years of rapid development, the regional disparity of HST construction of China is noteworthy. As Myrdal(1957) said, the more developed regions are, the more attractive they are to attract new investments. In 2012, scholars applied accessibility analysis on national HST lines and found that HST network can improve the accessibility of the whole country, but the promotion of accessibility is not balanced nationwide. They expected that with the expansion of HST construction to the west, it may be more balanced. Based on National High-Speed Rail data and GDP data in 2014 compared with data in 2006, Liu conducted a spatial analysis by GIS and found "corridor effect" along Beijing-Shanghai, Beijing-Guangzhou, Shanghai-Wuhan and Shanghai-Xuzhou-Xi'an. Places with high accessibility gathered near larger cities and HST corridors. Wen (2017) analyzed the influence of HST on the accessibility of Chinese cities on a scale of urban agglomeration. It is proved that the HST construction has the largest impact on the Yangtze River Delta area, and influence on Beijing-Tianjin and the Pearl River Delta followed. In this essay, I will examine the influence on the Yangtze River Delta.

2.2 debates on influence of HST on urban economy

Scholars who believe that the construction of HST promotes local economy explain that the HST lines can enhance the economic ties among cities, and then promote the integration and overall development of the regional economy. The main logic of this conjecture is that the HST strengthens city accessibility, thereby enhancing the regional production factors and ultimately bringing about economic growth. Scholars first proved that with the construction of high-speed rail network, the accessibility of cities has been significantly enhanced. There is an obvious correlation between accessibility and production factors in the region. From the perspective of time and space compression, faster speed redefines the boundary of the interconnected regions, facilitates cooperation in a larger regional market, and expands the scope of the flow

of production factors. Accordingly, some scholars with positive attitudes point out that "there will be an integrated development trend between cities or regions" and may form a "high-speed rail economic belt".
Along with the HST construction nationwide, more and more scholars remind the negative effects of HST construction on the development of cities along the line. For example, Wang Jie(2015) think that "siphon effect" is a major challenge for cities along the high speed rail line, that the lost resources exceed resources being attracted to invest in the target city. The development of regional transport network is a double-edged sword. The convenience brought by HST speeds up the resource flow, and also promote the accumulation of capital, talents and information to the regions with more competence. That is, the HST construction can greatly improve the accessibility of the city and promote the formation of a larger scale of the division of labor, but for some cities, the loss of the elements will also be accelerated.
Since the 70s of the last century, the impact of the construction of high speed rail on the urban economy and the regional economic pattern has attracted wide attention from scholars in Japan, Britain and France. For example, Bonnafous (1987), when studying the impact of French high speed rail (TGV) on the development of Lyon City, pointed out that high speed rail transit provides a new economic vitality for the economic development of Lyon. Pol (2003) also put forward a similar view by a case study in Lille, but at the same time, he believed that only cities with exceedingly economic potential can use the accessibility of large external traffic to improve their own economy. If not, the increase of external traffic accessibility will even bring the backwash effects. Puga (2008) also indicated that the high-speed railway benefited the core cities at the expense of minor cities, exacerbating the regional imbalance.
In China, scholars are still arguing about the effect of China's HST development on the urban economy. Some scholars believe that HST has brought opportunities for some cities, but they never indicate cities gaining profits while others losing fortunes on a scale of urban agglomeration. Some scholars point out that the siphon effect of HST construction has existed but fail to scale the influence, because the duration after HST construction is too short. This study tries to analyze the effect in YRD area, hoping to show the impact of the HST on the economic development of the cities.

3. Research design

3.1 research area

As cited above, the construction of China's HST started from east to west, and the urban agglomeration in the Yangtze River Delta is one of the first agglomerations equipped with HST and the speed of construction is astonishing and the passenger volume is remarkable. Considering the following three reasons, this study chose the Yangtze River Delta as the research object. Firstly, as a world-class urban agglomeration, the YRD is in the forefront of the country with an active market and strong capital flow, thence it is easier to observe the economic adjustment. Secondly, HST construction started relatively early in YRD, which can provide data for this study for a relatively long time. Besides, information and development data of the Yangtze River Delta urban agglomeration are relatively open. According to the development plan of the Yangtze River Delta urban agglomeration in 2016, this area includes Shanghai, 9 cities of Jiangsu province (Nanjing, Wuxi, Changzhou, Suzhou, Nantong, Yancheng, Yangzhou, Zhenjiang, Taizhou), and 8 cities of Zhejiang Province, 8 cities (Hefei, Wuhu, Ma'anshan, Tongling, Anqing, Chuzhou, Chizhou, Xuancheng), as a total of 26 cities. By 2016, 24 cities(except Yancheng, Zhoushan) had been included in the national HST network. In order to compare the relationship between economic development and high-speed rail transport, the panel data in this study ranged from 2006-2016. Finally, 166 objects were obtained, including Shanghai, Nanjing, Hangzhou, Hefei, Ningbo, Taizhou, Jiaxing, Shaoxing, Jinhua, Suzhou, Shanghai, Nanjing, Hangzhou, Hefei, Ningbo, Taizhou, Jinhua, Suzhou, Wuxi, Wuxi, Ningbo, Ningbo, Hangzhou, Hangzhou, Taizhou, Jiaxing, Jinhua, Suzhou.
In the context of China's high-speed rail, I consulted the difference between D line and G line.

High speed railways generally refer to "railway lines" while D line refers to a type of marshalling trains. According to some scholars' textual research, EMU trains run on high-speed railways in Russia, which means that the two concepts are not antagonistic. In China, the difference of high speed rail and motor train is in speed, that the D train runs at 200-300km/h speed while the G high speed rail reaches above 300km/h. According to China Railway Administration, trains running at more than 200km/h are HSTs, so cities with D trains passing through are also calculated in this study. The construction sequence of the Yangtze River Delta high-speed railway is shown in the following table.

Time	Line	Cities (in YRD)
2008	Hefei-Nanjing line	Hefei, Nanjing
2009	Yong-Wen line	Ningbo, Taizhou
2010	Shanghai-Nanjing line	Shanghai, Suzhou, Wuxi, Changzhou, Zhenjiang, Nanjing
2010	Shanghai-Hangzhou line	Shanghai, Jiaxing, Hangzhou
2011	Beijing-Shanghai line	Chuzhou, Nanjing, Zhenjiang, Changzhou, Wuxi, Suzhou,
2013	Hangzhou-Ningbo line	Hangzhou, Shaoxing, Ningbo
2013	Ningbo-Hangzhou line	Nanjing, Changzhou, Huzhou and Hangzhou
2014	Hangzhou-Changsha	Hangzhou, Shaoxing, Jinhua
2015	Hefei-Fuzhou line	Hefei, Tongling, Xuancheng
2015	Jinhua-Wenzhou line	Jinhua
2015	Nanjing-Anqing line	Nanjing, Ma'anshan, Wuhu, Tongling, Chizhou, Anqing
2016	Nanjing-Nantong line	Nanjing, Yangzhou, Taizhou, Nantong

Table1: construction sequence of HST in Yangtze River Delta area

3.2 model and variables

Taking the construction of HST as one of the independent variables, this study uses an econometric model to simulate the development of the urban economy. In the traditional econometric research, CD function is widely used to estimate the development of the urban economy. That is, economic progress is determined by technology, capital and labor force. In the study of economic development in the YRD area, some important conclusions have been obtained by simulation and correction of models. For example, Zhang Xiaodi and Li Xiaozhong (2005) compared the TFP and the growth rate of Jiangsu, Zhejiang and Shanghai in the YRD area, finding that the marketization and internationalization were the main ways to improve the regional efficiency. Zhou Xiaoyan (2009) analyzed the economic growth of the YRD by a stochastic production frontier model. It is believed that the improvement of the urbanization rate, the structure of the second industry, the level of infrastructure and the level of human resources in the second industry will increase the efficiency of production. Zhang Xueliang and Sun Haiming (2009) divided the economic growth of the Yangtze River Delta into four parts: capital accumulation, efficiency improvement, technological progress and human capital input through DEA analysis. It is considered that the dominant economic growth is still the accumulation of material capital, and the second is the accumulation of human capital. At the same time, they found evidence of TFP's leading role in economic growth in Shanghai.

Based on previous studies, this essay modifies CD function. First of all, the economic development of the YRD area mainly depends on the accumulation of capital and labor force. Other factors, such as technological progress, industrial structure and policy advantages, have different degrees of contribution. The first-tier cities, such as Shanghai, are more affected by technological progress. Considering the availability of data, this essay selects three main variables including fixed assets investment, labor quantity and three production proportion. According to the purpose of this study, the statistics of railway passenger flow and whether HST lines passes by are also included. To eliminate heteroscedasticity, I take the logarithm of both sides and the model in this study as follows:

$$lnY_{it} = c + \alpha_1 lnL_{it} + \alpha_2 lnK_{it} + \alpha_3 S_{it} + \alpha_4 lnQ_{it} + \alpha_5 P_{it} + \alpha_t + \beta_i + \varepsilon_{it} \quad (1)$$

The dependent variable Y is the annual gross domestic production (GDP) of each city.
The five independent variables are:
1) Variable L stands for the labor force. The value is the total number of employed persons in various cities at the end of each year.
2) Variable K stands for capital and the value is the total investment in fixed assets of different cities at the end of each year.
3) Variable S stands for the industrial structure and value is the proportion of third industries to the annual gross domestic production.
4) Variable Q stands for the railway passenger flow and the value is the railway passenger volume each city in a year.
5) P is a dumb variable indicating whether HST line passes through this city or not. The value is 1 since the year when HST line passed, which is 0 before this year.

The key variables of observation are: Q_{it} and P_{it}.
If significant positive effects of the dumb variable on economic growth are observed, it proves that HST promote urban economy. Besides, I will further study non-first-tier cities in the YRD area. If significant negative effects of economic growth were observed, it demonstrates significant siphon effect of HST on the non-front-line cities.

4. Results

Firstly, 166 objects are analyzed by a panel regression model. The results are obtained by using the fixed effect and the random effect, and the result of Hausman test is 0.1053. Therefore, the fixed effect estimation is selected (Table 2). According to the results, there is a significant positive effect (95% confidence interval) in labor force, capital input and industrial structure. In addition, within the 95% confidence interval, the railway passenger flow has a significant positive effect on the urban economic development in the YRD area. The dumb variable P has a significant positive effect on the urban economic development in the 90% confidence interval. Therefore, generally speaking, HST construction has positive effects on urban development.

Variable	estimated coefficients	standard deviation	P value
L	0.948	0.111	0.000
K	0.346	0.035	0.000
Q	0.110	0.035	0.002
S	1.894	0.351	0.000
P	0.053	0.032	0.100

Table2: Results of economic development and HST construction in Yangtze River Delta

Then the panel data of non-first-tier cities is analyzed. 12 cities, including Hefei, Ningbo, Taizhou, Jiaxing, Shaoxing, Jinhua, Wuxi, Changzhou, Zhenjiang, Wuhu, Ma'anshan and Nantong, are selected for further regression. The amount of objects is 111. Through Hausman test, p value is 0.0215, and thence this part chooses fixed effect regression model, and the estimated results are shown in Table 3.

Variable	estimated coefficients	standard deviation	P value
L	1.354	0.149	0.000
K	0.261	0.043	0.000
Q	0.070	0.043	0.104
S	2.953	0.494	0.000
P	0.018	0.042	0.668

Table3: Results of economic development and HST construction effect of non-first-tier cities in YRD

According to panel regression analysis, labor force, fixed capital and industrial structure have significant positive effects on the economic development of non-first-tier cities. In the 90% confidence interval, railway passenger flow has positive effects on the urban economic development. However, the dumb variable doesn't show a significant economic contribution. That is, for non-first-tier cities, the effect of HST on urban economic development is not significant.

5. Conclusion and discussion

This essay first analyzes the impact of HST construction on the economic development of cities theoretically. Due to the significant spatial compression effect, HST construction is conducive to the economic cooperation and development of cities along the line, but the risk of resources outflow of non-first-tier cities is also increasing. Further, I conduct an empirical test based on panel data of Yangtze River Delta area for 11 years. The results show that the overall construction of HST has a positive effect on urban economic development, but this effect is not significant for non-first-tier cities.

The results of this empirical analysis reflect the complex effects of HST construction on urban economic development. For cities with superior economic development and strong resource competitiveness, they can easily benefit from high-speed railway stations. For non-first-tier cities, the construction of HST does not have a significant positive effect on urban economy, perhaps because of the "siphon effect", but the negative effect on economic development has not been found in the empirical analysis either. Perhaps for the YRD urban agglomeration, HST construction can promote the restructuring of the urban agglomeration economic structure, but the specific effects need to be further observed.

However, there are still many deficiencies in data analysis, which include three aspects: sample selection, variables and time effect.

Firstly, the total amount of data selected in this paper is small. Although the Yangtze River Delta's HST construction is at the forefront of the country, many cities only have high-speed rail after 2010. In order to expand the number of samples and form a contrast, this paper extends the time of panel data to 2006-2016 years, but the time of high speed rail in some cities is too short, which is unfavorable to the analysis of panel data. In addition, the difficulty of obtaining urban statistical data leads to the lack of many samples, resulting in a smaller data range.

Secondly, the selection of variables is limited by data availability. For the economic development of the urban agglomeration in the YRD, labor, capital and land are important factors, but the influence of policy, innovation and technological revolution is also significant. In the previous study, some scholars pointed out that only Shanghai has found the significant influence of policy and technological innovation on the economic development. Therefore, in this research, the model is simplified, and these kind of variables are not included.

Thirdly, in the result of the quantitative analysis, the construction of HST has no significant effect on non-first-tier cities. This conclusion also needs further observation. For some cities, after the high-speed rail operation in 2014, there is not sufficient data in this study, which needs further observation and analysis.

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Urban Mobility in Transition: Perspectives and Challenges on Urban Living and Public Spaces in China

Moderator: GOETHALS, Sebastian (Vice President ISOCARP)

Speakers: PAN, Haixiao (Tongji University); WANG, Hongyang (Nanjing University, China)

ABSTRACT:

Automated and shared vehicles and mobility services – combined with electrification and connectivity – are about to transform our daily commuting habits and energy consumption modes in the urban and rural landscapes.

The traditional competition between private and public transport in cities is now challenged by the rapid emergence of “Mobility as a Service” (MaaS), including the sharing and hailing of not only cars and bikes but also buses, shuttles and parking spaces.

Since digital connectivity has opened new windows of opportunities for communities and commuters through the sharing economy, the way we use together and individually our streets and public spaces might be less segmented and informal, as a result of real-time and collective decision-making.

An optimized scenario of mobility revolution, integrating automation, sharing and electrification by 2050, presents a reduction from 4,600 to 700 megatons of CO_2 and from 2,1 to 0,5 billion vehicles worldwide.

A few cities are now starting to test smart mobility systems, but most of them dramatically lack of urban planning strategies in terms of integration of public transport and new mobility services, public spaces and parking management.

Chinese cities have recently become vast laboratories of mobility innovation and digitization. While large projects of urban mass transit networks have flourished across the country, multiple forms of car/bike sharing and hailing have appeared. In July 2016, the Chinese Ministry of Transport published the 13th Five-Year Plan on developing a smart urban mobility infrastructure, with the wish to integrate mass transit, electrification of vehicles and mobility services, especially the last-mile transport services, such as community shuttles, bike-sharing and smart parking and streets for all modes.

The session proposes to identify the major coming trends and challenges of the urban mobility revolution in Chinese mega-cities, approaching this complex transition from the experience of daily commuters and local planners involved in the session.

The first part of the session includes the introduction of the research topic and the presentation of five Chinese case studies of urban transport policies. Five Chinese urban planners will then witness their professional and commuter’s experience of the transforming urban mobility landscape in Beijing, Jinan, Ningbo, Nanjing and Guangzhou.

The third and last part of the session will be dedicated to a rapid visioning by the session participants of integrated solutions for healthy and smart mobility, public spaces and streets in Chinese cities, putting in perspective the role of city planners in the technological transition of cities.

How to develop a new public service

Moderator and Speaker: GUSCHL, Larissa (Urban planner based at participatory planning and design office WeloveTheCity, Rotterdam, The Netherlands)

ABSTRACT:

Citizens have plenty of ideas for the neighbourhood in which they live, work and play. Unfortunately, they don't always have access to the right information to develop their ideas into a concrete proposal. That's why Freie und Hansestadt Hamburg, Roma Capitale and The Royal Borough of Kensington and Chelsea want to share a combination of open data and expert knowledge. The smarticipate platform allows citizens, entrepreneurs, NGOs and city officials to submit their proposal for a sustainable neighbourhood and to receive immediate feedback. This means everyone can get involved, even those who have never interacted with local government before.

Smarticipate is based on a co-creation strategy which consists of three complementary concepts: Urban story, Smartathon and Smart Implementer Summit. This strategy resulted in three prototypes (Plant a Tree App, Urban Transformation App, 3D Planning App) which where tested by more than 350 participants in the pilot cities. During these testing sessions, or Smartathons, several citizens and entrepreneurs demanded to have access to the technological core of the digital platform. These so-called 'smart implementers' want to plug in their own topic like:

New Public Service
Improving cycle infrastructure
The German cyclist's association (ADFC) comprises 165.000 members. They are triggered by smarticipate's immediate feedback function and want to plug in their own topic: a better cycle infrastructure in the Hamburg Metropolitan Region. This brand new application should mobilize their members to come up with realistic proposals for infrastructural improvements like more 30 km roads, handy short-cuts and car free school zones.

New Public Service
Locating water pumps
The Dutch development aid organization (Cordaid) works in more than 50 urban slum areas in Africa and Asia. They also see the potential of smarticipate's immediate feedback function, especially in combination with its location-based feature. Their topic: finding the best locations for water pumps. This application, which will be based on an existing prototype / Plant a Tree App, should mobilize slum dwellers to point out the right spots for this essential piece of urban infrastructure.

We will invite all conference participants in Bodø to test the smarticipate prototypes. Besides that, we will challenge them to think about which kind of New Public Service they would like to introduce and how the smarticipate platform could help them in achieving that goal.

The smarticipate project is funded under the Horizon 2020 research and innovation programme under grant agreement No 693729. It runs from February 2016 to January 2019. For more information, check www.smarticipate.eu

Land Suitability Evaluation for Resilient Urban Planning: a Planning Practice of Pingdingshan City, China

Xin KAI, Shanghai Tongji Urban Planning & Design Institute, China

1. Introduction

1.1 Resilient urban planning

Cities are increasingly becoming complex systems of social, economic and ecological factors. However, they are very vulnerable when any of their subsystems are destroyed or fail to adapt to new challenges (Xiaoling Zhang, 2018). From 2005 to 2010, the world's urban population increased at a rate of 1.9%. Rapid urbanization and growing mega-cities point to a need for more resilient cities that have the capacity to withstand the shocks of population growth, rapid demographic shifts in population, and environmental catastrophes (Kevin C., 2013). Thus, fostering resilience gradually becomes an important goal for urban planning.

The concept of resilience has traditionally been used in physics and psychology to respectively indicate the ability of an object to return to its original position after receiving a hit and the ability to successfully survive a shock or trauma. It was first introduced into ecology in 1973 by Holling who described it as a measure of the ability of systems to absorb change and disturbance without losing the pre-disturbance relationships between their constituent elements (Ayyoob Sharifia, 2014). Resilience in terms of cities generally refers to the capacity of a city to rebound from destruction (ARUP, 2016), the ability to absorb, adapt and respond to changes in an urban system (Kevin C., 2013).

Urban resilience is divided into several main aspects that cover ecological, infrastructural, economic and social dimensions. The *Rockefeller Foundation* carried out a research about *city resilience index* in 2016, the result shows that the resilience of a city relates to 4 key dimensions, including people, organisation, place and knowledge. Underpinning these four dimensions, 12 goals are defined to represent the city's immune system (Tab.1). This paper is mainly concerned with the place dimension, the quality of infrastructure and ecosystems that protects, provide and connect people.

Table 1: The dimension and goals of city resilience

Dimension	**Goals**
People: health & wellbeing	Minimal human vulnerability, Diverse livelihoods & employment, Effective safeguards to human health & life
Organisation: economy & society	Collective identity & community support, Comprehensive security & rule of law, Sustainable economy
Place: Infrastructure & ecosystems	Reduced exposure & fragility, Effective provision of critical services, reliable mobility & communications
Knowledge: Leadership & strategy	Effective leadership & management, Empowered stakeholders; Integrated development planning

Source: ARUP (2016) City resilience index, The Rockefeller Foundation

1.2 Land suitability evaluation

Land suitability evaluation processes, the bases to guide the urban planning, are essential for assessing and reacting to land conditions, opportunities, and threats for urban planning. The reasonable and orderly land suitability evaluation is of great significance for ordering spatial development, guiding population resource environments and ensuring socio-economic resilient development.

The *Urbanization work conference of CPC Central Committee* in 2013 paid high attention to the improvement of ecological-living-industrial space, which means reducing industrial land, appropriate increasing living land, and delineating ecological protection red lines for agricultural space such as cultivated land, garden land, vegetable fields. Wu Yanjuan (2016) built a land suitability evaluation framework from the perspective of the ecological-living-industrial function of land resources.

Table 2: Ecological-living-industrial land classification system

Classification		**Details**
Ecological land	Important land	Conservation land for water, soil, wind and sand fixation, flood regulation, riparian protection and biodiversity, including forest land, shrub land, woodlands, grasslands, pond water, beach coating, inland tidal flats, ditches, glaciers and permanent snow land
	General land	Saline-alkali land, swamps, sand and bare land
Industrial land	Agricultural land	Paddy fields, dry land, gardens, agricultural facilities land
	Industrial land	Mining land
Living land	Urban land	Cities, towns, scenic spots, railways, highways, airports, port terminals, pipeline transportation, reservoir water and hydraulic construction land
	Rural land	Village, rural road land

Source: WU Yanjuan, YANG Yanzhao, YANG Ling, ZHANG Chao, YOU Zhen（2016）"Land spatial development and suitability for city construction based on ecological-living-industrial space——take Ningbo City as an example", Resources Science, Vol.38: 2072-2081

1.3 Research purposes and methodology

The aim of this research is to propose a land suitability evaluation for resilient urban planning and applied it to the planning practice of Pingdingshan City, China. The methodological approaches of the Multi-Criteria Decision Analysis, Analytical Hierarchy Process and Delphi Process were used for the research. And the evaluation process is supported by a geographical information system (GIS) within the framework of ArcGIS software, combined with the Remote Sensing Image processed by ENVI (The Environment for Visualizing Images) software.

1.4 Research framework

The land suitability evaluation involves natural, agricultural and urban ecosystem resilience. From the aspect of natural ecosystem resilience, the evaluation involves three factors, including forest vegetation factor (vegetation coverage index, vegetation type index), river & reservoir factor (water level index, water quality grade index) and animal factor (biodiversity index). In the dimension of agricultural ecosystem resilience, two factors are considered, including crop factor (agricultural output value index) and farmland factor (Prime cropland area index). As for the urban ecosystem resilience, urban construction factor (elevation index, slope index, land-use situation index) and urban disaster factor (geological subside disaster index, flood disaster index) are selected. Finally, put forward resilient urban planning based on the result of land suitability evaluation (Fig.1).

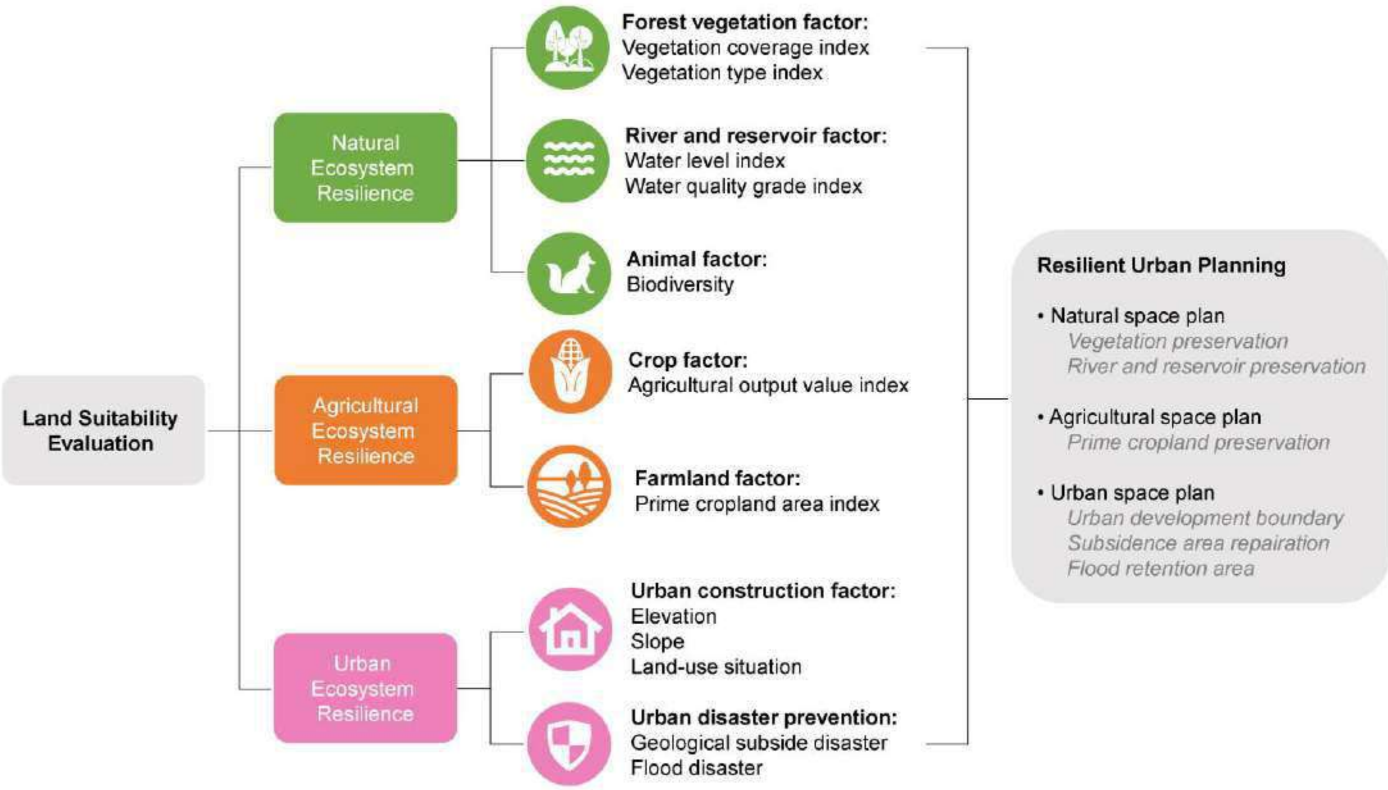

Figure 1: Research structure of land suitability evaluation

2. Land Suitability Evaluation for Pingdingshan City, China

2.1 Study area

Pingdingshan is a prefecture-level city covered 7,882 square kilometers in central Henan province, China. The city had 4,048 thousand inhabitants in 2016, 52.5% of whom lived in the urban area. Compared to similar inland cities, Pindingshan is very rich in water and ecological resources, and 42% area of the city are mountains and hills. But the urban economy has mostly relied on coal mineral exploitation for four decades, causing irreversible damage to the environment. Therefore, the planning of Pindingshan urgently needs a resilient and holistic approach of urban development and land use.

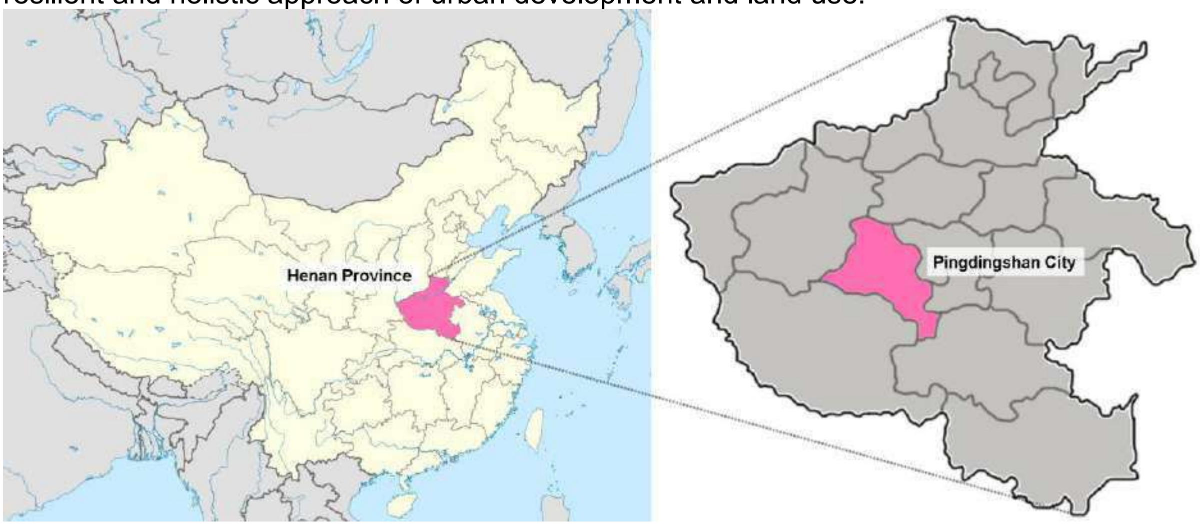

Figure 2: Location of Pingdingshan

2.2 Natural Ecosystem Resilience

For the forest vegetation factor, the area with important vegetation and high forest coverage need protecting. Normalized difference vegetation index (NDVI) was used to assess whether the area being observed contains live green vegetation or not. The formula is NDVI=(NIR-R)/(NIR+R), NIR means near infrared reflectance, and R means red reflectance. And based on the remote sensing image processed by ENVI (The Environment for Visualizing Images) software, the different area of coverage level was identified (Fig.3). Combination with the analysis of different vegetation type layout (Fig.4), the result shows that the western area of Pingdingshan has precious high coverage vegetation, which need strictly protecting. The northern and southern area of Pingdingshan has precious vegetation too, but the coverage rate is low, therefore these areas urgently need to be planed into the protection zone.

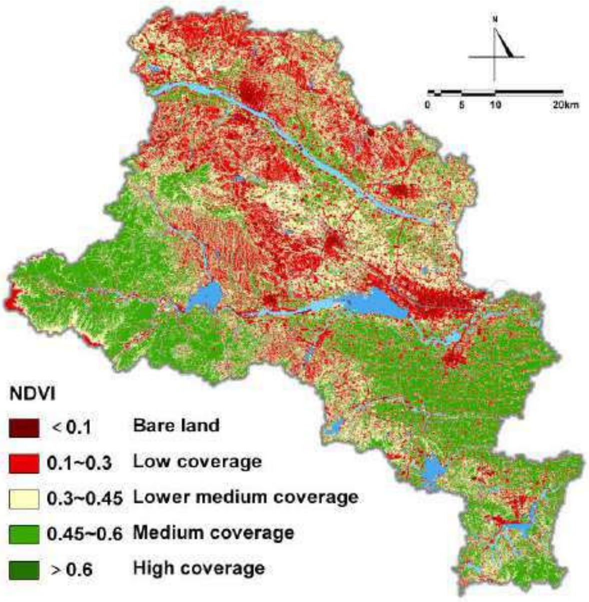

Figure 3: Vegetation coverage

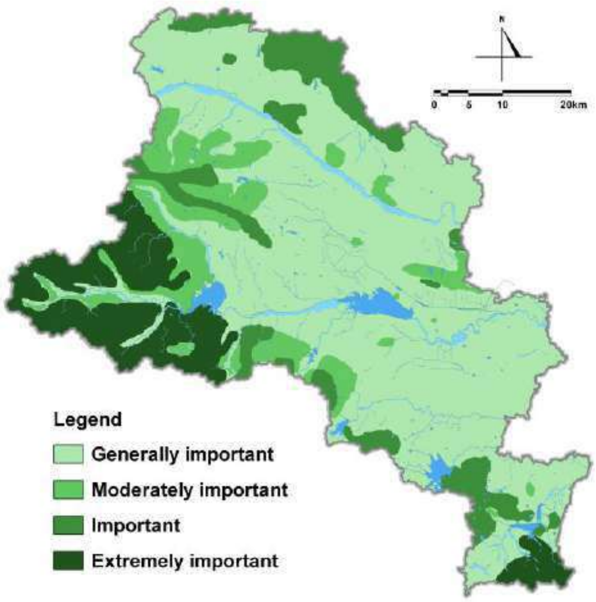

Figure 4: Layout of different vegetation type

Table 3: Importance of vegetation type

Grading standards	**Importance**
farmland, waters, wetlands	generally important
sparse shrubbery, subtropical economic forest, subtropical bamboo forest, low-to-medium coverage grassland, evergreen orchard	moderately important
subtropical broad-leaved or deciduous shrubs, high-coverage grasslands	important
natural or natural secondary subtropical evergreen broad-leaved forest, deciduous broad-leaved mixed forest, subtropical coniferous forests, evergreen deciduous coniferous broad-leaved mixed forest	extremely important

Source: Chang Bin et. al, 2014

For the river and reservoir factor, the quality, volume and grade of water are considered. And the water surrounding urban built-up area faced with serious pollution (Fig.5). One canal, five reservoirs and eight rivers are key protected objectives (Fig.6), which need strictly protection measures.

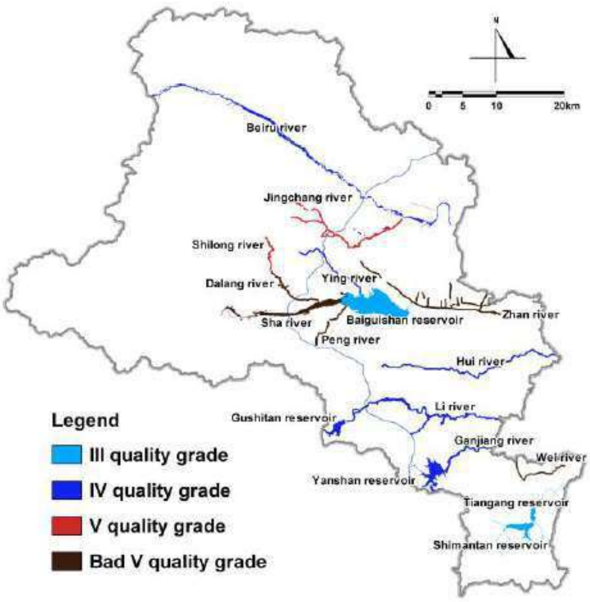

Figure 5: Water quality of river and reservoir

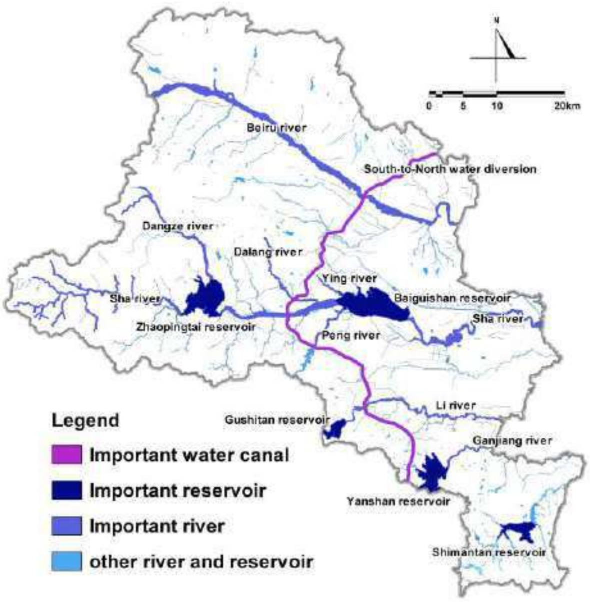

Figure 6: Important river and reservoir

Table 4: Water quality of river and reservoir

Water quality grade	**The water and reservoir in Pingdingshan**
III quality grade	Baiguishan reservoir, Tiangang reservoir, Shimantan reservoir
IV quality grade	Beiru river, Ying river, Hui river, Li river, Ganjiang river, Gushitan reservoir, Yanshan reservoir
V quality grade	Shilong river, Jingchagn river
Bad V quality grade	Dalang river, Sha river, Peng river, Zhan river, Wei river

Source: Pingdingshan Municipal Development and Reform Commission (2017) The "13th Five-Year" Comprehensive treatment plan for water environment in Huaihe basin in Pingdingshan

Table 5: The protection area for important water resource

Water resource	**Protection area**	**The water and reservoir in Pingdingshan**
water canal	200m land area on both sides of canal	south-to-north water diversion
reservoir	200m land area surround reservoir	Baiguishan, Zhaopingtai, Gushitan, Shimantan, Yanshan
river	100m land area on both sides of river	Ganjiang, Li, Sha, Beiru, Dangze, Peng, Ying, Dalang

Source: Pingdingshan Municipal Water Conservancy Bureau (2015) The "13th Five-Year" plan for the development of water conservancy in Pingdingshan

For the animal factor, based on biodiversity survey data, identifying the priority species living areas, assess the conservation of ecological diversity. The western and northern areas of Pingdingshan with diversity ecosystem types and species, require strict protection (Fig.7).

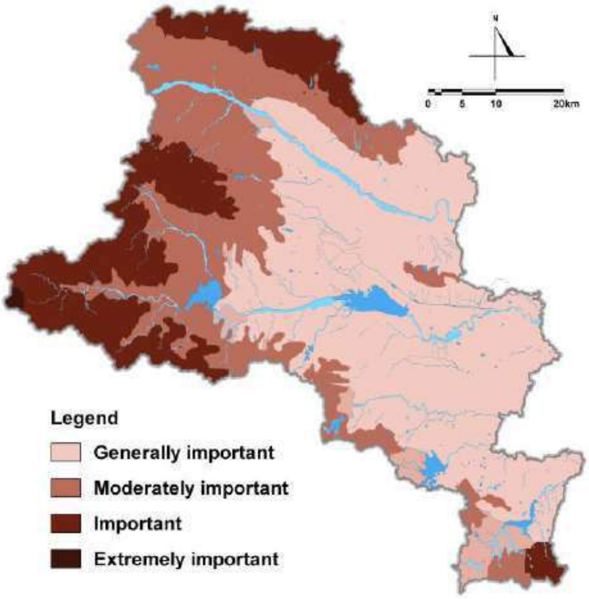

Figure 7: Importance of biodiversity

Table 6: Importance of biodiversity

The ratio of biological species to the total number of species in the city	**Importance**
Species ratio < 5%	generally important
5% < Species ratio < 15%	moderately important
15% < Species ratio < 30%	important
Species ratio > 30%	extremely important

Source: Chang Bin et. al, 2014

2.3 Agricultural Ecosystem Resilience

For the agricultural factors, the output value of agriculture, forestry, animal husbandry and fishery per unit area represents the capacity of agricultural production. The higher output of agriculture area has higher agricultural value, where is not suitable for large-scale construction (Fig.8).

Figure 8: Importance of agricultural output

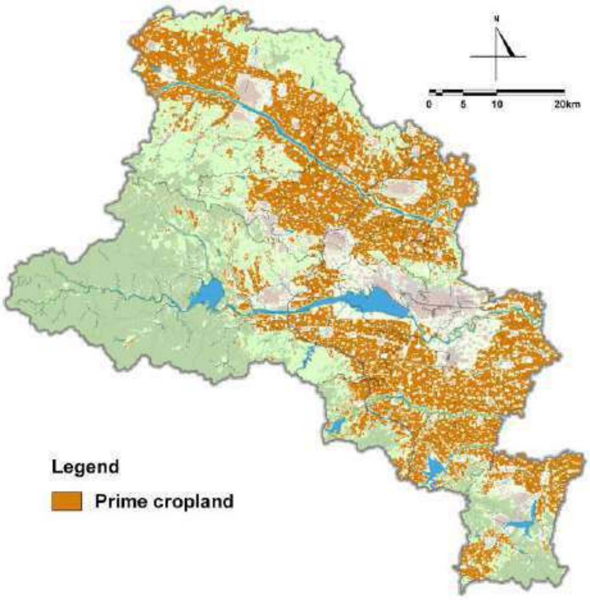

Figure 9: Layout of prime cropland

Table 7: Importance of vegetation type

Production value of agriculture, forestry, animal husbandry and fishery per unit area (10,000 yuan/km2)	**Importance**
production value per unit area＜100	generally important
100＜production value per unit area＜200	moderately important
200＜production value per unit area＜300	important
300＜production value per unit area	extremely important

Source: Chang Bin et. al, 2014

2.4 Urban Ecosystem Resilience

For the urban construction, the areas where elevation is higher than 120 meters (Fig.10), the slope more than 15° (Fig.11), are high ecological sensitive for construction. The highly ecological sensitive areas of elevation and slope are concentrated in the west, north, south of the city. And the urban built areas are low ecological sensitivity.

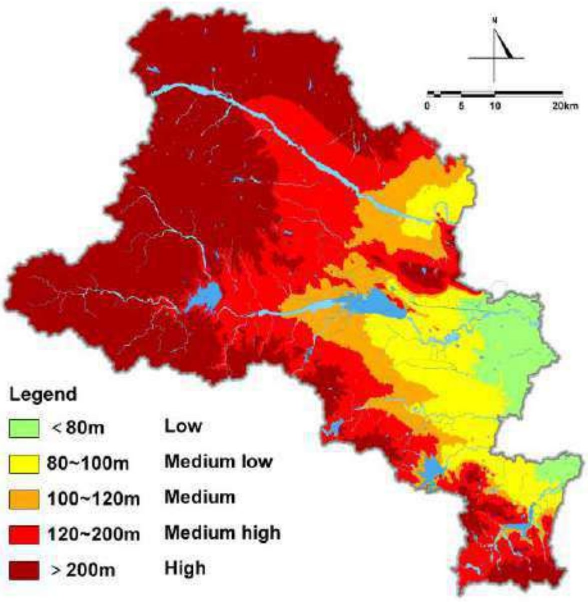

Figure 10: Elevation of Pingdingshan

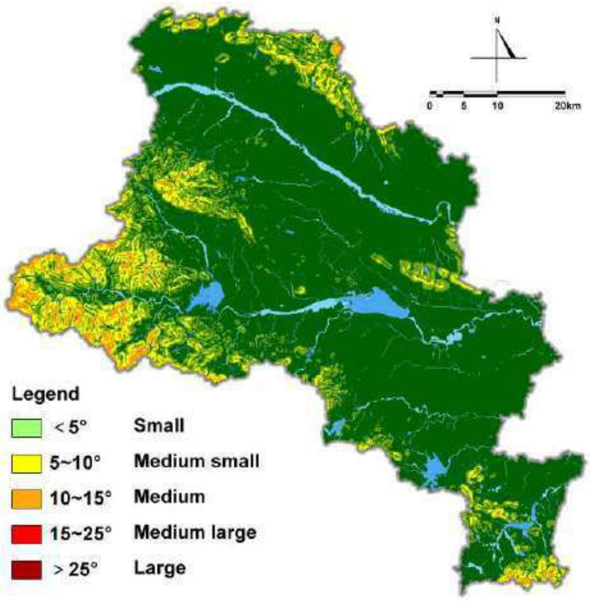

Figure 11: Slope of Pingdingshan

For the urban disaster prevention, geological subside disaster and flood disaster are the two main disasters in Pingdingshan. Because the urban economy has mostly relied on coal mineral exploitation for four decades, Pingdingshan is threatened by geological disasters such as landslides, landslides, ground fissures and mudslides. The coal mining subsidence areas are scattered and need to be strictly controlled and protected (Fig.12). Pingdingshan belongs to flood-disaster-prone areas, in particular, the area surrounding Baiguishan reservoir has a greater hazard of flooding. Therefore, it is necessary to plan the flood disaster prevention partition (Fig.13).

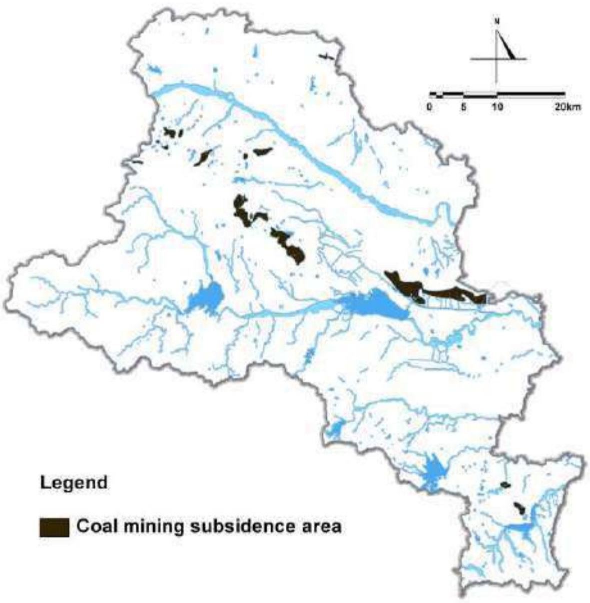

Figure 12: Elevation of Pingdingshan

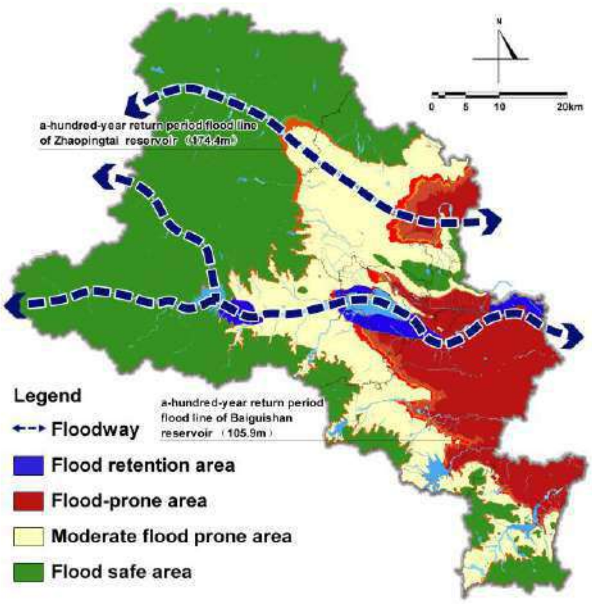

Figure 13: Flood disaster prevention partition

Table 8: Flood disaster prevention partition

Flood disaster prevention partition	**Location**
Flood safe area	the areas where elevation is higher than 174.4m, the one-hundred-year return period flood line of Zhaopingtai reservoir
Moderate flood prone area	the areas where elevation is between 105.9m and 174.4m, between the one-hundred-year return period flood line of Zhaopingtai reservoir and Zhaopingtai reservoir
Flood-prone area	the areas where elevation is lower than 105.9m, the one-hundred-year return period flood line of Baiguishan reservoir
Flood retention area	downstream of Zhaopingtai reservoir, Baiguishan reservoir, Sha river
Floodway	Dangze river, Sha river, Beiru river

2.5 Comprehensive Land Suitability Evaluation

Using GIS overlays the vegetation coverage, slope and elevation (other factors cannot be overlaid to the GIS due to the data type reason). The ecological sensitivity is divided into five levels. Ecologically high and medium high sensitive areas have high ecological value and need strictly protecting. These areas mainly locate in Lushan County, Wugang City, and Ruzhou City. There are also distributions in the north of Pingdingshan, the southwest of Ye County, and the northern part of JiaCounty. The low sensitive and medium low sensitive areas are suitable for construction. These areas are mainly located in built urban areas with low elevation, gentle slopes, and low vegetation coverage.

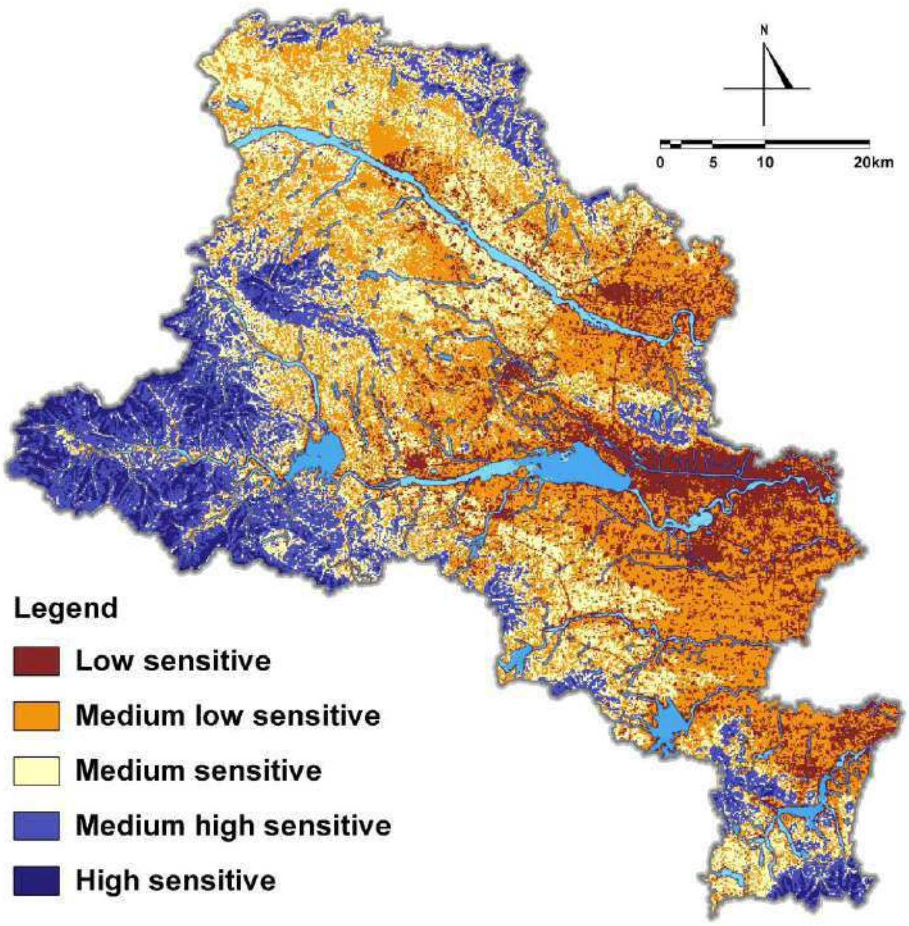

Figure 14: Ecological sensitivity area analysis

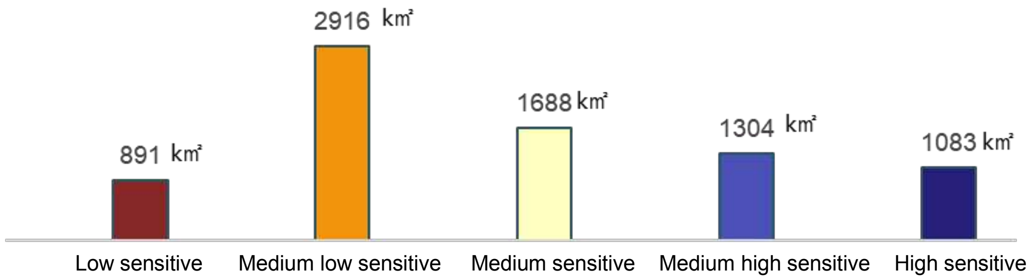

Figure 15: Area of Ecological sensitivity spaces

Table 9: The indexes of ecological sensitivity spaces

Index	Low sensitive	Medium low sensitive	Medium sensitive	Medium high sensitive	High sensitive	weight factor
Vegetation Coverage	＜0.1	0.1-0.3	0.3-0.45	0.45-0.6	＞0.6	0.4
Slope	＜5°	5°-10°	10°-15°	15°-25°	＞25°	0.3
Elevation	＜80m	80-100m	100-120m	120-200m	＞200m	0.3

3. Resilient Urban Planning for Pingdingshan City, China

3.1 Natural space plan

In current situation, only Jia county and Baofeng county has the ecological red line planning, the coverage is too small to protect the whole area. Therefore, based on the land suitability evaluation, plan ecological red line area 2433.7 square kilometres, accounting for 31% of the total Pingdingshan city. The ecological red line including vegetation preservation area and river & reservoir preservation area, any development and construction unrelated to the protection in the area shall be forbidden. For the vegetation preservation area, based on the five existing forest parks and five existing scenic spots, plan ten vegetation preservation areas with a total area of 1600.97 square kilometers. The river and reservoir preservation area are totally 832.73 square kilometers.

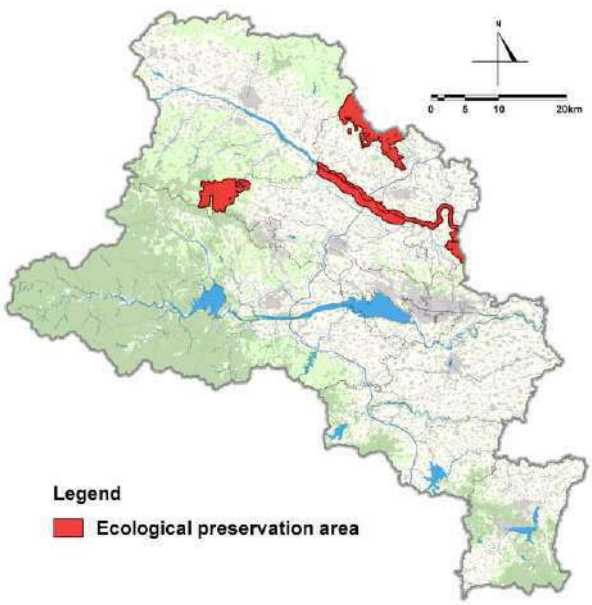

Figure 16: Current ecological red line

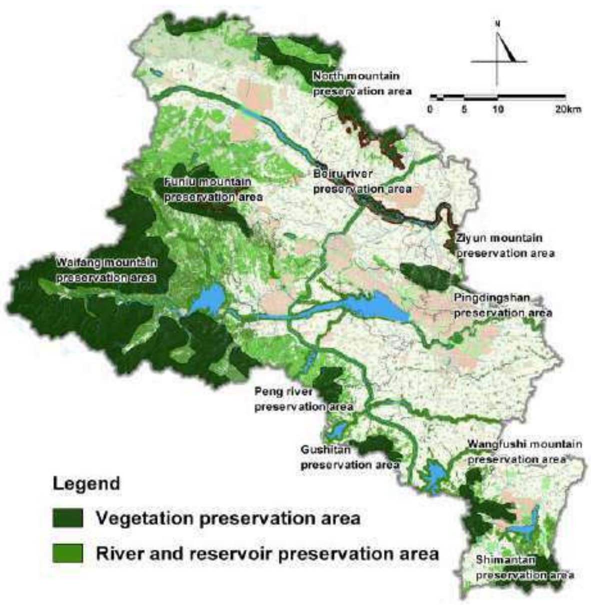

Figure 17: Planning ecological red line

3.2 Agricultural space plan

Based on the existing prime cropland planning of Pingdingshan, plan 3,049 square kilometers agricultural spaces, accounting for 39% of the total area of Pingdingshan. The agricultural spaces include 2,723 square kilometers of prime cropland, 79.6 square kilometers of general cropland, and 246.4 square kilometers of village area.

3.3 Urban space plan

According to the analysis of ecological sensitivity, plan the urban development boundary in the low and medium low sensitive area, and all the construction should happen within the boundary. The coal mining subsidence areas are totally 124 square kilometers, and the green belt not less than 500 meters wide between the living area and the mining area. In 2035, the area of urban development boundary is totally 690 square kilometres, and 60% of the area are concentrated in the core development area. The plan of urban development boundary follows three principles. The first principle is the protection of ecological core resources. Based on the existing ecologically protected red line and permanent basic farmland, protecting river ecology and agricultural core resources. The second principle is the protection and restoration of ecological fragile area, protecting ecologically fragile areas and gentle slope repair areas, avoiding subsidence areas and flood storage areas. The third principle is protecting natural patches inside urban development boundaries, including rivers, wetlands, mountains and important ecological corridor.

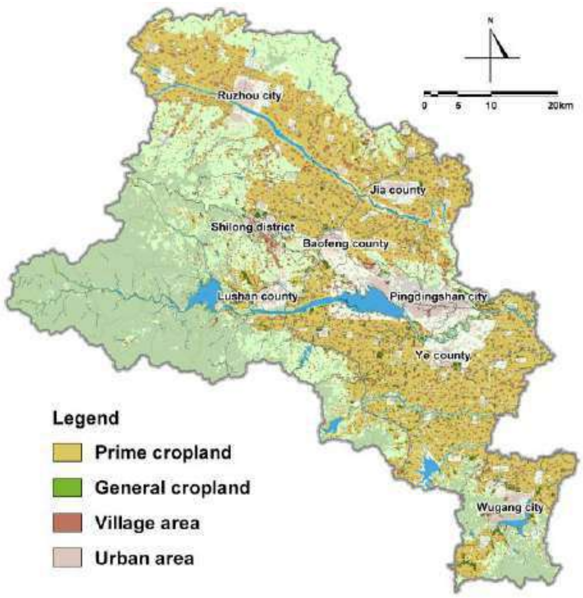

Figure 18: Layout of different cropland

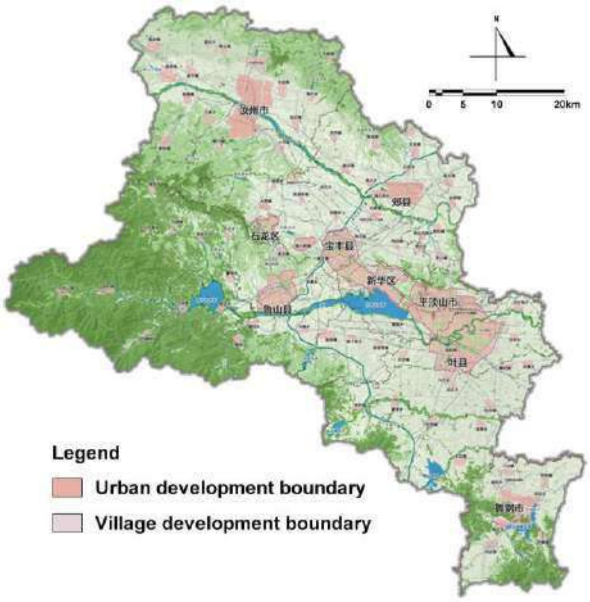

Figure 19: Urban development boundary plan

3.4 Resilient urban planning

Plan prohibited-construction, restrained-construction and construction area. In prohibited-construction area, any urban development and construction are forbidden. The area is 6,288 square kilometers, accounting for 80% of the total area, including prime cropland, mountain forest land, river reservoirs and ecological parks. Urban and rural construction should be avoided as much as possible in restrained-construction area. The area is 179 square kilometers, accounting for 2% of the total area, including geological subsidence area and independent construction land. The construction could appropriately expand based on the built-up area according to the traffic location conditions, and all the constructions should be controlled within the construction area. The area is 1415 square kilometers, accounting for 18% of the total area.

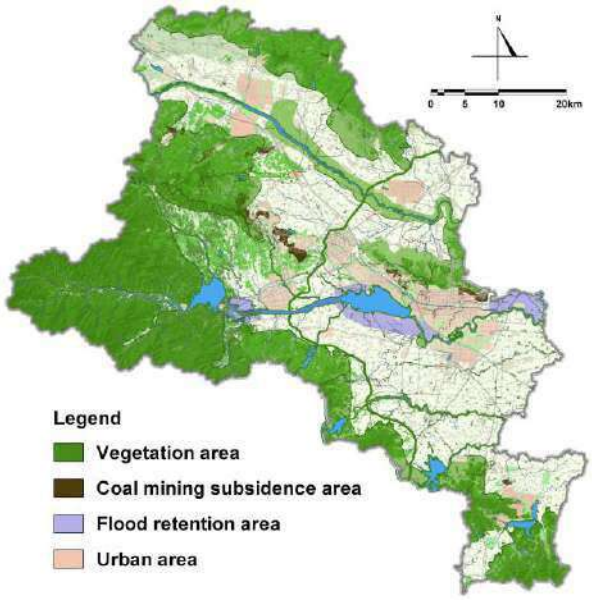

Figure 19: Natural, agricultural, urban elements

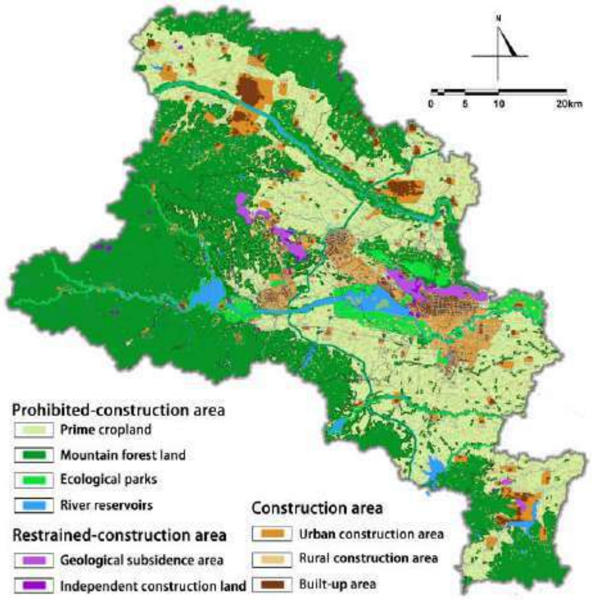

Figure 20: Resilient urban planning

4 Conclusion and Discussion

Overall, the output of this study can be used as the basis for land suitability evaluation in urban planning processes. In the process of ecological strategy planning, the land suitability evaluation model is used to identified the ecological valuable and sensitive areas, providing an ecological basic framework for land-use planning. The model has the capacity to provide decision makers with a clear and comprehensive picture of the urban infrastructure and ecosystems resilience development proposal and supports them in making better informed decisions to deliver cooler cities in our warming planet.

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Hot climate and runnability: how climate affects outdoor running activities. A case study of Doha, Qatar

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ABSTRACT:

Over the last decades, with the increasing reliance on car transportation, wealthy communities faced problems resulting from sedentary lifestyle and unhealthy diets. These contributed to increased risks of non-communicable diseases, such as heart related problems, strokes, high blood pressure, diabetes and many others. In order to reverse these trends many actions and strategies have been undertaken in cities. One of the simplest is prevention – promoting healthy lifestyle, which includes regular physical activity of citizens.

This article discusses runnability as a feature of built environment that allows and encourages running outdoors. Recently there have been many studies on walkability, connectivity, cycling (bike sharing, commuting etc.), but very little has been done to assess how urban space can be used more effectively for running. Running and jogging is one of the most simple physical activities that does not require much skill and equipment.

It is not only the lifestyle that affects activity levels, but also the environment – both the built one as well as the natural. They impact the way people can exercise outdoors. Apart from the discussion of the physical features the relation to climate is made. Doha, Qatar is a perfect testing ground for this study, as it is one of the hottest countries in the world. It has a dry, subtropical desert climate, with intensely hot and humid summers, while winters are quite pleasant, with average temperatures around 20 degrees Celsius. Moreover there is a large orientation of the government towards promoting and encouraging healthy lifestyle, which results in many strategies being implemented locally.

The article discusses: (1) impact of hot climate on outdoor physical activities, (2) use of infrastructure throughout the year in relation to weather conditions, (3) features of infrastructure that were designed to aid outdoor activity and (4) Doha's newest infrastructure for outdoor recreational activities.

The case study is based on dataset with running and cycling activities gathered by tracking devices and applications. The dataset consists of GPX linear tracks of individual activities recorded throughout the year. These are correlated to weather conditions outside. It also examines how the activities were related to the use of outdoor infrastructure, which were more attractive and why. Recently there were new parks and other areas opened, so it is also possible to draw conclusions on how these attract runners and impact their running habits – how the new infrastructure has changed the previous patterns. Moreover there is a discussion of desired qualities for good running space in warm or hot climate are also included.

The article also presents growing role of sports in local culture, despite hot climate, as well as the case studies of massive investments towards FIFA 2022 World Cup. These not only comprise of the stadiums, but also other infrastructure that is available to citizens, including a high-end sports district Aspire, with Aspetar – specialised orthopaedic and sports medicine hospital. Moreover there are plans for extensive cycle paths and running links.

The conclusions and examples presented can be used as a reference for planning and designing outdoor spaces to be running friendly in response to weather conditions in other cities. They will allow cities to be more runnable and encouraging for their inhabitants to exercise more and aid their well-being. Runnable cities are more sustainable, healthy and have happier citizens.

Smart City Governance – Co-creating Urban Planning and Inclusive Communities

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What are the challenges for the creation of integrated and open urban governance solutions and systems? How best to ensure the development of a robust model of urban governance and decision-making that effectively addresses the commonality of the drivers of change at global and pan-European level that impact cities? And what are the most effective transition pathways to the realization of visions of a new open governance model for Europe's cities?

This paper seeks to address these questions drawing on findings of a number of EU funded (FP7 and Horizon 2020) open smart city governance research and innovation projects supporting the development of open governance solutions for urban planning in collaboration with the partner cities of Rome, London and Hamburg, Helsinki, Antwerp, Milan, Bologna, Madrid and Amiens.

Transitions to Sustainability

The European Environment Agency (EEA) report Perspectives on Transitions to Sustainability (March 2018) demonstrates that transitions in the societal systems that drive environmental degradation and climate change are essential if Europe is to meet its sustainability goals in coming decades. Knowledge creation, sharing and use are fundamental to the governance of these sustainability transitions. Yet developing the knowledge needed to support transitions presents diverse challenges that also requires transformation of the existing knowledge system, including the creation of open governance structures that promote knowledge sharing across government and society more broadly, and the development of more forward-looking information.

Europe's persistent sustainability challenges are systemic, in the sense that they are tied in complex ways to prevailing economic, technological and social systems. These interlinkages often make it hard to effect rapid reductions in socio-economic and environmental pressures. Nonetheless, it is necessary to go beyond incremental improvement to secure fundamental transitions or transformations in core systems, entailing profound changes in dominant institutions, practices, technologies, policies, lifestyles and thinking. These include the consumption-production systems that meet key human needs, including food, mobility and energy. But there is also a need for fundamental change in other systems, such as urban, fiscal and financial systems, and knowledge systems supporting decision-making, and the governance model.

The notion of 'systemic challenges' was first taken up in the EEA Report European environment — state and outlook 2010, which identified the need for more integrated approaches addressing persistent socio-economic and environmental problems. However, associated research provided only limited insights into how transitions occur in practice, and how decision-makers at different scales of governance could catalyse and steer complex processes of systemic change towards long-term sustainability objectives. This raises questions concerning both the nature of the governance model that can most effectively deliver sustainability objectives, and at the same time the most effective means of creating this governance model and the associated transition pathways?

Research also indicates that some complex systems are actually causing environmentally and socially undesirable outcomes, and that in these circumstances, system resilience actually represents a problem. Indeed many factors that support resilience and also produce lock-ins in socio-technical systems, such as long-term investments and infrastructure, jobs and earnings, social norms and rebound effects. For example, the contribution of the division of labour into specialised silos within business or government locks each unit in optimising individual elements rather than holistic assessments. Hence, calls for trans-disciplinarity and the co-creation of knowledge to support sustainability transitions acknowledging the limitations of academic silos.

Many elements of transformations research focus on environment-society interactions in an urban context providing focus on land use. This focus on spatially defined systems directs attention towards interactions and trade-offs across different systems and resource uses within a particular area, as exemplified by food-water-energy nexus assessments, so emphasising the importance of spatial planning and land use.

Systemic change is understood to require multi-scalar, society-wide processes of innovation, experimentation and learning; upscaling, replication or adaptation of new technologies or practices; and disruption of the established regime, often as a result of external shocks. Transitions are multi-actor processes that involve interdependent changes in technologies, behaviours, rules, and values. Policymakers and institutions are generally perceived to be part of the system that needs to be transformed, rather than being separate actors with the power to steer society towards long-term sustainability objectives.

Governments and governance institutions may be part of the problem but also have an essential role to play, and it is vital to consider how governments can best use their powers to enable transitions — not only by means of hierarchical legislating but also by creating the institutions and infrastructures to enable markets and networks to function. These insights point to the critical importance of innovation and broader societal engagement in systemic change, as well as the need to embrace and promote a more diverse mixture of open governance approaches, including adaptive, polycentric and participatory styles of governance, based on social interaction and information sharing.

Furthermore, there is a need to complement sustainability policies with a much more diverse mixture of policy approaches. Regulations and environmental taxes have an important role to play, but achieving systemic change depends to a significant extent on creating an environment in which novel technologies, practices and business models can emerge through experimentation and subsequently displace established ways of meeting societal needs. This may necessitate adopting different governance styles at different stages of transitions.

Communities and cities emerge as key actors across the different perspectives, reflecting the capacity for innovation to emerge in local settings, and the potential for local systems. The impact and influence of local initiatives is enhanced by new platforms for networking and communication, including stakeholder platforms. Such platforms can facilitate the sharing of ideas and practices across 'communities of communities', which allow innovations to be shared, replicated and adapted.

Transitions also rely on innovation and reconfiguration across multiple areas of society. As multi-scalar processes, they are dependent on policy mixes and governance interactions across local, national and international scales. A major governance challenge therefore resides in steering such uncertain and wide-ranging processes of change towards desirable end points. Here, government interventions can contribute in a variety of important ways, to inform and shape visions, policy and governance at national, regional and local scales, engaging communities in participatory processes that develop narratives, which can help illustrate the implications of alternative futures.

In addition, achieving sophisticated policy mixes and coordinated governance is also likely to require changes in public sector institutions, competencies, skills, and knowledge systems. Tackling complexity and achieving transitions will depend in part on overcoming silos and enabling information to flow freely across government and across scales. It will also require the development of adaptive governance frameworks that operate via iterative cycles of planning, implementing, and monitoring.

The systemic nature of Europe's sustainability challenges highlights a key concern to specify the nature of the governance model that can most effectively deliver the sustainability objectives. The central requirement for integrated approaches to sustainability transition has long been advocated as an essential response to socio-economic interdependencies and the multi-scalar nature of governance responses in a pan-European framework. At the same time innovation and broader societal engagement in systemic change is promoting demands for open and participatory styles of governance based on social interaction and information sharing. Furthermore, enhanced communication overcoming silos and enabling free information flow across governments and scale emphasizes the common requirements for common foundations and interoperability in the governance system.

Disruptive Technology

Disruptive technology applications for urban governance and decision-making offer major opportunities for engaging multi-disciplinary partners and stakeholders, and integrating evidence based decision-making in governance process addressing societal challenge. The aim is to create planning scenarios delivering "win-win" policy co-benefits from optimised socio-economic and environmental solutions for local communities. In this regard it is critical to develop pathways for the introduction of disruptive technologies, developing new ways of providing public services and optimising work processes, and simultaneously develop business plans to ensure long-term sustainability of the services defined.

Disruptive technology applications for network governance combine more bottom-up engagement with greater degrees of cooperation and coordination. The emergence of these new governance modes reflects the dynamic of change, and changing roles and relationships of different actors, in which change is more rapid and fluid, with non-public sector actors, including social entrepreneurs and creative industries increasingly involved in delivery. This transformational governance therefore aims to harness the dynamic of both societal and technological innovation.

Transformational governance enables ICT to promote wholesale restructuring and repurposing of governance as open governance. This open governance approach is based on 3 pillars including modern stakeholder engagement, analytical technology and agile iterative implementation. Open governance deploys open data with open services and open process, but to be fully realised needs a broader open governance framework linking and integrating worlds inside government as well as worlds outside government, hence governance as a platform. Governance as a platform supports the modernisation of public services, however for this to succeed with a viable business model, the open governance framework also needs to be supported by a strong ICT backbone that is interoperable and based on common reusable modular public services facilitating the interoperability of European public administrations.

The principles of urban governance are based on the twin pillars of an integrated and participatory urban governance, that define requirements driving the development of a common model of governance globally, which in turn is driving the development of common methodologies of urban governance and land-use planning. Integrative governance addresses the complexity of the interconnected socio-economic and environmental considerations constituting city life, that must be managed in the urban spatial frame. Furthermore, all urban governance and land use planning decision-making processes require the provision of a political mandate for the urban plan and associated development proposals, generating the political will essential to implement the plan. In various ways stakeholders including citizens, business representatives and civil society organisations must be engaged in the decision-making process to facilitate political decision-making, providing endorsement of plans and development proposals, so securing necessary legitimacy for the decisions in a framework of democratic governance.

Technological innovation allied with an intersecting social innovation is providing a new and powerful dynamic of change that is promoting and shaping the development of common and generic applications of integrated and participatory urban governance. This dynamic is focused on the context of smart city governance whereby ICT derived tools and methodologies are applied to the operationalisation of decision-making within the framework of the policy cycle in respect of both integrated and participatory urban governance, enhancing the opportunity for more effective realisation of sustainable urban development objectives. Smart city open government initiatives building on innovation and research conducted globally involving city planners, research institutes and industry is creating new means of impact assessment, stakeholder engagement as well as simulation and visualisation of urban futures.

Urban Governance Challenges – Complexity

This real-world context for governance transformation emphasizes the challenges that cities face in trying to deliver sustainable urban development, and makes clear that the challenges are not only strategic, technical and financial but also relate to urban complexity, city management and institutional barriers.

The socio-economic architecture of the city-region defined in a territorial context determines the extent to which the cities of Europe positively contribute to Europe's global commitments to halt climate change by reducing greenhouse gas emissions, which are substantially associated with motorised forms of urban transport. The overall shape and structure of the city- region, the extent of urban sprawl, the density of population and the dominant mode of transport between homes and work, and recreational and cultural facilities substantially determine the level of greenhouse gas emissions. As a result of the interconnected nature of socio-economic drivers and environmental impacts, these socio-economic variables critical in city formation also fundamentally influence the health of the urban population, primarily as a result of air pollutants generated by motorised transport. Furthermore, the form of the city-region and its physical connectivity and interaction with its hinterland substantially determines the wider impact of the city on the natural environment, and the conservation or loss of biodiversity.

The interconnectedness of social, economic and environmental challenges in the urban context create complex conditions for urban management, and as a consequence barriers to delivery of a more sustainable urban development. This interconnectedness and complexity is illustrated in Figure 1, whereby the relationship between more compact city and city-region solutions or more sprawling cities is substantially influenced by the land use - transport relationship that impacts directly on air quality, noise and greenhouse gas emissions, and so influences human health, climate change as well as biodiversity degradation.

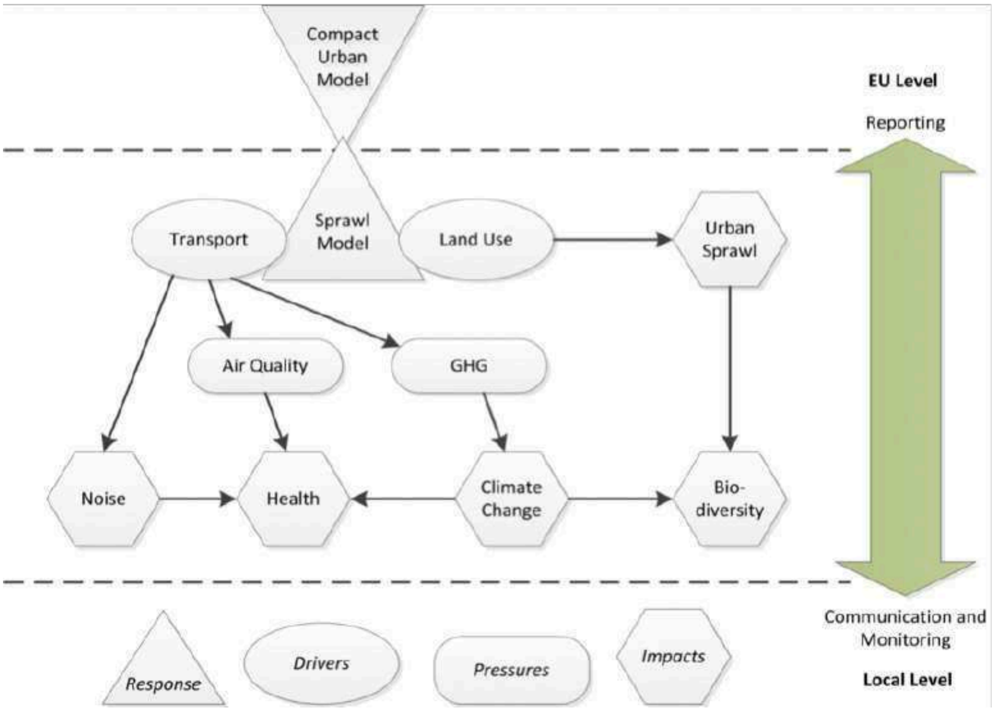

Figure 1: Urban interconnectedness and Complexity

Urban Governance Challenges - Fragmentation

All levels of governance, local, regional, national and European, have an impact on urban development, the difficulty is to merge the actions of these different levels of governance into a consistent and integrated urban policy due to the fragmentation of responsibilities and decisions. Inadequate governance arises as a result of the growing mismatch between administrative delineations and the ‘real’ urban structures that extends far beyond the limits of the municipality of the core city. In emerging large polycentric city-regions, urban structure is often composed of a network of small and medium, urban, peri-urban and rural municipalities located around the major urban centre. Urban policies have to be defined at a larger scale than municipality scale for operational reasons in order to provide better services for users (e.g. public transport), for cost-efficiency reasons in order to share costs (e.g. utilities, infrastructure, public transport); for strategic reasons in order to develop policies at the appropriate scale and involve the key actors (e.g. economic strategies and programmes); for territorial reasons in order to take into account the characteristics of the place (eg. protection against flooding).

Urban Governance Challenges – Stakeholder Engagement

In this fragmented environment (institutionally and spatially), urban governance is further complicated by the number and the variety of actors (private and public) operating at different territorial levels (e.g. Municipalities, Urban-Rural Region, Metropolitan area, City-Region) with various competences (e.g. agencies, services providers) and objectives. Besides public and semi-public sectors, the policy-making process involves heterogeneous actors from private sector, third sector and citizens. These private sector including firms and companies operate at national (e.g. infrastructure providers), regional, city and individual (e.g. property development companies) levels of activity. Third sector agencies including NGOs, civil society organisations, non-profit-making organisations (e.g. interests groups, ecological associations, neighbourhood committees) are also engaged.

As a consequence of the various challenges identified above transformational governance, which attempts to drive the socio-economic and environmental transformations necessary to deliver the sustainable development objectives adopted by all cities of Europe, is confronted with the limitations of the policy instruments that are inadequate to deal with urban complexity. Furthermore, current governance models are insufficiently agile to cope with the entrepreneurial environment encountered, and to respond to the pace of change in demography, societal expectations, and technology etc.

Transformational governance seeks solutions in integrated and multi-level urban governance, an arrangement for making binding decisions that engages a multiplicity of politically independent and interdependent actors, private and public, at different levels of territorial aggregation. Coordination, cooperation, participation and integration are the key principles of the multi-level urban governance approach. Accordingly, the practical implementation of this multi-level concept is a complex challenge for all levels of power. It is a relationship based on a permanent process of ‘negotiation-deliberation-implementation’ between numerous actors at different territorial levels and within each level. Urban governance is particularly characterized by the need for cooperation between a large variety of actors of many domains (e.g. utilities, housing, urban planning, health) and the necessity to engage stakeholders (e.g. citizens, business, NGO’s) in the decision-making process.

Cooperation and effective collaboration between levels of government (vertical dimension) and spatial cooperation (horizontal dimension), aims to enable efficient policymaking and service delivery:

• **Vertical Dimension:** involving linkages between higher and lower levels of government, including their institutional, financial, and informational aspects;

• **Horizontal Dimension:** concerning co-operation arrangements between regions or between municipalities, as a means to improve the effectiveness of local public service delivery and implementation of development strategies.

Transformational Governance - Participation

In addition to the integration model of governance outlined above, the involvement of civil society in the decision-making process is essential. For policy-makers and decisions-makers, dialogue with citizens is not only a way to understand society’s expectations but also to identify barriers and opportunities for transformation, supporting the effective implementation of policies. Engagement of stakeholders and the variety of domains actors is supported by both top-down and bottom-up approaches at the urban level:

- **Top-down approaches**: based on regulatory and economic instruments developed by EU, national governments and regional governments, for example, focused on sectoral policies (e.g. energy, waste, water, transport);

- **Bottom-up approaches:** including participation of the local level and society (e.g. citizens, NGO’s and sectoral actors) in the policy process.

Top-down and bottom-up practice-based approaches are both essential to strategically manage multi-level and multi-stakeholder change processes, but societal process is also critical, involving fundamental change in the structure, culture and practices of the societal system. To achieve transition towards sustainable cities it is necessary to critically examine institutions (e.g. global markets), the scale (e.g. district, municipality, city, city-region, region) the values and norms, and daily practices (e.g. commuting by car), as well as the characteristics of the place (e.g. territorial capital). Change needs to occur at many levels, at small and large scales, and among many stakeholder groups.

Transformational Governance – Co-Creation and Participatory Process

Transformational governance combines technical planning capabilities with greater collaboration, within and across traditional policy and administrative boundaries within and between cities and communities. Some cities have adopted ambitious policy agendas with targets to plan, organise and manage the city in order to achieve these goals. These approaches can be used to influence and facilitate societal changes and to orientate actions of all actors towards sustainable pathways. But transformational governance cannot be realized via a top-down approach alone, and efforts to shape or accelerate it are greatly enhanced by open co-creative and participatory processes, involving all relevant actors, including business, civil society, researchers, policy-makers and public administrations.

In this frame of transition management, policy-makers and city administration do not have full control of the process that is driven by stakeholders and citizens. At the start of the process, it is not possible to determine the nature of the vision which is determined by stakeholders. The results may not be fully in line with the initial goals and plans of the municipality, so policy-makers have to rethink their roles in driving decision-making in their communities, bearing in mind that lasting changes will depend on citizens. The target of the process is the empowerment and engagement of a community around a shared vision and agenda.

Transformational Governance – Planning and Decision Making

The above general principles of transformational governance are applied to the specific needs of urban planning and land use decision making. This requires the development of an overarching policy integrating various sectoral policies, setting collaborative networks, involving multiple actors, combined with a decision making process. Here the land use plan, including collective goals and long-term vision for the territory, provides the framework for operational decision making level, in which individual decisions on land use development proposals drive the implementation of the plan in response to the provisions of the land use plan and other relevant policy frameworks.

Operational decision making supporting the implementation of the land use plan is effected via the policy and decision making cycle in respect of the traditional top-down model of urban planning is identified in Figure 2. The policy and decision making cycle, in a sequential and iterative fashion, mobilises and operationalises intelligence, integrating governance, based on the following:

- **assessment** of socio-economic and environmental impacts of alternative development options
- **stakeholder engagement** regarding alternative development options
- **political decision making** and plan implementation

Figure 2: Planning Decision Making Cycle - Top Down Model (Managing Urban Europe 25, 2008)

In the traditional top-down model the planning requirement for ICT enabled solutions is based on a sequence of actions that deploys information and intelligence, communicates this intelligence between planning agencies in order to inform assessment as a basis for decision involving:

- assessment methodologies, visualisation, simulation
- integration of information and analysis (cross departmental/multi-scalar)
- limited engagement of stakeholders

Operational Decision Making – Co-Creative and Participatory Process

The co-creative model of decision making, in contrast to the top-down model recognises that transformational governance cannot be realized via a top-down approach alone, and effective decision making can only happen in a co-creative, participatory process, involving all relevant actors, including business, civil society, researchers, policy-makers and public administrations. The top-down model defines as essential to good governance effective collaboration across government departments and with non-governmental actors, requiring working across portfolio boundaries to jointly achieve integrated responses to the issues of policy development. The co-creative model stresses effective collaboration with societal actors in public service delivery and policy-making helping government agencies to improve their response to user needs and release their problem solving capacity. Effective engagement with societal actors also help citizens to actively participate in the decisions that affect their lives, to be involved in the co-creation of services, including design and delivery, as well as in finding solutions to societal challenges as demonstrated in Figure 3 below. Here the red elipses (crowdsourcing, participatory 3-D sketching, and participatory ex-ante impact assessment) indicate opportunities for ICT enabled co-creative process applied to the policy and decision-making cycle.

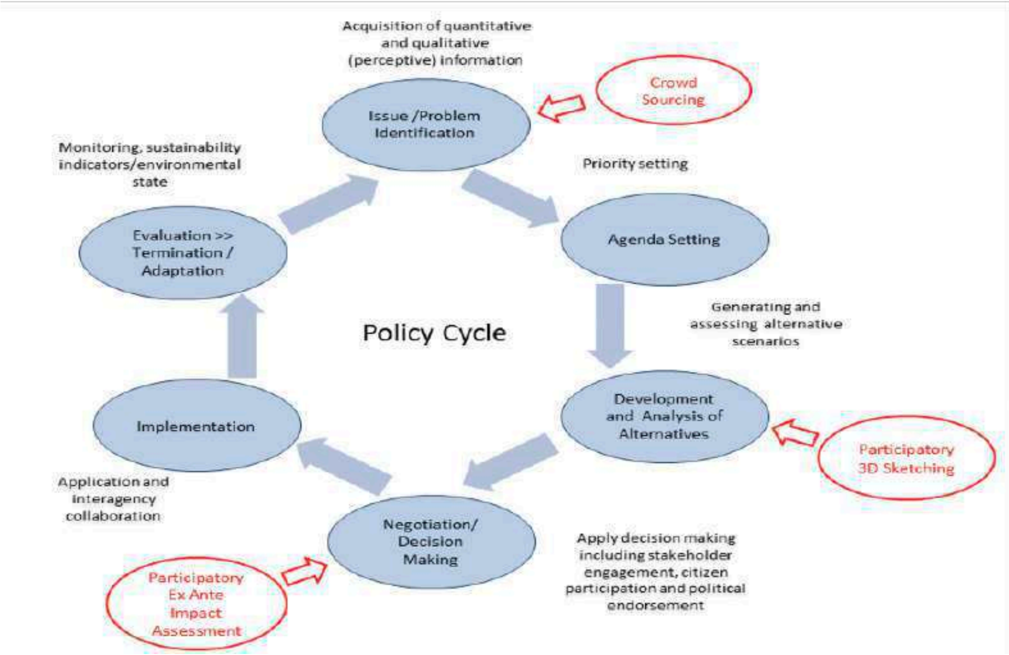

Figure 3: Planning Decision Making Cycle - Co-Creation Model

The co-creation model, forms the basis for all interventions in the land use planning and governance process, and thereby redefines the governance model. Here the land use planning requirement for ICT enabled solutions is based on a sequence of actions defined according to an open government paradigm driven by open public data and services and facilitating collaboration in the design, production and delivery of public services, with benefits including:

- making government processes and decisions open to foster citizen engagement improving the quality of decision-making for public institutions;
- open processes, activities and decisions enhancing transparency, accountability and trust in government. ICT facilitates bottom-up, participative and collaborative initiatives that tackle specific societal problems;
- open governance improving the efficiency, effectiveness and quality of public services by introducing new processes, products, services and methods of delivery enabled by ICT.

Common Solutions

The conceptual frame shaping common ground in urban sustainability described above is a transformational governance based upon the understanding that urban managers throughout Europe face common challenges in responding to the need to secure urban economic vitality, social inclusion and environmental sustainability in urban society in relation to the global challenges of urbanisation. The commonality of the drivers of urban change offers a major opportunity and requirement for the development of common solutions. These solutions are increasingly based on the dynamic of smart urban governance supporting the development of generic ICT applications and methodologies, harnessing social innovation, and grounded in integrated assessment process and wide stakeholder engagement. EU funded smart city governance research directly addresses these potentials, developing common models of policy formulation and implementation in respect of information generation and management, as well as stakeholder engagement, thereby supporting the potential for widespread application of the tools developed throughout the cities and regions of Europe.

The development of an integrated, more powerful and effective urban governance aims to manage the most intractable urban planning issues, including the management of the complexity of urban interactions, specified in socio-economic activity, set within both environmental limits and the territorial frame. This transformational governance requires greater stakeholder engagement in the urban planning process. Municipal experts providing a top-down view of the urban vision, and its local level specification, are no longer able to manage the inherent complexity of the sustainable city alone. Greater bottom-up stakeholder engagement thereby secures the quality of integrated assessment necessary to effectively plan the modern city, providing inputs in respect of the political diversity of views on the best way forward, all essential to secure the democratic legitimacy of the urban plan.

The specification of a common framework for analysis of smart city governance applications, is set against a background of the evolving dynamic of social and technological innovation, in which opportunities for development of the integrated and participatory governance model, together with it's requirements for enhanced intelligence and communication tools are identified. As a result powerful synergies between diverse initiatives may be harnessed, to support the development of a critical mass of capacity building for urban transition pathways, operationalising the integrated and participatory governance approach.

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Planning for a changing climate: A GIS and Remote Sensing approach to urban flood modelling in the Gauteng City Region

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Abstract

The Gauteng City Region (GCR) is one of the fastest growing city regions in South Africa. Considered the economic heartland of South Africa, the GCR continues to attract increased populations and urban developments. Parallel to increased urbanization and city growth are increasing climate change impacts such as severe weather conditions and urban flooding incidents. Climate change impacts are affecting cities globally causing major damages to urban infrastructure, human settlements as well as natural landscapes. In the Gauteng City Region, climate change impacts are becoming frequent, requiring innovative, integrated, resilient and sustainable solutions to mitigate and manage climate change impacts. GIS and Remote Sensing technology have allowed urban planners and city policy makers to gain critical insights on various urban and rural development elements. This paper therefore explores the potential use of GIS and Remote Sensing in identifying potential flood-prone regions and climate change policy adaptation in the Gauteng City Region. The study focused on the proposed 'aerotropolis' of Ekurhuleni as an emerging urban growth region in the Gauteng City Region. Hydrologic modelling techniques using digital elevation models (DEM), watershed boundaries, hydrography, and land cover data were used to model flood risk regions. The results of the analysis were then compared with the municipal spatial development framework, disaster and risk management plans and strategies on risk preparedness whilst providing recommendations for integrated, resilient and sustainable solutions for responding to climate change in the Gauteng City Region. The study also promoted the use of GIS and Remote Sensing technology as a smart and inclusive approaches to plan and respond to climate change and its impacts on the growth and sustainability of the Gauteng City Region.

Key words: *Climate change, Resilience, hydrological analysis, co-production, GIS and Remote Sensing, Sustainability and SDGs.*

1. Introduction

Cities are experiencing rapid urbanization leading to a competitive demand on land for urban developments, this increasing risk vulnerability to climate change impacts such as urban flooding (Abhas, 2011; Moench, 2012; Mai and De Smedt, 2017 and Dalu et al, 2017). Changing climate conditions are increasingly posing a risk for cities around the world (IPCC, 2014; Kulkarni et al, 2014). In South Africa, increasing natural disasters such as severe storms and urban flooding are also causing damage and disruptions on urban infrastructure, mobility as well as socio-natural eco-systems (Abhas, 2011; Musungu, 2015 and). These global climatic changes are also said to affect vulnerable communities especially those living in informal settlements who are often located on floodplains (Mahmoud, 2017). It is further reported that urban flooding accounted for 43% of all recorded global natural disasters in the last two decades (Choy, 2018). In South Africa, the past 50 years have seen an increase in rainfall trends increasing the probability of flooding and disruptions to urban infrastructure (SANCCRS, 2004, Kruger and Nxumalo, 2017). As such, recent studies reaffirm increases in climate change as well as its impacts which affects livelihoods and the fragile growing economy of South Africa (SANCCRS, 2004:6). Climate change therefore requires more adaptive and resilient approaches to policy and urban developments.

Whilst there are various discussions and definitions for resilience in literature for resilience (Smit and Wandel, 2006; Fatti and Patel, 2013; Rollason et al, 2017). In this paper, climate change resilience is defined as the capacity for managing and mitigating climate change impacts through the adaption and reorganizing of planning tools and policies to reduce climate change impacts and increase sustainability (Folke, 2006 and Nelson et al, 2007). Vulnerability on the other hand is defined using McCarthy et al (2001)'s three characteristics which are expressed as (a) *adaptive capacity*, (b) *sensitivity* as well as (c) *exposure* (McCarthy et al, 2001). These characteristics are based on the assumption that preparedness for changing climate conditions can be affected by the unique risks, vulnerability as well as exposure to various climate change impacts that cities face. Smit and Wandel (2006) further argued that achieving climate resilience involves adapting a resilient framework that incorporates various multi-stable tools beginning with policy making, innovative tools as well as social ecological systems. GIS and Remote Sensing technology therefore presents the capabilities for comprehensive and integrated flood modelling techniques for better responses to climate change impacts (Correia et al, 1997). Studies on the use GIS applications for hydrological models on flooding have been carried widely in the global north, with very limited similar research in the global south (Musungu et al, 2011). Musungu et al (2011) further argues that limited flow of climate change information contributes to lack of involvement on mitigation measures especially in South African informal settlements. This has been a case in the City of Johannesburg, where residents of Alexandra Township resided on the banks of the Jukskei River (Modise, 2017). Residents refused location by the city due to poor Government to Citizen Relationships (G2C), resulting in severe flooding impacts and displacement during the rainy season (Modise, 2017). It is therefore argued in this paper that GIS and Remote Sensing tools can play a critical role in promoting information building adaptive capacity and resilience on climate change impacts. Innovative tools can increase opportunities for the co-production of resilient strategies and actions (Kulkarni et al, 2014). As a result, planning for changing climate conditions requires integrated and innovative approaches to modelling climate change resilience and sustainability which accommodates citizens and non-government actors to influencing policy and building adaptive capacity (Chen et al, 2008).

This paper therefore proposes the use of GIS and Remote Sensing as a means for building adaptive capacity and reorganizing planning tools for better climate change resilience. There are numerous other methods used for flood inundation and risk modelling which employ both hydrologic and hydraulic modelling techniques (Aksoy et al, 2016). These include more sophisticated 2D and 3D models such as HEC-RAS and FLO-2D (USACE, 2010). However, basic hydrological modelling in GIS using Remote Sensing data can still be useful in identifying flood risk as a first stage. As a result, this paper uses a basic hydrologic model in ArcGIS which uses a digital elevation data to model water flow characteristics. The results of the GIS analysis were then used to assess the appropriateness of the Spatial Development Framework (SDF) as well as the Disaster Risk Management Strategy of Ekurhuleni Municipality. Further discussions on the role of GIS and Remote Sensing in influencing planning approaches by considering climate change trends as well as development approaches the Gauteng City Region are presented. The following key assumptions are made in the paper; (1) that innovative tools such as GIS and Remote Sensing can play a critical role in transforming urban policy and development approaches towards resilience and sustainability. (2) That GIS and Remote technology presents a platform for disseminating and integrating complex geographic information for interpretation by various urban actors including citizens (Piketh et al (2014). (3) Climate change modelling can build consensus, local resilience and adaptive capacity. Grist (2018) argued that climate change resilience can also be built by building people's capacity to respond to climate change which includes access to better information and technical knowledge (Willemen et al, 2016 and Grist, 2018). It is argued that effective mitigation can be achieved if individual actors advance their own interests independently (IPPC, 2014:46). Therefore, citizens form a critical component in the mitigation of climate change impacts, both as actors and victims of the results of climate change.

Kruger and Nxumalo (2017) argued that South Africa already has a relatively extensive station network and rain trends data records. They however indicated challenges related to gathering and detecting rainfall changes (Kruger and Nxumalo, 2017). Other challenges cited by Kruger and Nxumalo (2017) were based on the organizational functions and facilitation of climate change risk management, which they argue is often not very inclusive to citizens and local based knowledge. These assertions are consistent with the observations by Musungu et al, 2011 citing the organization of risk management in the City of Cape Town. Research found that there is a need for understanding the human dimensions of risk generation and management. Lack of integrated perceptions to climate change risks poses limitations to developing inclusive resilience strategies and actions (Musungu et al, 2011). There is still a large number of South Africans living in flood risk areas, this is also true for the GCR. As a result, flood risk and other climate change impacts remain a high probability for vulnerable communities as well (Piketh et al, 2014).

1.1 Climate change resilience and policy contexts in South Africa

South Africa is a member and signatory of the United Nations (UN) Paris agreement on Climate Change. The Sustainable Development Goals (SDG), goal 13 calls for member countries to strengthen resilience and adaptive capacity to climate related hazards and natural disasters (UNFCCC, 2017). Goal 13 of the SDGs further highlights the need to incorporate climate change measures into national policy and strategic planning governance (UNFCCC, 2017). As a result, South African government and cities have put in place disaster management strategies and policies that aim to provide guidance towards the realization of sustainable and resilient cities towards climate change impacts (SANCCRS, 2004, Ngwenya et al, 2016 and EMMDRMS, 2017). The South African National Climate Change Response Strategy of 2004 paved the way for the incorporation of climate change strategies at various levels of government. The results of such measures can be noted on the incorporation of climate change mitigation plans into the National Development Plan (NDP Chapter 5, 2011) as well as the National Climate Change Response White Paper (2011) Since its inception, most South African cities including those in the Gauteng City Region have developed climate change strategies which take into account their contextual vulnerabilities to the impacts of climate change and mitigation measures (GCC: 40, 2011). These plans provide a good framework for organizing and integrating resilience and adaptive capacity efforts between various stakeholders in South African cities. However, some critiques on these plans and strategies have been focused on three main points (a) Forward planning (b) responsive measures versus prevention, what (Smit and Wandel, 2016) addresses as system driven and process driven approaches (c) Citizen engagement and co-production (Musungu et al, 2011). The Gauteng Provincial government has put in place a provincial disaster management strategy under its disaster management unit, whilst the various cities in the Gauteng City Region have put in place their own disaster management strategies which look at climate change and its impact at a broader spectrum.

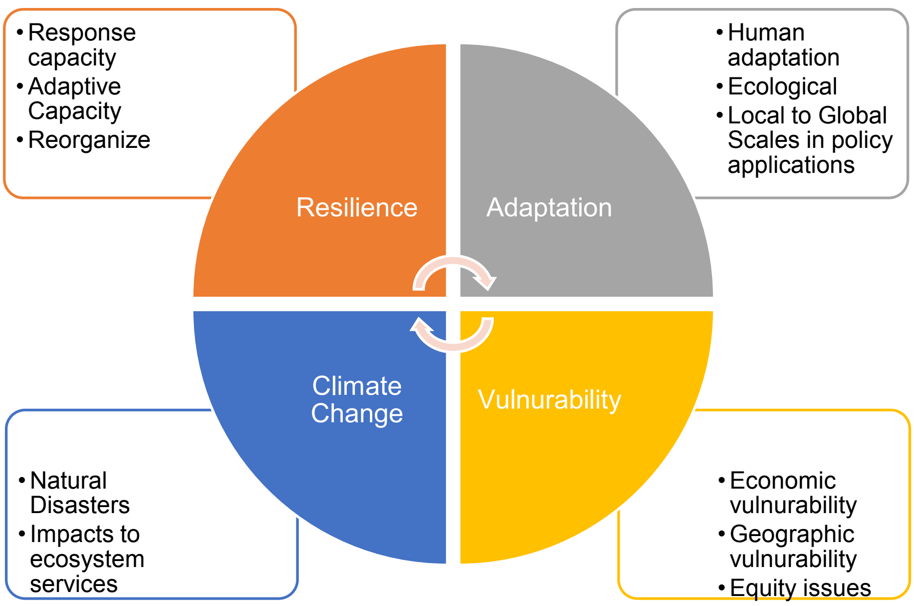

Figure 1: Research framework (Source: Smit and Wandel, 2006)

According to Smit and Wandel (2006), climate change resilience encompasses a dual function, the first one is to absorb shocks whilst the other focuses on self-renewal. Adaptation is concerned with the creation of systems, processes and actions to mitigate climate change impacts (Smit and Wandel, 2016).This framework was adopted in this study as a guide for discussions on the relationship between climate change, resilience, adaptation and vulnerability. As a result, the discussions in this paper present GIS and Remote Sensing approaches to creating resilient cities as adaptive capacity building tools.

1.2. Challenges in realizing climate change resilience in the GCR

Whilst the Gauteng City Region has evidently put in place disaster management strategies and policies at various levels of government, Spatial Development Frameworks (SDFs) still have very limited inclusion of GIS and Remote Sensing analysis climate change impacts. Spatial Development Frameworks are critical tools that guide urban growth, governance and spatial arrangements in South Africa (Afesis-Corplan, 2013). Identified urban development corridors and the protection of environmental sensitive areas are key considerations on SDFs. However, very limited information is provided by SDFs on the evolution of climate change impacts management and urban development. Previous localized studies indicated that residents were dissatisfied with municipal responses and actions towards climate change impacts such as flooding (Fatti and Patel, 2013). These studies further indicated that perceptions on flooding mitigation efforts by government were more reactive than proactive creating ineffective relations between government and citizens (Fatti and Patel, 2013). These findings and the evidence of increasing flooding incidents especially in rainy reasons indicate a systematic gap between municipal strategies and achieving resilience. In addition to this gap, whilst disaster management strategies indicate there role and need for incorporating citizens in climate change impacts mitigation, there is very limited engagement and interaction between citizens and other urban stakeholders.

As a result, these future spatial plans appear not to be considering and promoting integrated approaches that make use of technology such as GIS models for modelling climate change impacts on the urban landscape. The UN IPPC report highlights the importance of transformations in economic, social, technological and political decision and actions to promote sustainable developments. It further highlighted the introduction of new technologies, practices and structures of governance are key opportunities for attaining sustainability (IPPC, 2014: 80). Approaches to urban flood monitoring are still a key topic of discussion. In the Gauteng City Region, each metropolitan municipality has a disaster management strategy which provides guidelines on managing and mitigating urban flooding.

2. Methodology and study area

The aim of this study is to investigate and assess the use of GIS and Remote Sensing as crucial tools in planning for climate change resilience and sustainability in the Gauteng City Region. The method of enquiry used in this study involved a two stage process. The first process involved the delineation of watershed boundaries and stream order mapping within the Ekurhuleni Metropolitan Municipality (EMM). The Shuttle Rader Topography Mission (SRTM) 1 arc per second Digital Elevation Model data (DEM) was used as the input dataset with elevation information. This stage of led to the identification of flood-prone areas within the watershed boundaries of EMM using snap pour points in the hydrology toolset of ArcMap. Snap pour points are used to ensure the selection of drainage points of high accumulation in GIS. The second stage involved the assessment of climate change policies, municipal spatial development framework as well as disaster risk management plans. Primary and secondary datasets as well as literature were collected and analyzed to gain crucial insights on municipal policies climate change adaptive capacity, risks vulnerability mapping activities, climate change trends as well as urban growth strategies. Digital elevation models from USG Earth Explorer were collected, processed and analyzed in ArcGIS. Additional datasets on rainfall trends, soil saturation index as well as MSDF land uses were also collected for overlay analysis and confirmation of climate trends.

A simple hydrologic model is used to model watershed regions that are at risk of urban flooding in the Ekurhuleni Metropolitan Municipality. The results of the model are then compared and overlayed with the municipality's Spatial Development Framework (MSDF) to determine the relationship between potential flood risk, current and future land use complexes. The results are also used to make a case for the potential of GIS and Remote Sensing urban flood modelling influencing policy, participation and strategic planning. Recommendations on the potential use of GIS are then presented with an emphasis on web GIS applications and their potential in promoting co-production of climate change impacts for better preparedness and resilience. The hydrologic model presented a simplified approach to flood risk assessment a first step towards understanding flooding impacts. It is important to delineate flood prone areas well in advance to be able to take preventative measures to minimize any damage from flooding (Aksoy et al, 2016). GIS allows for the studying of urban flooding in a temporal and spatial scale (Aksoy et al, 2016). This technology has made it possible to model flooding more accurately and faster.

2.1 Using hydrologic models and DEMs for flood risk assessment

Hydrologic modeling has be widely researched as a useful tool for early flood warning and reservoir management (Borus et al, 2014). These models are also widely used for engineering purposes with different variations and complexities (Chen et al, 2009). Digital elevation models and contour data are typically relied on for surface based models such as hydrologic models due to their surface representation qualities. Elevation data can therefore be used for modelling streams and watersheds for better understanding of the movement of water on the earth's surface (Werner, 2001).These models can be very complex and advance for water drainage and storage simulation. Many scholars have experimented with different variations of these models (Wang and Zhang, 2005). Obtaining robust results from these models still remains a much debated factor. However, research indicates that their contribution in understanding stream flows and flood risk modeling remains relevant (Martinez and Gupta, 2010 and Bai et al, 2017). It is argued however that desktop hydrological models for flood prediction may have some limitations in promoting information and interaction between key urban role players such as citizens due to being highly technical (Kulkarni et al, 2014). Al-Shaban et al, (2003) argued that hydrological models for forecasting flooding hazards were often poorly suited for real time application. These limitations may affect the efficacy of these models in providing climate change resilience and early warning systems for flooding. Real time data on flooding risk can play a critical role as a decision support tool.

2.2 Study area

The study was based on Ekurhuleni Metropolitan Municipality in South Africa. Ekurhuleni forms part of the Gauteng City Region (GCR) which is a cluster of cities, towns and urban nodes making with a population of 12.27 million (StatsSA, 2011). The GCR population makes up 20% of the South African population. The Gauteng City Region is considered the economic heartland of South Africa (Wray, 2011) and continues to attract a substantial percentage of South Africa's population due to economic opportunities. Ekurhuleni Metropolitan Municipality is one of Gauteng's metropolitan cities with a population of 3.1 million (StatsSA, 2011). It is the home of Africa's busiest airport and considered the gateway to Africa (EMMAR, 2016). The municipality is one of the growing regions in the Gauteng City Region with the ambition of becoming Africa's first aerotropolis. It covers a total area of 1600 km² with new emerging urban nodes. In the last two year, the municipality has been affected by extreme flooding incidents leading to the closure of the airport and major road networks. The recent flooding events caused severe damage and loss of life, effecting economic activity as well as livelihoods (Piketh et al, 2014). The municipality was used as a case study for this paper as it forms part of the Gauteng City Region, with a growing urban footprint and new urban nodes such as the aerotropolis and the Moderfontein smart city development. Ekurhuleni therefore plays a key role in attracting an increasing population as a result of its industrial and commercial opportunities.

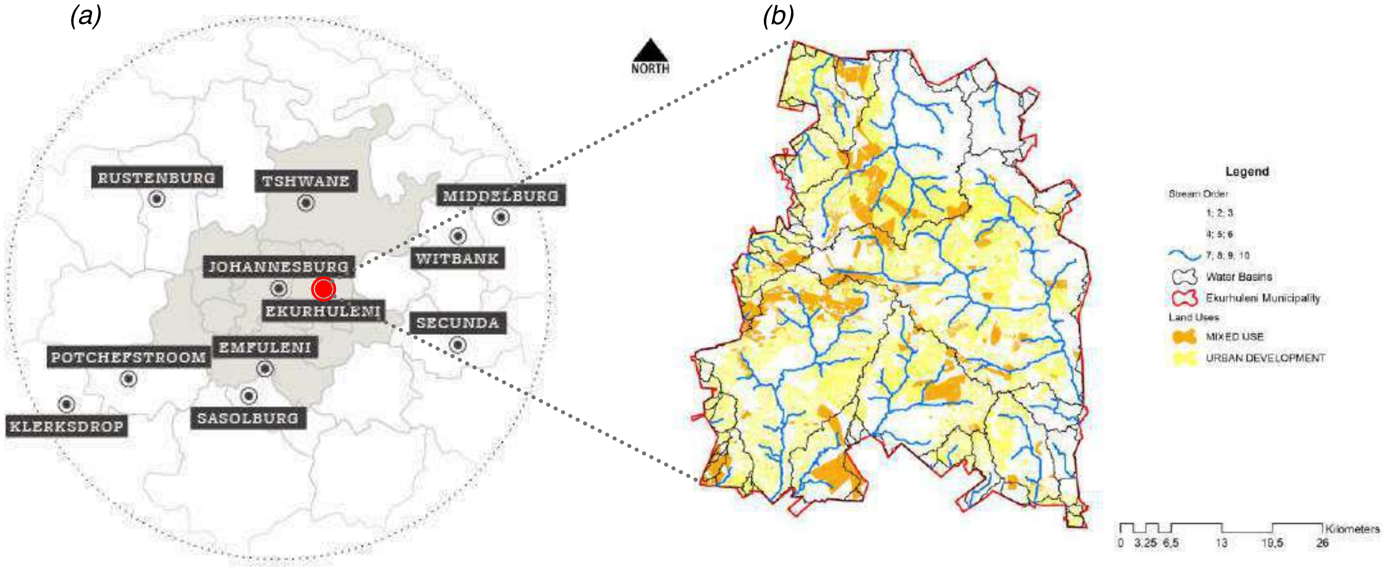

Figure 2: (a) The Gauteng City Region (source: GCRO), (b) Ekurhuleni (source: Mahlangu, 2018)

2.2. Land use cover and Hydrological properties on flooding

Land use patterns and topographical profiles of households, urban development zones and vegetation have an influence on the spatial distribution of flooding impact (Chen et al, 2009; Correia et al, 2013 and Dalu et al, 2017). Studies on Hydro-meteorological disasters have indicated an existent relationship between urban development and increased flooding potential in urban areas (Dalu et al, 2018; Guha-Sapu and Hoyois, 2012). As a result, in these cases hydrologic analysis approaches offered unique opportunity to understand water flows and accumulation from known catchment boundaries and well as modelling run-off water (Aksoy et al, 2016). These applications coupled with the power of GIS ensured that flood risk was identified and communicated sufficiently in time (Singh and Fiorentino, 1996). Foley et al (2005) further argued that complexities of modelling urban flooding arose from the various perceived sources of floods which were categorized as riverine floods, urban floods and coastal floods (Coaffee, 2013, Aksoy et al, 2016). Therefore Urban Developments and land cover change are contributing factors to the decrease in vegetation cover and its ability to mitigate flooding risks and impacts (Foley et al, 2005). Artificial urban storm water drainage systems are contributed to the increase of peak stream flow and discharge speeds (Ouma and Tateishi, 2014). These characteristics were excluded in this model, however rainfall quantities were used to confirm increased quantities as a result of climate change.

2.3. Data collection and processing

The SRTM 1 Arc-Second Global elevation (30 meters) was collected from the USG Earth Explorer and checked for voids. The fill tool in Arc Toolbox was applied to cleanout voids on the Digital Elevation Model allowing it to be used in the hydrological model. Additional datasets on the Ekurhuleni Metropolitan Municipality's Spatial Development Framework were collected and processed for errors and missing data. The MSDF was then symbolized on land use categories. Other datasets and journal articles were acquired from online journals and government online catalogues. Rainfall datasets were acquired for insights on rain patterns during the January to July seasons of 2017 and 2018. These were not factored in the hydrological model but rather used for understanding rainfall trends in the Gauteng City Region and comparing them to the national mean rainfall in millimeters.

Digital Elevation Specifications	
Projection and Datum	Geographic (WGS84)
Spatial Resolution	1 arc-second for global coverage (~30 m)
Raster size & C-band wavelength	1 degree tiles – 5.6 cm

2.4. The hydrologic model

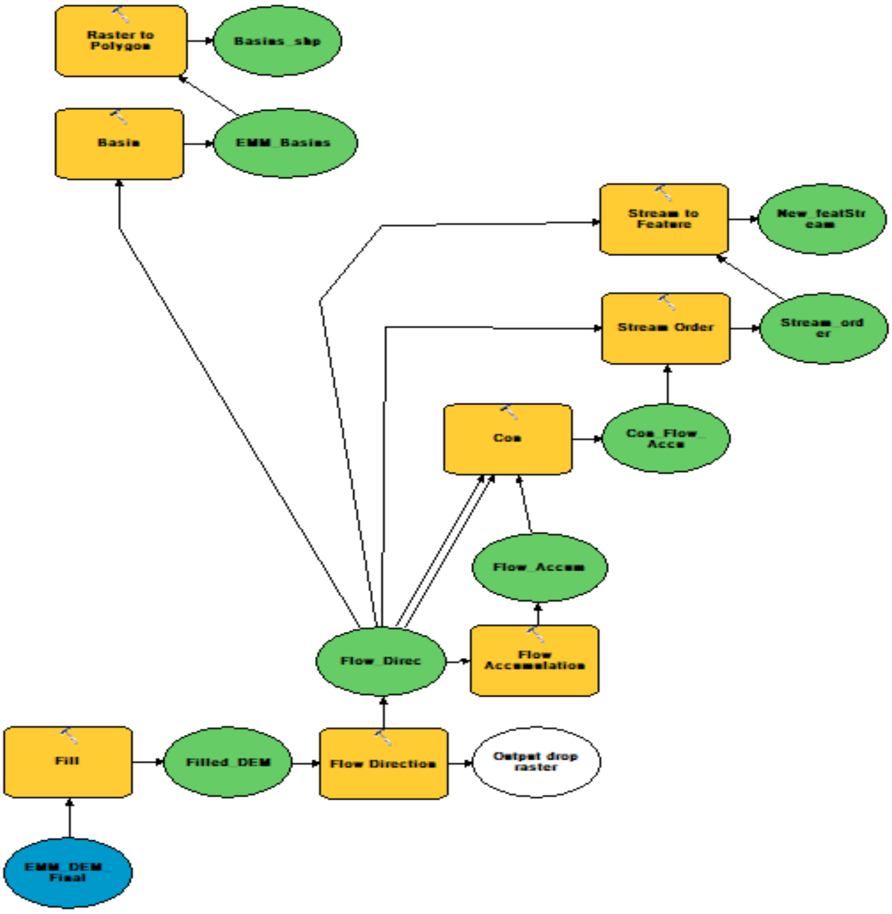

Figure 3: Hydrologic model in ArcMap (Mahlangu, 2018)

The DEM was used as the input raster dataset. Using the fill tool in spatial analyst, the DEM was corrected for voids and used to generate flow directions. Flow accumulations were then produced leading to the delineation of stream orders and basins. Watershed boundaries were established and used to identify areas of with the highest pour points per water basin area and stream network. These areas were classified as areas of high accumulation and high flooding probability. Lastly, the MSDF land use dataset was overlaid on the identified high accumulation basins and were analyzed for land use versus watershed qualities.

3. Results and discussions

It is argued that global warming has affected rainfall patterns leading to increased flooding risk especially in urban areas (Kulkami et al, 2014). This is the case in South Africa, according to Kruger and Nxumalo (2017), rainfall quantities in South Africa have been on the increase especially during the rainy seasons. In order to begin with the analysis and assessment of flood risk areas, data were collected for both rainfall quantities as well as soil saturation. These datasets are used to further discuss vulnerability based on rainfall (mm) and soil saturation (SSI) index as contributors to urban run-off and extensive flooding. As argued by Ouma and Tateishi, (2014), increased rainfall quantities and high soil saturation contribute to artificial urban run-offs which may also be impacted by man-made contributors such as poor Stormwater management systems and loss of vegetation. As a result, these results are presented first by considering the overall trends in rainfall and soil saturation for the whole country as well as the Gauteng City Region as a major urban center.

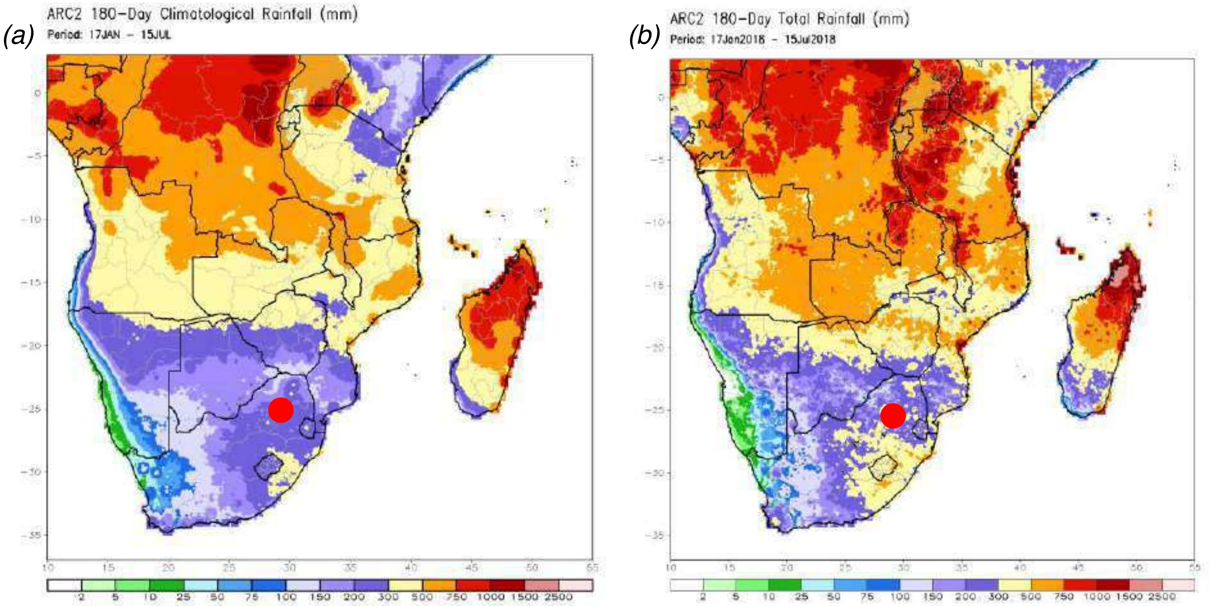

Figure 4: Climatological rain falls over the GCR (a) Jan-July 2017 (b) Jan-July 2018 (Source: Agricultural Research Council, 2018)

Figure 4 indicates rainfall trends over the Gauteng City Region, data were collected from the Agricultural Research Council (ARC, 2018). The rainfall data indicates that the Gauteng City Region falls within a region of South Africa with an average of 300mm rainfall between January and July. The data represented were collected for 2017 and 2018. The year 2018 had decreased rainfall quantities in the recorded timeframe, however the Gauteng City Region still averaged between 250 and 300 mm rainfall. This is an indication that the Gauteng City Region falls within a summer rain region of South Africa. This data is consistent with results from other studies on rainfall trends in the North Eastern region of South Africa (Carmin et al, 2009).

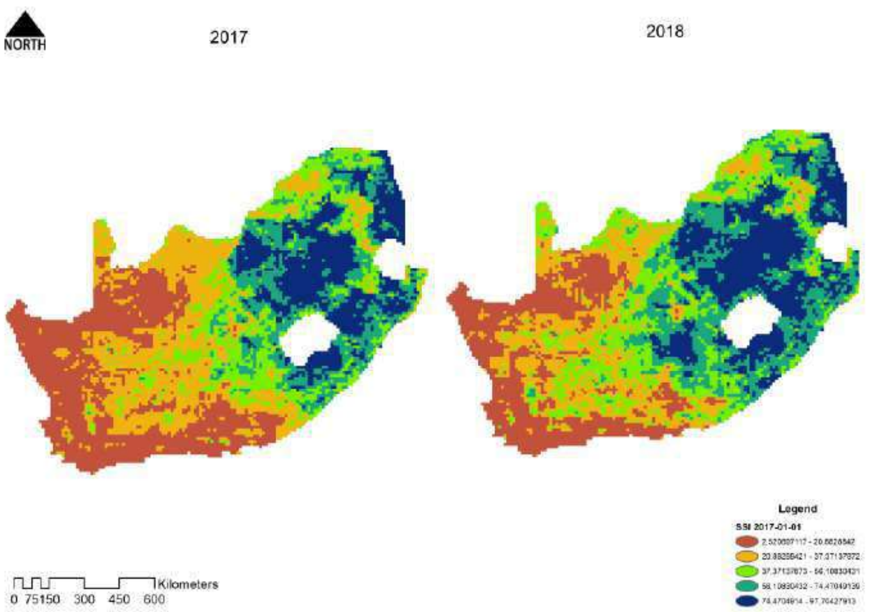

Figure 5: Soil saturation index (SSI) (Source: Mahlangu; SAHG, 2018)

Figure 5 is a representation of Soil Saturation in South Africa, recorded by the Satellite Applications and Hydrology Group which is a partnership between the Department of Water Affairs, The Water Research Commission as well as the University of KwaZulu-Natal. This research group uses satellite applications to record near real-time soil moisture for South Africa.

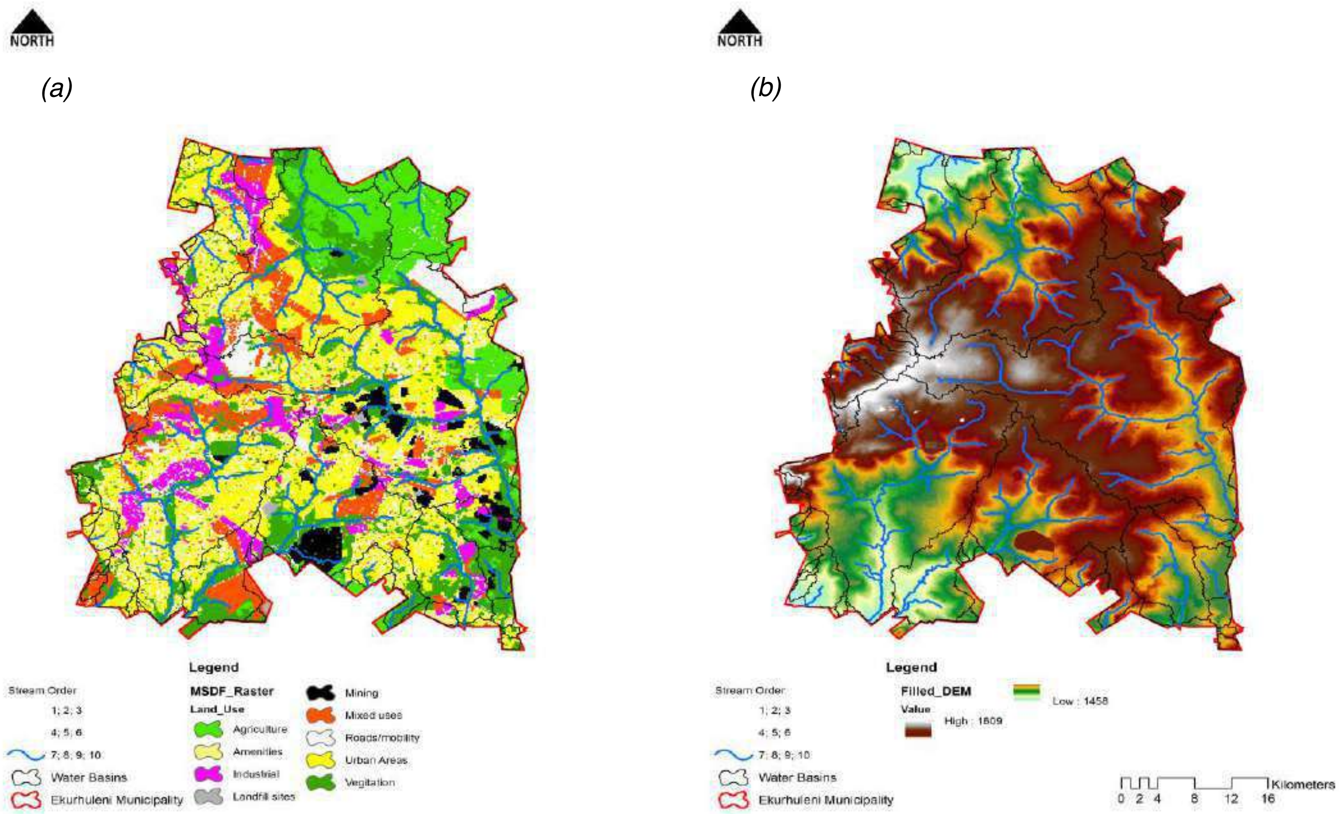

Figure 6: (a) MSDF Land Uses of Ekurhuleni (Mahlangu; EMM, 2018) (b) Ekurhuleni Digital Elevation Model (Mahlangu; USG, 2018)

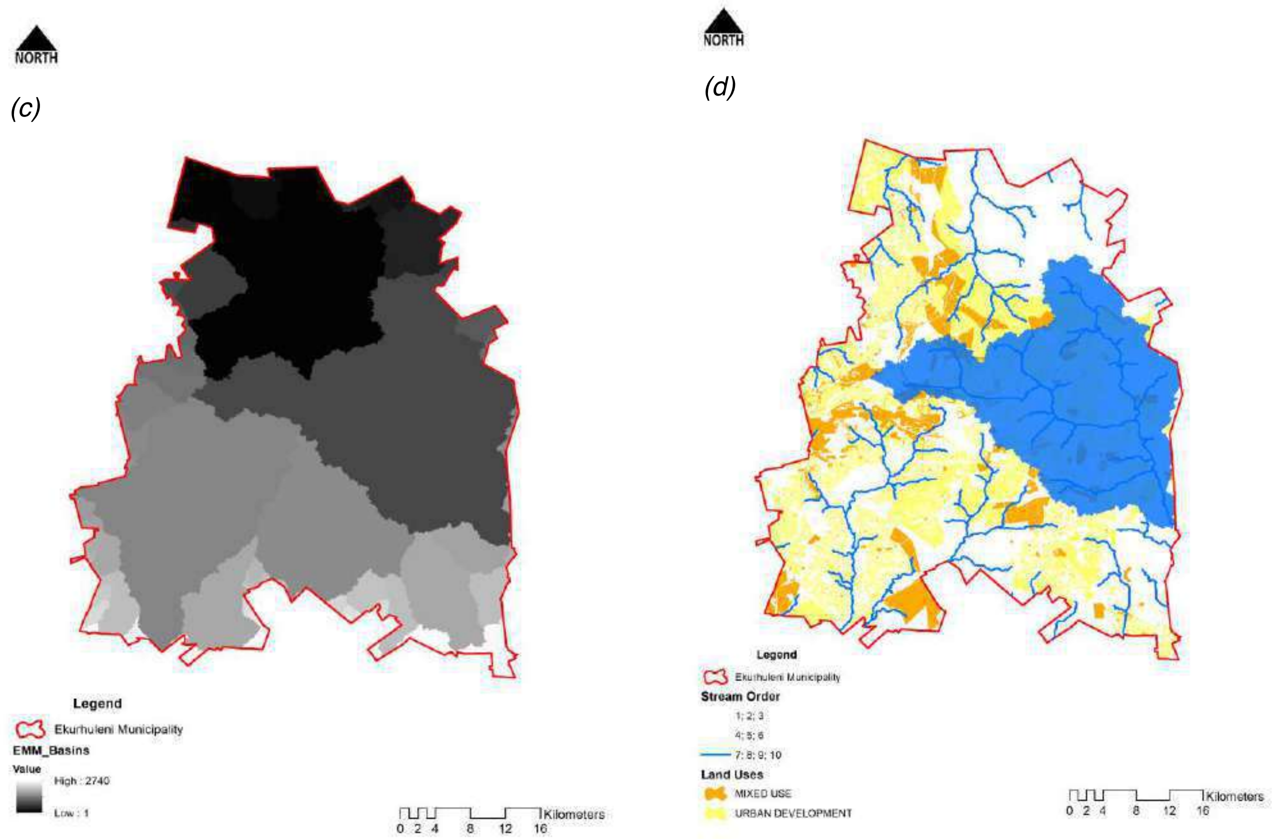

Figure 7: (c) EMM basins (Mahlangu; EMM, 2018) (d) Ekurhuleni Flood risk region (Mahlangu; USG, 2018)

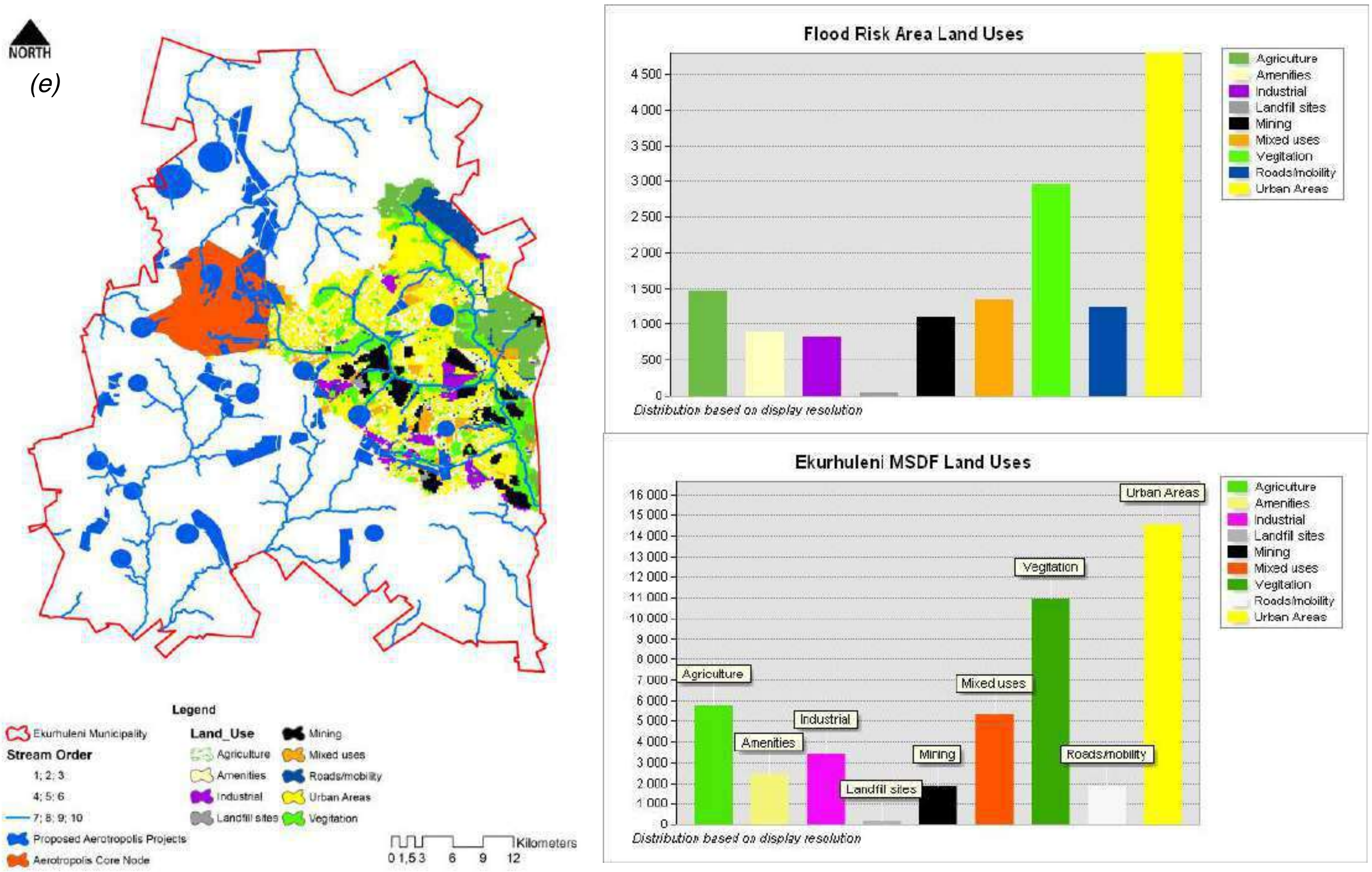

Figure 8: (e) EMM Flood Risk Basin (Mahlangu; EMM, 2018) (f) Land use composition (Mahlangu; USG, 2018)

Figure (a) presents the results of the Ekurhuleni Municipal Spatial Development Framework 2016/17 which is the municipality's spatial vision and development framework. The MSDF guides new developments and investments within the municipality and acts as a spatial policy linked to the municipality's integrated development Framework. Figure (b) is a representation of the EMM Digital Elevation indicating the relationship between elevation and stream network. Using the hydrology toolkit in ArcMap, the water basins represented in figure (c) indicate the drainage basins in the region. Figure (d) is the result of the hydrologic model's selection of pour points for selection of points of highest accumulation, they represent outlets from the watershed components. Using the raster surface of the watersheds, the snap pour points identified the highest flow accumulation in the selected watershed. This indicates that the watershed has the highest flow accumulation. It can therefore be noted that this watershed will contribute the highest flow within the EMM. As a result, the land use classes existing and planned in the region were converted into a raster and computed by cell statistics to represent the population of cells within a given land use class. Only land uses classified as urban development and mixed use zones were overlaid with the output watershed with high accumulation flow to determine how many cells are affected.

Figure (e) represents the highest accumulation watershed land uses, the EMM's proposed aerotropolis project sites as well as the core economic node. It can be confirmed from the overlay that the main economic node as well as some of the planned aerotropolis project sites fall within the watershed with high flow accumulation. Figure (f) represents the computed affected cells within the watershed area in comparison with the overall municipal land use class cells. The MSDF indicates that urban areas form the largest composition of cells when converting the land use classes into raster. According to (Coaffee, 2013), urban areas with higher urban land uses increase the risk of run-off water as a result of loss of absorption areas such as vegetation. This notion is also supported by Ouma and Tateishi (2014), who also argued that artificial urban drainage systems increase flooding probability. Other scholars argue that external and manmade elements may increase flooding probability as Stormwater drainage systems get clogged with hard waste and debris (Piketh et al, 2014). While hydrologic models alone cannot simulate flooding risk, they can model the flow characteristics of water on the earth's surface using natural earth features. These results indicate that the model is able to identify watersheds with the highest accumulation flow. These watershed can therefore be used to understand flood origin areas due to the high accumulation flow identified through snap pour points.

These results are consistent with findings from the municipal Stormwater management report (EMM EMF, 2007). The report addressed issues of pollution and its impact on Stormwater drainage systems within the municipality. The EMM State of the Environment report also noted that urban developments have had an impact on natural eco-systems and drainage channels. However, the MSDF and Aerotropolis Development Plans do not address issues relating to climate change and the impact of urban development on Stormwater and natural drainage systems 9EMM SOER, 2004). There is very limited incorporation of GIS and Remote Sensing analysis and flood modelling in the MSDF. The MSDF addresses wetlands and Pans without considering the incorporation of changing climate changes such as increased rainfall quantities. The EMM and the Gauteng City Region fall within a higher summer rain region, increasing the possibilities of runoff water. An assessment of the Gauteng Disaster Management Strategy, the EMM Disaster Management Plan, the Spatial Planning and Land use Management Plan as well as the Climate Change White Paper of 2014 indicate that policy structures are in place. The South African government has responded and complied with the International obligations on climate change responses (Ngwenya et al, 2016). However, the assessment of these plans indicates the following shortfalls:

- Climate change and disaster management plans have very limited incorporation of forecasting techniques such as GIS and Remote Sensing.
- Building resilient strategies that involve the participation and contribution of all urban actors still remain a key challenge in the EMM and the City of Johannesburg. There is a lack of integrated information systems for sharing and co-producing climate change information, resilience strategies as well as adaption mechanisms.
- The Spatial Development Framework as a spatial policy and development vehicle does not incorporate innovative tools such as GIS for modelling climate change impacts, rather it accommodates socio-political and economic elements.
- The role of vulnerable communities in policy making for climate change resilience is minimal, as argued by (Musungu et al, 2011). Other studies have found affected communities did not only include those living in informal settlements (Musungu et al, 2011).
- Surface run-off water is estimated to have increased by almost 300% above the natural drainage yield (EMM SOER, 2004).

4. Conclusions

GIS applications offer an opportunity for co-production of knowledge and engagement between various parties. The modelling and viewing of the spatial characteristics of water flows incorporating hydraulic models that consider rainfall quantities, slope, land use/land cover data and soil saturation index can therefore be further explored as an opportunity for predicting flood risk areas from urban run-offs, Building climate resilience and planning for adaptive capacity requires engaging and sharing climate and flooding risk with communities. GIS and Remote Sensing technology such as hydrologic models offer innovative, proactive opportunities to understand water flows and accumulation from known catchment boundaries. The results of these models can be used to inform Spatial Development Plans and Risk Management Strategies on distributing resources for resilience. This paper has demonstrated the relationship between policy, GIS and Remote Sensing and the existing gaps in planning for resilience for a changing global climate.

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Smarting the Cities: A Catalyst for Acculturation in Ghana?

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Abstract

Cities and towns, which have been engines of growth and incubators of civilization and have facilitated the evolution of knowledge, culture and tradition as well as industry and commerce, are experiencing a dynamic metamorphosis through the application of Internet of things (IoT) and smart technologies. Post-oil Ghana has become a melting pot for new developmental concepts and urbanization drive of which smarting of communities is getting to the forefront. The smart city concept, which is rapidly being embraced by governments and city authorities, is premised on the use of intelligent applications for new technologies whilst incorporating social and environmental capital to transform city life and work. It is this transformation that this paper seeks to question and investigate whether it can serve as a catalyst for acculturation of the communities and the cities in Ghana. Acculturation is defined as the changes that occur as a result of contact with culturally dissimilar people, groups, and social influences. As an exploratory research, a mix method was adopted in collecting data from persons within Kumasi and the campus of the Kwame Nkrumah University of Science and Technology, Kumasi to gauge the level of acculturation and know their perception of the concept of smart communities. The research also explored the epistemological assumptions underpinning of smart communities and acculturation processes through literature review and case studies. Findings indicated that acculturation is taking place at alarming among the Asante people, one of the historic and dominant tribes in West Africa. A catalyst for this phenomenon is the advent of IoT. Education, language greetings and marriage were perceived to be the most acculturated aspects. It is recommended that innovative measures using the same IoT and smartness be adopted to stem its acculturation and marginalization but rather promote and enhance the culture instead.

Key words: Smart City, Internet-of-Things, Acculturation, Culture

1.0 **INTRODUCTION**

The world's population currently stands at 7.63 billion as of July 2018. It is projected to reach 8.5 billion by 2030. The phenomenon is accompanied by a similar increase in urban population (Worldometers, 2018). Countries in Sub Saharan Africa such as Rwanda, South Africa, Nigeria and Ghana are undergoing a digital revolution and it is projected to be the fastest growing mobile subscription base in the world (Ericsson, 2014; Olsen, 2018). By 2020 about 720 million smart phone users will be in Africa. The rising trend is due to high investments in deep sea cable installations to increase internet of things (IoT), the people and smart technology (Rice-Oxley, Mark; Flood, 2017).The global mobile connection stands at 3.5 billion with a projection to 5.9 billion by 2025 largely driven by Asia, Sub Sahara Africa and Latin America. In the same era IoT connections will reach 25 billion with smart homes, buildings, cities, enterprises and innovations in ecosystems (Olsen, 2018).

The twentieth century has witnessed an explosion of communication and information technology distorting the conventional use of connectivity to mass media which hitherto was a face to face dialogue between neighbors and friends. This has made the world shrink in size is now called a global village as ascribed by Marshall McLuhan (Ratti and Claudel, 2016).This form of technology has made it possible to connect humanity to any part of the world from any and every location breaking the boundaries of cultures and exposing the diversity of cultures to all. With the prospects of the smart technology, Ghana have been seen as the future of Africa by Google in terms of technology (Asemota, 2018), the adaptation and usage of this technology will speed up the initiation of smart city concepts in the country as well as be a potential catalyst to the acculturation of the Ghanaian culture. It is important to the global community of networks, which Ghana cannot be excluded from its advancement, that this threat is highlighted for the preservation of the Ghanaian culture through proactive measures.

2.0 THEORETICAL FRAMEWORK

2.1 Smart City Concepts

The world in the 21st century is witnessing the digital revolution in urban design for resilience and sustainability in our cities. The smart city concept has become the mantra for governments and city authorities, which basically depends on the use of intelligent applications for new technologies whilst incorporating social and environmental capital, to transform city life and work (Deakin, Mark.,Al Waer, 2012). Smart city and smart community are given the same meaning and defined from various perspectives depending on specific attributes which range from industry to technology and environment (Giffinger and Strohmayer, 2014). To the government it will mean the use of technology to transform its basic infrastructure, energy and resource usage. To the people it will mean the use of technology for convenience, through transportation and connectivity, and to the entrepreneur it means an enterprise or city that sells itself through resilience by increasing profit and lowering cost. Now, many cities are embracing the concept as a solution to their complex issues. For example, Amsterdam Smart City Initiative is integrated e-services whilst the Malta Smart City Strategy use business parks to leverage economic growth (Deakin, Mark.,Al Waer, 2012). The European Union (EU) recognizes governance as key in building smart cities through collaborative digital environments to boost local competiveness (Curwell *et al.*, 2005; Deakin and Allwinkle, 2007; Paskaleva, 2009). Smart is further more used to describe a city's use of modern technology in everyday urban life (Giffinger and Strohmayer,

2014). However there are many who believe that the use of the term smart in describing urban economies are misguided as they tend to mostly dwell on IT. (Schaffers, Komninos and Pallot (2012) expressed concern of what they called fragmented city leading to what Hollands and Hollands, (2008) called self-congratulatory tendencies. Various global ranking indexes use different definitions to rank smart cities as seen in Figure 1.0. The reasons for these rankings are based on the parameters used for the survey.
The smart cities concept can thus be said to be a response to the rising challenges of the urbanized world in terms of how it manages resources efficiently and sustainably (IHS, 2014).

City Ranking	***CIMI-2017 IESE***	***Global Cities Index-2016***	***Cities Prosperity Index***	***Global City Competitiveness Index***	***Global metro Monitor***
1	New York City	New York City	Oslo	New York City	Tokyo
2	London	London	Copenhagen	London	New York city
3	Paris	Paris	Stockholm	Singapore	Los Angeles
4	San Francisco	Tokyo	Helsinki	Hong Kong	Seoul
5	Boston	Hong Kong	Paris	Tokyo	London
6	Amsterdam	Los Angeles	Vienna	Sydney	Paris
7	Chicago	Chicago	Melbourne	Paris	Osaka
8	Seoul	Singapore	Montreal	Stockholm	Shanghai
9	Geneva	Beijing	Toronto	Chicago	Chicago
10	Sydney	Washington Dc	Sydney	Toronto	Moscow

Figure 1.0: Ranking of Cities in Some Global Indexes on Smart Cities
(Source: Extracted from literature)

Critics such as David Walter's and Mitchell (Leydesdorff and Deakin, 2017) and Gu (2008), posit that the smartest places should be the mix of both physical and virtual worlds where tele presence and virtual worlds merges in a particular location. In fact these initiatives and concepts in various countries are spearheaded by super tech companies such as IBM, to take advantage of the digital revolution to advance their corporate branding other than social intelligence critically needed for them to be smart. In an attempt to bring exactitude to the definition of smart city, it draws a semblance of the intelligent city's four components as espoused by Komninos (2008) which are: 1. Applying various electronic and digital technologies, 2. Using ICT to transform the life and work, 3. Placing such ICT in the city, and 4. Customizing the above three to bring ICT and people together to enhance innovation, learning, knowledge and problem solving.

The smart city concept must therefore begin with the people and human capital before IT to transform and improve city living (Hollands and Hollands, 2008). The result will ultimately be finding a solution to the rather splintering urbanism perception as suggested by Graham et al, (1996) where the diverging forces of the digital environment is balanced by the converging forces of human interaction in the physical space (Walters, 2011). There is now a rapidly growing sophisticated digital world with information portals and platforms for e-learning, e-governance, community participation and decision making which are being used in smart cities and communities, but this cannot be effective if the vital concepts and tools of physical urban design forms the basis of the electronic discourse (David Walters & Linda Luise Brown, 2004)

2.2 Smart City Characteristics

The smart city or community concept has been assigned varying degrees of factors that characterize any city seen or perceived as smart. This has made it a very subjective matter depending on the author's point of argument. But the use of technology through the IoT to enhance the work and life of the urban dweller has become the central point which characterizes any smart city, be it in the aspects of governance, people, environment, transport or living. Thus for a city to be seen as smart, six broad characteristics (Giffinger & Strohmayer, 2007, 2014) are used in the ranking of smart cities of medium-sized cities in Europe (Figure 2.0).

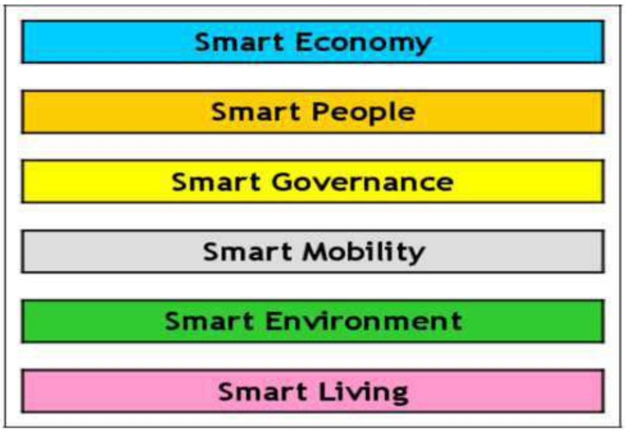


Figure 2.0: The six smart city characteristics
(Source: Centre of Regional Science, Vienna UT, 2007)

Each of these characteristics has a number of features within them. In **Smart economy** features like the economic competitiveness of the city's economy which ranges from innovation, internationalization and the ability of the city to transform are essential. The human and social capital features are embedded in **Smart people**. A critical feature of interest is how they receive the outside world issues of interfaces regarding assimilation and acculturation. **Smart governance** features the levels of political participation in decision making, provision of critical services as well as management and administration, the level of transparency, and how diverse political strategies and viewpoints are. ICT and transportation infrastructure is the nerve center of **Smart Mobility**. It ranges from both local and international accessibility and the available options in the ICT and modern sustainable transport systems. **Smart Environment** describes how resilient and sustainable the natural environment portrays- climate and green space. How is the city dealing with pollution, protection of the environment and management of resources (Giffinger, 2007)? Lastly **Smart Living** measures the quality of life and work of individuals within the city taking into consideration aspects of safety, health, culture, housing, education, tourism, cultural facilities, tourism and social cohesion (Giffinger and Strohmayer, 2014)

2.3 The concept of Acculturation and its processes:

Acculturation is a general phenomenon that arises when groups of people with different cultures come into first hand contact with consequent changes in the original cultural patterns of either groups (Redfield et al, 1936). Kim et al (2009) add that the acculturation process involves changes that the individual goes through in relation to their attitudes, values and identity following being in contact with other cultures. There are more than 100 theories of acculturation posited by various theorist (Rudmin, 2003).

Whilst the concept of acculturation is used to define the cultural diversities ensuing from these group of encounters, the concepts of psychological acculturation and adaptation are employed to denote to the psychological changes and eventual outcomes that occur as a result of individuals experiencing acculturation (Berry, 1997). Schwartz et al (2010) refer to acculturation as the changes that occur as a result of contact with culturally dissimilar people, groups, and social influences. Originally, acculturation was conceptualized as a uni-dimensional process in which preservation of the heritage culture and acquisition of the receiving culture were cast as opposing ends of a single continuum (Schwartz et al., 2010).

Individuals who migrate to another country will inevitably go through acculturation. Immigrants expects to take on a new cultural identity and therefore are more willing to adjust and adapt (Tsang-Feign, 2017). The stages of acculturation can be illustrated in the following four phases:

1. **Elation** (Enthusiastic Acceptance): This is usually based on experience that one finds quite stimulating that most of the things are so unlike or different back home and are eager to experience this new culture.
2. **Resistance** (doubt and reservation). The second stage occurs from comparisons one makes between their home culture and the host country making everything back home seem so much better. It is at this stage that people of same ethnic background often relocate or settle in enclaves within their host country.
3. **Transformation** (Adjustment): The third stage takes place at a later stage when individuals familiarize with the environment and start to see the good side of the host country. This stage is also referred as integration or adjustment as individuals are now able to adjust to the cultural norms of the dominant culture.
4. **Integration** (Accommodation and Evaluation): In this case, cultural barriers are bridged. Individuals learn to appreciate both their own heritage and the new culture (Bradbury, 2017) .

   Other theorists add a fifth stage called ***marginalization*** where both the culture of the host country and the home of origin are rejected (Berry, 2003)

2.4 Smart Cities and Acculturation

Culture is the bedrock of every community and communities live and breathe, like a human being, not as structures or enterprise to be engineered. The cities ecosystem, the support, the expressions of social life, the shared interest and capabilities as well as the linkage between the city's institution and individual citizens are all vital elements for development (Robinson, 2012) the cultural environments of any society basically include beliefs, norms, customs, lifestyles, food, religion, governance, music amongst others. These are elements that identify any cultured society. But these elements are shaped by the physical environment they are bound to which include urban fabric, rural and peripheral fabric, public open spaces, the green infrastructure and road and transportation infrastructure. These are the linkages to the cultural environment. The unique society is thus seen from both the cultural and the physical environment. The internet and the social media for example, have tremendously shaped the way we communicate with others.

A study by social media today (Asano, 2017) indicate that the amount of time people especially teenagers on the internet is rising at an alarming rate. An average of nine hours a day is spent on social media with 60 percent of this done on smart mobile devices.

Smart city infrastructure therefore must be designed in context of the aforementioned two environments- cultural and physical (Robinson, 2012). The smart technology has resulted in a powerful collision of physical and the digital era that compliments both which hitherto was not possible to merge traditional urban patterns with cyberspace (Ratti and Claudel, 2016). The resultant of smarting a city brings about the dynamics of the complex interplay within the city which manifest as a cultured or accultured city. A representation of the smart city in context looking at the six components - goals, people, ecosystem, soft infrastructures, city systems and hard infrastructures is shown in Figure 3.0

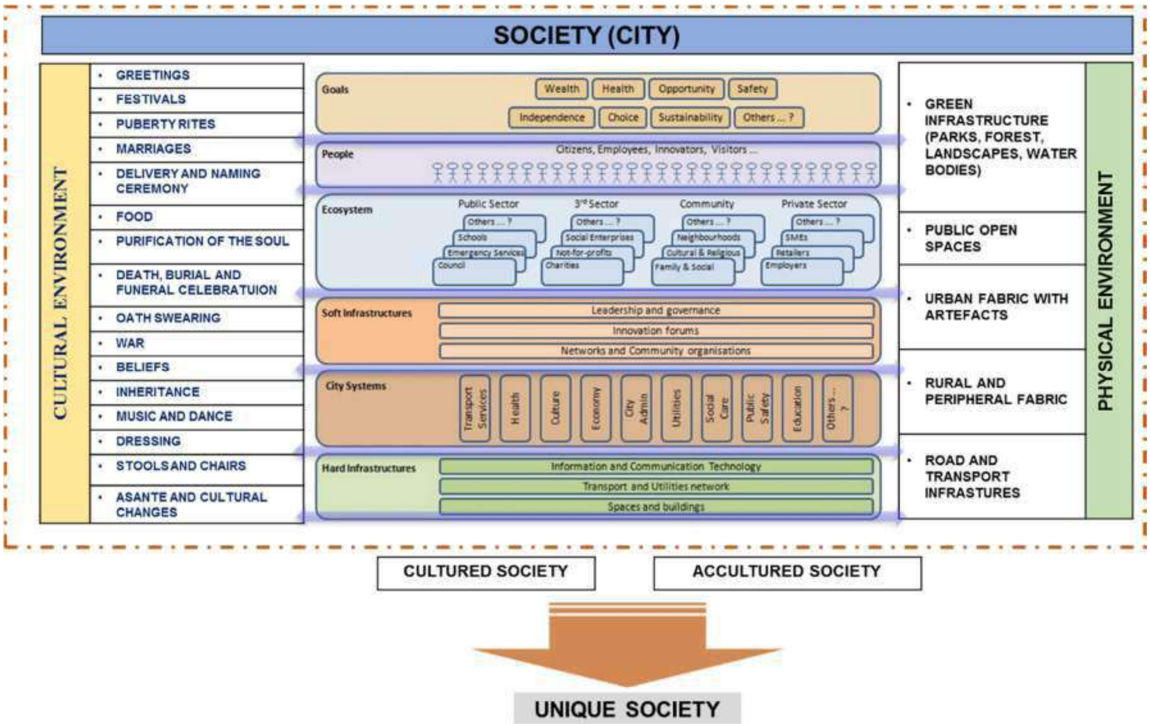


Figure 3.0 Linkages between Smart City Initiative and Acculturation
(Source: Authors Construct, 2018, with extraction from Rick Robinson, 2012)

Every smart initiative has goals specific from sustainability to economic growth with the people whether employers, citizens or visitors in focus. Thus user centric or citizen centric smart city initiative should be the ideal concept through a process of co-creative dialogue processes. This rather achieves much success than the top down approach of imposing products on citizens whether needed or not. It can be seen that each of the six components are impacted by both the physical and cultural environments and vice versa.

2.5 The Asante culture

Urbanization serves as a conduit for accelerated acculturation due to complexities and heterogeneous nature of the urban fabric. Culture continues to play the critical role of possessing the spirit, soul and life of every society making it the biggest asset and genesis for the development of any society (Asante, 2013). Ghana is located in West Africa with a population of 29 million, six main ethnic groups and more than 100 ethnic groupings. The dominant ethnic groups are Akan, Ewes and the Ga Adangbe. The diversity in Ghanaian culture and Asante culture in particular have both been acculturated and enculturated due to colonization, urbanization, education, religion and the influx of western cultures (Anquandah J. , 2015). The Asante tribe from the Akan ethnic group is one of the most culturally rich societies that cuts across national boundaries. They were originally known for the fearless battles, magnificence and power and wealth. Kumasi the capital city houses the center for national culture and the seat of the monarch of the Asante kingdom Otumfuo Osei tutu II. A culture reflected in every fabric of the society from elaborate funerals to celebration of festivals, religion and even music and rhythms (Asante Appau et al, 2015).

Their rich culture is seen in their architecture, governance, music, and food, customs such as funerals and marriage rites as well as religion. For example their architecture of the traditional courtyard as seen in figure 1 below depicts the outdoor activities performed in the open space bounded by the four sides of the building with verandahs and ornamentation of the facades (Asante Appau et al, 2015).

Figure 4: Verandahs of Asante Common House
(Source: Civilization Fanatics Center, 2014)

Another cultural practice that was distinct was the greetings in various forms which was a duty of any native when he meets a person. It was considered disrespectful not to greet your elders. Greeting styles such as which was dependent on the relationship you had with the person such as '*maakye*' or '*maadwo*' will elucidate a response of '*yaa oburu', 'yaa opeafo'* or '*yaa amu'* (Arowolo, 2010). Now most greetings especially from the young adults and teens greet using the western greetings of good morning, good afternoon or good evening with the same phrases as a response. Perhaps the dilution of the education practice as was in force before colonization could account for this. The trio-educational practice of firstly receiving initial education from family: secondly acquiring special sills in apprenticeship and thirdly having a community sponsored education was typical of the Asantes.

Other practices include; Puberty rites, marriage rites and naming ceremonies. Babies born are given names after eight days from birth with given names according to their day of birth.

The belief that every baby comes with a god given name which is usually the day they were born. This is seen in Figure 5.0

DAY	MALE	FEMALE
Sunday	Kwasi	Akosua
Monday	Kwadwo	Adwoa
Tuesday	Kwabena	Abena
Wednesday	Kwaku	Akua
Thursday	Yaw	Yaa
Friday	Kofi	Afia
Saturday	Kwame	Ama

Figure 5.0: Names given according to day baby is born in the Asante culture
(Source: Authors Construct, 2018)

A middle name is given to indicate the era and event that surrounded the birth of the child. Now it is not strange to see names such as *"Quasi" or "Aquiya*" representing a male Sunday born or a female Wednesday born respectively. Asante names have both cultural and social contexts that identify the bearer. These are quite different from the western names which are predictable, because a child's name cannot be accurately determined until is born with the surrounding circumstances (Agyekum, 2006)

Occurrence	Name And Meaning
Happenings	Dwabɔ: for somebody born on a durbar day Amantuo: for somebody born when running to seek refugee status in another state
Situation	Hia: for a baby born when the parents were poor Yadeɛya: for a baby when one of the parents was not healthy Afriyie: a good year
Festive Days	Adae: for someone born on Akwasidae or Awukudae festival
Deity	Anowuo: for somebody whose parents went to seek help to get pregnant from the Anowuo deity
Important Days	Buronya: for somebody born on a Christmas day
Child's Features	Buroni: for somebody born with light skin like an European
Place Of Birth	Takyiman: for somebody born at Takyiman. Dɔkota: for somebody born at the hospital

Figure 6.0 : Some Asante Names Based on Occurrences surrounding their birth
(Source: author's construct, 2018, with information from afropedia and Wikipedia)

Education amongst Ghanaians has suffered a significant acculturation from the west and the European cultures which has been attributed to the cultural capital and language facility over other cultures (Organista et al, 2010). The colonial history of the country has also been attributed to this phenomenon with most Ghanaians seeing education abroad as a great achievement and a guarantee for good prospects in life Irungu (2013).

There is a growing trend nowadays in the way Ghanaians are rapidly embracing foreign cultures especially from the west. This has led to the marginalization and gradual erosion of the sacred customs, beliefs and practices of typical Ghanaian. Major aspects of culture which have suffered most are dressing, music, food and education. Currently almost open space and food joints are serving foreign dishes to the detriment of local foods due to the craving for foreign dishes (Ibok, 2018). Similar sentiments have been spoken on the music culture where most people especially the youth are copying foreign culture through explicit music from these cultures (Anquandah J.,2015; Mawuli, 2005).The once beautiful rhythms of African songs and drums that resonates the expressive thoughts, emotions and beliefs of the Ghanaian way of life (Boafo-Arthur, 2014) is being brought back. For instance, a Government have even initiated national Friday wear to encourage the wearing of the traditional cloth for all occasions in the hope of encouraging the citizens to be proud of their culture and also introduce national chocolate day to encourage the local patronage of Ghana Chocolate and cocoa products.

Certain customary practices like purification of the soul, death, burial and funeral of the dead as well as divorce were very sacred and often solemn. Most marital cases were settled by families of both parties and if peace could not prevail the marriage is dissolved with the woman returning the drinks offered to her by the man. The woman was also restricted from making love to any other man for a period of three months as a surety of not carrying the husband's baby. The belief in the soul as a deity which should not be offended and when offended must be pacified was another core belief of the Asantes. This can be seen in the elaborate and expensive reverence given the dead in the kingdom. Knowing that death is just a transition to another world every preparation is made for the dead to transition comfortably to the other world. (Asante E. A., 2013) (Johnson, 1970). Cultural symbols such as stools/chairs, umbrellas and drums are very important in the chieftaincy institution of the people. The type of stool depicts the kind of authority and position a chief holds whilst the shape of drums are tailored to make unique sounds for different occasions. These are used to play beautiful Asante orchestra such as '*adowa', 'kete', 'sikyi', 'penpensiwa'* with the *'fontonfrom' drum.*

2.6 *Smart Community Initiatives and Acculturation - Case studies*

Two smart cities based on their peculiarities were studied as part of literature based on their smart city initiatives, location, culture and acculturation

2.6.1 Case Study 1: Singapore

Smart city initiative started form a smart nation vision that was established in 2014. Singapore is a city nation singling it out as a special case for study. The initiative is pivoted on the three key parameters – ICT, Networking and Data to respond to the urban challenges of ageing population, density and energy sustainability. With a population of 5.5 million, it is said that one in five is aged 65 and above. Today it is one of the most digitally connected cities in the world (Infocomm, 2018); the national data revealed that 650,000 own vehicles, 83% and 81% have at least one computer and internet respectively whilst mobile penetration stood at 137% .Though Singapore's smart initiative is in the early stages their ambition of becoming the world's first true smart nation is progressing steadily. Their slogan driving their objective is *everyone, everything, everywhere* (E3A). They seek to rely on their strong smart services – intelligent transport systems and e-governance, and strong government funding to build smart nation hinged on the six characteristic features of smart cities as discussed above. This ambition has been in existence for over four and half decades. Their major achievement so far include the integration of different governmental agencies on one platform ranking them first in delivering e-government; first in smart living in Asia after recording the highest quality of living as reported by Mercer (Mercer Survey, 2018) and in smart economy, it is ranked second as the most networked country in the world economic forum report (Report et. al, 2015)

Singapore has one of the most sophisticated information technology systems to enable smooth flow of traffic and safety on the roads. Smart mobility actions include one motoring which is a common platform for all vehicle owners to access traffic information, express monitoring and advisory systems and vehicle recovery service, your speed sign – a smart real time speed check device alerting drivers on speed violations, parking guidance system to guide drivers to available parking lots and bus information system called mytransport.sg smart application which provides real time information for commuters. The nation seeks to be a "car less" nation by 2050 with the injection of huge infrastructure in light rail transport to the tune of over 40 billion dollars. This is to make sure no Singaporean own a vehicle (Infocomm, 2018). Overall the ambition of the nation city to become a smart nation seems to have a promising future and special observation will be how their unique system of physical integration yet operating discretely will work together with the utilization of highly advanced smart systems (Kim, 2016).

The Singaporean culture is very complex and dynamic, rooted in geography and history, and diametrically different form the western culture (Yeo, 2016). Their culture developed over the years has a very welcoming and inclusive society, yet on issues of religion, race and language they are sensitive and often reserved. The country is an abode for all the nine member countries of the ASEAN with each having a strong presence in Singapore. But the Chinese culture bores an inseparable part of the Singaporean which dates back to the wars of china against japan. India and Malaysia are two other countries that have profound links to the Singaporean culture (Yeo, 2016) and it is now said that each Singaporean has a multiple identity. The openness and cultural diversity has given rise to the nation picking the best from each and incorporating them into their culture whilst maintaining a good cultural mix (Pitlane Magazine, 2018). However it is the British and the American culture that have had serious impact on Singaporeans in the area of writing (education) and governance. The colonization of the country brought them under the western culture through the development of the industrial age. These technological and digital age has accelerated the exposure of the younger generation to identify with the pop, music and dance and fashion culture from the west. Now there is growing concern about the craving for personal gain, material wealth, status gain and traits of ethnocentrism which hitherto was foreign to the Singaporean.

2.6.2 *Case Study 2: Tel Aviv:*

The city of Tel Aviv started its smart city project in 2011 with a unique approach of bottom up which focuses on residents rather than the infrastructure. The city is captioned with a slogan as the non-stop city. In their method of application they used a set of decentralized and low-cost processes to build a modular approach. This was rewarded in November 2014 at the world smart city expo, Barcelona when they were declared the world's smartest city. The smart model relies on strengths such as focus on residents, low cost, ability to receive feedbacks and liaising with entrepreneurs and private sector. (Aviv and Toch (2016) ; J. Kim (2016) cite a global ranking as the world' second best ecosystems with 70 start-ups and 1000 entrepreneurs in 2014. The core objective is to improve local resources and improve local resident's engagement in governance. This has created more trust between the municipality and its citizens. Through citizen oriented innovations, local solutions are found to address specific localized problems. (Curwell *et al.*, 2005; Batty, 2013) The city's perspective on smart city is in agreement with (Hollands and Hollands, 2008) and Angelidou (2015)as a process of driving technology into the fabric of the city making it an ongoing process with the human being as the conduit to achieve effective results.

Tel Aviv's smart services hinges on connected set of information sources and systems extensively used in the digital media often operated through citizen interactions on mobile applications, social media and municipal websites. This case draws some insightful lessons for future adaptations by cities. Firstly smart city projects must address a very specific pressing need of the society. Secondly the power of individuals was unleashed through local competition initiatives. Thirdly smart initiatives can be started with little budget and not necessarily relying on government for huge funding. Fourthly, the city is micro managed through the use of small scale projects to control the city's budget. Lastly there is active participation through active participation of all. Persons with Disability (PwD's) are able to communicate their ideas and proposals to the city authorities through the various platforms provided. The global attention given to this approach of smart city initiative puts Tel Aviv up as a global city. One challenge of this approach is how to converge all these different operating platforms. This is recommended for sustainable smart cities with a bias towards ICT (Townshend, 2002; Paskaleva, 2011).

The country of Israel is a young country of just seventy years with a population of nine million. Majority of the population are Jews and Arabs or Palestinians forming about 20 percent. The Israeli parliament has just passed a law that principally classify the country as a Jewish state and makes the Hebrew language the official language of the country (BBC, 2018). This sums up the cultural identity of the people of Israel which determines to be known as a Jewish state with Hebrew as the state language. This is a defining moment in their history. Israel's large information technology industry is amongst the largest in the world with 80 percent of the population having internet access (Internet World Stats, 2017). The Israeli cultures continue to be closely guarded against losing their Jewish identity, a reason people believe resulting in the passing of the bill. The culture is hinged on their religion of a monotheistic God which defines every aspect of their life. Festivals, practices, dressing, language, food and housing etc. all have links to their Jewish religion (British Library, 2017). In spite of the technological advancement spearheading the country's development not much traits of acculturation can be seen from other cultures.

3.0 METHODOLOGY AND PROFILE OF STUDY AREA

3.1 *Methodology:*

The study was conducted in Kumasi, the capital of the Ashanti Region of Ghana. The study adopted the mix method of qualitative and quantitative methods in a QUAL-QUANT ratio of 50:50 as it sought to investigate a phenomenon in real life context (Yin, 1984). Mixed methods research was adopted due to its representation on research that involves collecting, analyzing, and interpreting quantitative and qualitative data in a single study or in a series of studies that investigate the same underlying phenomenon. This is often preferred over a single method for this kind of research because it has a superior advantage over the two major paradigms due to its pluralism therefore affording the reader a better understanding (Harrits, 2011). The qualitative aspect of the study involved the case study of the Kwame Nkrumah University of Science and Technology (KNUST) and Kumasi City whilst the quantitative aspects dealt with the precedent studies of Singapore and Tel Aviv in in Israel by virtue of their smart initiative strategies. Perception of levels of acculturation was assessed on the KNUST campus. Data was gathered through a structured questionnaire survey and interviews in accordance with existing theories and findings from literature. A purposive sampling method was used to gather this data from a cross section of people both students and lecturers. They were asked to identify and rank aspects of the Asante culture perceived to be acculturated as well as perception on smart city concept for Ghana. In all 98 people were sampled.

Data collected was analyzed through SPSS and Excel in table and graphical representations of results. Ranking was done using a score of 1 to 5 with 1= lowest and 5= highest to measure the respondents perception about factors on smart concepts. In calculating the scores for the variables in each category, weights were given to the ranking (1= -2; 2= -1; 3= 0.5; 4= 1; and 5 = 2). The sums of average scores of each category were summed up to obtain overall score on total score of 200.

3.2 Profile of Study area:

Kumasi is often referred to as the cultural capital of Ghana due to its rich cultural heritage. It is the home to about 1.9 million inhabitants and is the second largest city after the national capital Accra. It is the home of the king of the Asante, the king of the great Ashanti kingdom. The Asante region has the highest population of 4.7 million out of Ghana's population of 29.4 million. (Ghana Population, 2018). Kumasi is divided into ten administrative regions as seen in figure 7. The study area Kwame Nkrumah University of Science and Technology lies in the heart Oforikrom sub-metro district of Kumasi metropolis. The University is well-known for its strides in science and technology innovations for the country since independence (KNUST, 2017). The campus provides services to over 55,000 people of all ages ranging from educational, health, recreational, commercial, religious and residential. It is the greenest zone on the city map and a major commercial hub for surrounding towns and those avoiding transactions in the undue traffic towards the central business district

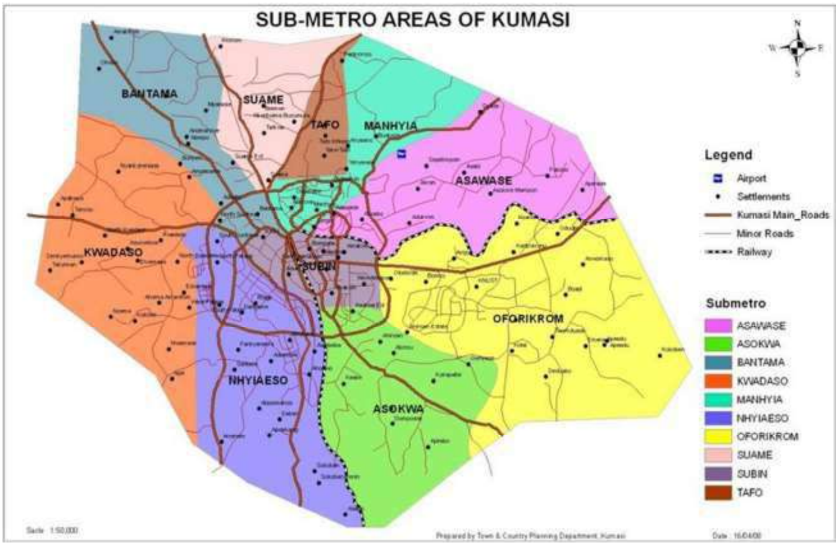


Figure 7.0: A Map Showing the administrative areas of Kumasi city
Source: Town and Country Planning, Kumasi.

The campus has good infrastructure facilities. Over 90% of all roads are tarred and in good condition with major road spines having pedestrian walkways and well-lit street lights boosting the level of security and safety on campus residents. Security has being complemented by the recent installations of CCTV at major junctions on campus. Bus shuttle and taxi services are available with bus/rest stops at vantage points.

4.0 RESULTS AND DISCUSSIONS

4.1 Characteristics of Sample Population

A total of 98 people were sampled from postgraduate students, lecturers and the other workers on campus during the second semester of 2017/2018 academic year (January-May, 2018). The cross mix sample population was chosen to give a true reflection of this exploratory study of the people in Kumasi. Respondents were voluntarily asked to participate in the survey. The successful respondents comprised 74 students, 14 lecturers and 10 from other occupations.

4.2 Mobile Phone Usage and Data Accessibility on University Campus

The respondents indicated a 100% access to mobile phones as well as the internet, with 93.8% owning smart phones, 4.2% with a feature phone. The university campus has good reception for most of telecom companies with staff and students having a prescribed data package every month for use. This has enabled many to have access to the internet to perform varying tasks. In spite of this, many of the respondents (76.5%) still relied on prepaid data bundles as their main source. Free Wi-Fi services accounts for 12.7% of data source and the remaining 11.8 relied on postpaid data.

The respondents spend 4.8 to 15 Euro equivalents/ month on extra data. Most of these data are used for smart application such as the social media, way finding and navigation, information and research amongst others. This confirms an earlier research the use of smart phones on a similar study on smart campus initiatives as seen in the Figure 8.0 below.

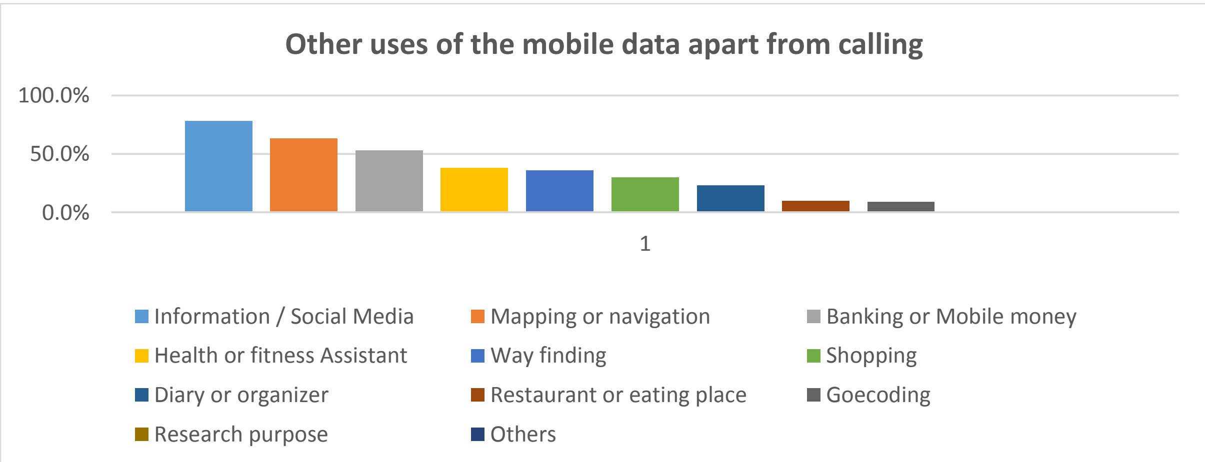


Figure 8.0: A Graphical representation of respondents other usage of mobile phone data
Source: authors construct, 2017.

4.3 Perception on Smart City Concepts

The majority of the respondents when asked about smart city concepts (69%) indicated their knowledge of the smart city concept from four different sources- literature, social media and course study, and conference/workshops. When asked of their opinion on whether it is a threat or an opportunity for national development 75% agreed that it was an opportunity. Though most agreed to the concept as good, they thought it is expensive with 62% in this category and 38% think it is less expensive. On the question of whether Ghana is really ready for such initiatives the opinion was divided with 60% agreeing the country is ready for it.

4.4 Perception on Smart City Concepts in Kumasi

To further explore the smart city concept potential with the city the respondents were asked to rank the smart city characteristics from 1(lowest) to 5 (highest) according to what they believed was the city's performance. The table below (Figure 9.0) indicates the responses showing the varied perceptions of each variable. On scale of 1 to 200, smart people concepts scored the highest (59.79). This is rightly attributed to the number of tertiary institutions within the city. The city is home to over 20 public and private tertiary institutions. The rest fell below expectation with smart mobility and smart living obtaining a fair outlook. Smart environment had the lowest score, perhaps an indication of the environmental degradation and pollution within the city. Smart economy came second with a mean score of 37.13. The city has a potential of business enterprise and development due to their strategic location with Ghana and the sub region. Most of the countries of West Africa use the city for business and commerce.

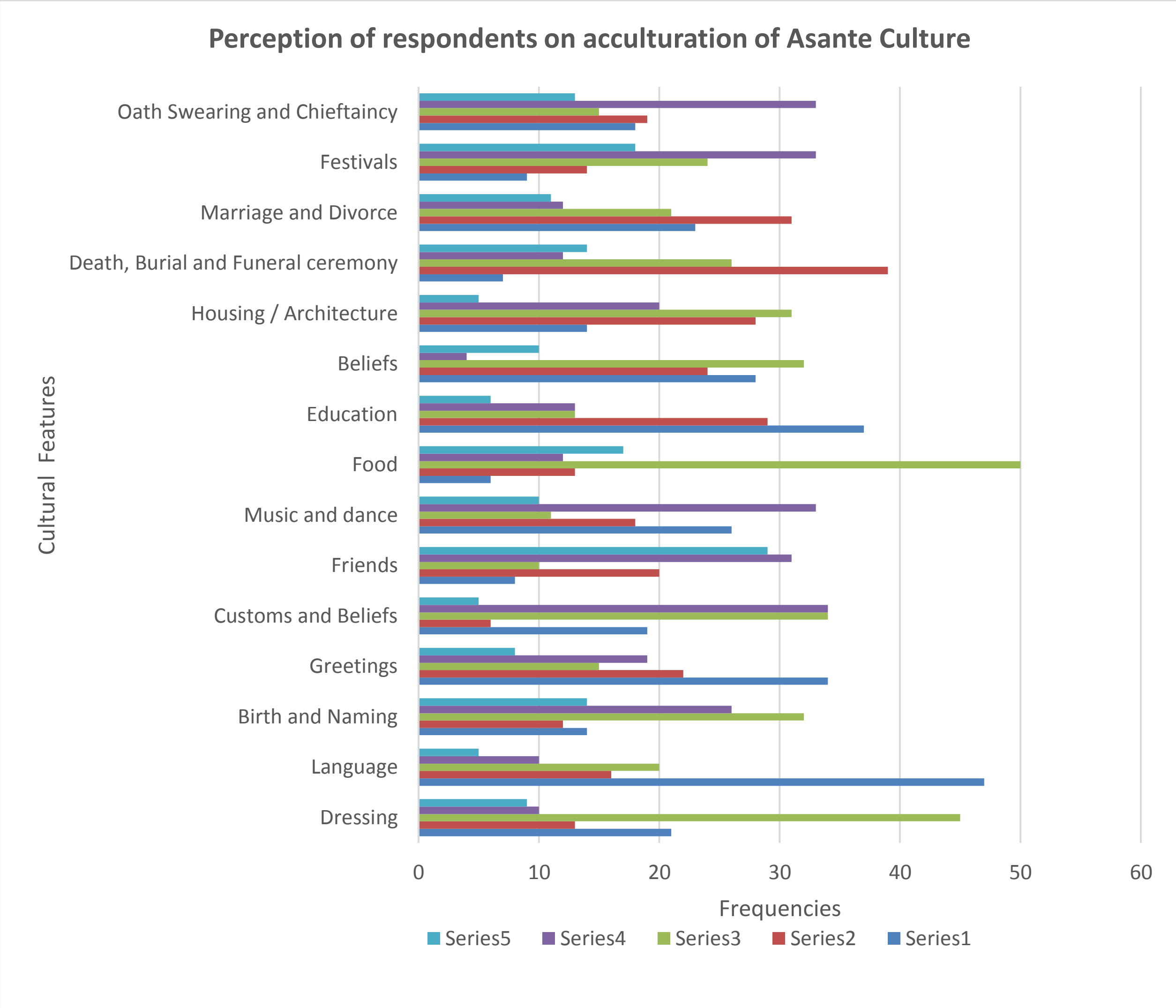
ITEM	***FACTORS***	***MEAN SCORE***
1	Smart Economy	37.13
2	Smart People	59.79
3	Smart Governance	21.19
4	Smart Mobility	33.10
5	Smart Environment	19.63
6	Smart Living	33.77
	Overall Mean Score	**34.10**

Figure 9.0: A Table showing overall Score of the Kumasi City on smart city concepts (Source: authors construct, 2018.)

However the Kumasi city performance on the overall mean score of 34.10 was below average performance. Though the city has a lot of potential in its citizens and economy, there is much to be desired in addressing major issues that gives the city a negative perception on its smartness.

4.5 Perception on levels of acculturation in the Asante culture

Out of the 98 respondents 81 indicated that they were Ghanaian, 11 were African and 6 foreigners, 70 of them were between 20 and 40 years whilst 28 were above 40 years. All the 98 respondents believed that acculturation has been accelerated by smart technology in the Asante culture, though with varying levels of dominance. Again when asked whether smart technology has accelerated its impact, 2 out of 3 respondents perceived that it has. Figure 9.0 shows the perceived acculturation levels of the Asante culture.



(Series 5= very high; Series 4= high; Series 3= average; Series 2= low; and Series 1= very low)

Figure 10.0: A chart showing levels of acculturation of the Asante culture
(Source: Author's construct, 2018)

The survey indicated most people perceived that education, marriage and divorce, beliefs, greetings and language are the most acculturated aspects of the Asante culture. Education and language for example had 69.3 and 64 percent of respondents respectively indicating a high to very high levels of acculturation, whilst greetings and marriage and divorce aspects had 57.1 and 55.1 percent respectively. Food had a significant 51percent indicating an average level of acculturation with 19 percent indicating a high to very high level of acculturation.

Death, burial and funeral ceremonies as well as architecture and dressing all had average levels of acculturation. Aspects of the Asante's culture that had low levels of perceived acculturation included friends (61%), festival (51%), and oath swearing and chieftaincy (46%).

These findings are reflected in the prevailing culture within the region. Formal education has become the seemingly only option for every child and opting for the traditional way of education which involved tutelage under elders and apprenticeship is seen as a failure and frowned upon. Even the citizens are willing to pay huge sums of foreign cash in order to have an education abroad which is seen as a success and preferred over Ghanaian degrees. Closely linked to this is the language spoken. With the country adopting a foreign language (English Language) as the official language, the use of the local language (Asante Twi) is frowned upon even in schools as it is an optional subject and not a medium of instruction.

This language imposition by the colonial masters of United Kingdom and the eventual adoption by succeeding governments as the official language has given rise to a psychological cultural dominance of the English culture to that of the Asante culture which is reflected in all aspects of their culture. For example most couples prefer the white way of dressing and marriage to that of the Asante traditional dressing and marriage as seen in Figure 11. And to satisfy both their psychological preference and family/society tradition many are now doing both bringing unnecessary cost to marriages nowadays.

Figure 11: The traditional and white wedding practices in the Asante culture.
(Source: Pictures taken from yen.com.gh and onobello.com and edited by author, 2018)

In furtherance to finding out the levels of acculturation it was important to also find out the respondents perception of the foreign cultures impacting on the acculturation of Asante culture. In this regard respondents were asked to indicate one potential foreign culture of dominance to the Asante culture. The results are shown in figure 12.0. Respondents were of the view that western culture, the Chinese and the European culture are the three foreign cultures that has the potential of accelerating acculturation of the Asante culture through technology. The onset of the digitization of the media landscape has given rise to free to air channels of which most are in these three aforementioned cultures.

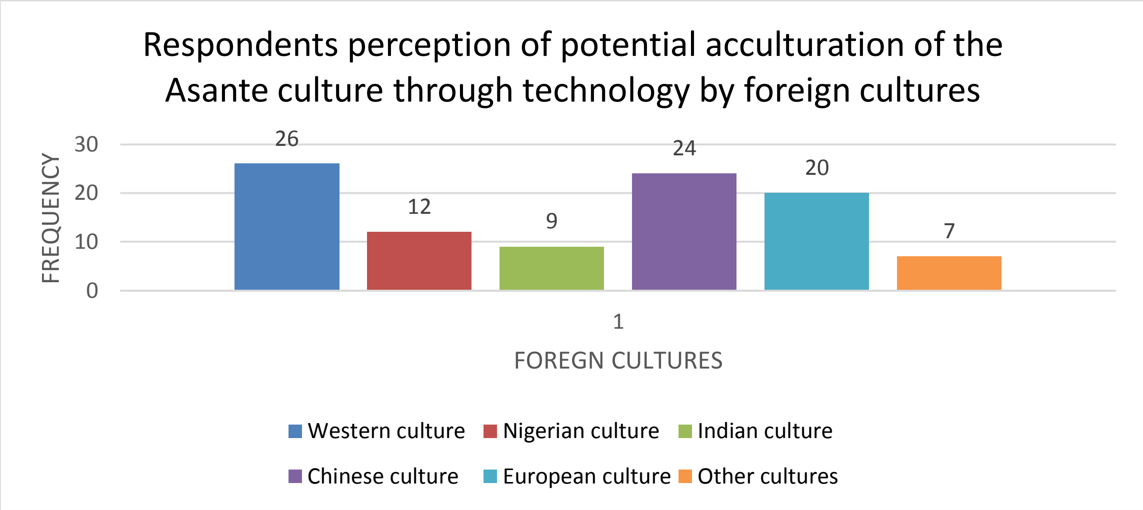


Figure 12.0. A graph showing the potential foreign culture dominance over the Asante culture (Source: Author's construct, 2018)

At the same time they are responsible for most of the technologies that are being used for smart cities concepts. Nigeria is the only African culture mentioned as a potential for acculturating the Asante culture. This might be due to the preference for Nigerian films, music and lesser extent their dressing over the local ones.

5.0 Conclusions and Recommendations

The population of the worls currently at 7.63 billion is projected to reach 8.5 billion by 2030. This phenomenom is accompanied by a similar increase in urban population. There has been a global rise in IoT connections projected to reach 25 billion with smart homes, buildings, cities, enterprises and innovations in the urban ecosystem. The groth in the urban population and IoT has had negative influence on the culture of peoples leading to acculturation of many cultures. A number of countries have attempted to use the IoT as a positive influence although acculturation exist. This study sought to explore how marting the city of Kumasi had affected it conclusions.

The study makes the following conclusions

1. The study revealed that acculturation is a phenomenon that is taking place in many countries at different levels depending on the cultural orientation of their citizens.
2. Acculturation has occurred in the Asante culture with technology speeding up its integration into marginalization.
3. Acculturation is high in areas such as greetings, education and language.
4. There is a high potential of acculturation being accelerated through smart city initiatives.

The study thus makes the following recommendations

a. Smart city initiatives should be citizen sensitive or the bottom –up approach processes be engaged from throughout such initiatives
b. There should be a conscious effort by key holders such as traditional authorities and government to proactively sensitize the citizenry on their culture
c. Further research is need to investigate and identify the actual relationship and the extent to which smart city initiatives can have on acculturation of culturesIntegration strategies as well as policies to slow down the transformation in the midst of smarting the city.
d. The use of Emojis and Apps should not replace greetings and languages but reinforce it into enhancing barrierfree and inclusive communities.

e. The culture of food, dressing and education, mobility could be integrated through careful anthropological research that can reduce marginalization tendencies of IoT for the cultures of the various local communities.

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Tourism and ICT; a new urban challenge to planners

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Abstract

Tourism has been one of the economic activities that have developed most in urban space, in the last decades. The growth in the number of people who make tourism along with the changes in information and communication technologies (ICT) are having a significant impact on the appropriation of urban space.
The climatic alterations will have an increasing impact on the tourist activities, reducing some, but valuing others. Information about the weather and the time that is felt in every place is an important aid for planning tourist trips.
The evolution of Information and Communication Technologies (ICT), from static to relational information, the mobility and connectivity of the devices and the possibility of secure transactions have had a very rapid and exciting development.
From the national level to the local or neighbourhood levels, technology is changing the way information reaches the local and foreign population.
But urban planning is far from being able to predict or control these new forms of appropriation of urban space and accommodate them.
The easy way to disseminate tourist information through public services such as municipal services, allowing each territory to disclose what they consider most interesting or where they want to invest, or even the most innovative place without any intermediation, is significant and can be or not, a sustainable way of economic development.
The development of useful APPs for tourism activities that disseminate information and facilitate the appropriation of the urban or rural space in a much larger way than traditional tourism use to do is amplifying the economic impact but also opening new territories to tourists that were not prepared for that.
The "anarchic" way in which private housing owners put their apartments in the international market in undifferentiated buildings and without the consent of neighbours is another type of new situation that can create many problems in some quarters, challenging the resilience of territories to these sudden changes.
At the outset of technology use, ICTs have proved to be very useful to everyone, but more and more problems are emerging at the local level.
This presentation intends to analyse some of these new challenges to the urban planning and city management, created by the tourist activity at the local level. It also wants to reflect on new urban management instruments, which are faster and adapted to the speed of urban changes.

1. Introduction

The intelligence represents, from a territorial approach, a new planning paradigm, based on knowledge-based economies and in a globalised innovation. This new planning paradigm, in general, related with smart cities, has not been researched in all facets, in special the negative ones or at least not wholly positive results for urban quality of life. One of the functions that have been profiting from the new technological changes with the use of the internet, in a radically new way, is tourism.
This research **a**nalyses the change in the tourism (urban and cultural) and the behaviour of the tourists in the last decade according to the development of the access of internet in the

city and in particular in mobile phones (smartphones) and the relation with climate exchange. The methodology used for this research involves the analysis of the technological evolution of the devices, that can distribute information about tourism and related subjects.
Analyze qualitatively the information, and the impact it has on the behaviour of people namely the tourists.
Relate it to the traditional methods used in the planning and management of the territory to draw conclusions, about the changes that must be made in the knowledge areas of planning and land management.
The first smartphones were in the market in the middle of the 90's of last century, but the real change happens in 2007 with the iPhone from Apple, and since then the APPs are increasing every day (fig.1).

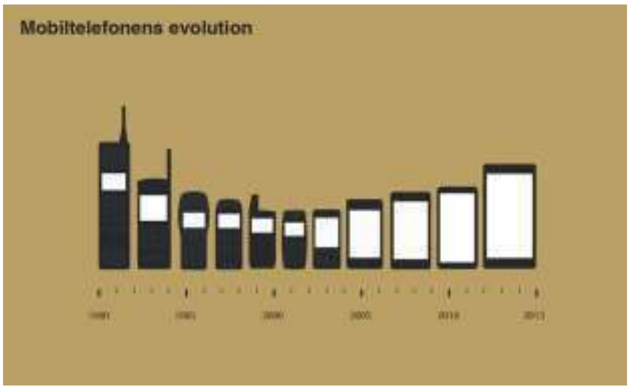

Figure 1 Evolution of Mobile phone
Source: https://www.engadget.com/de/2015/05/04/infografik-die-evolution-der-handys/?guccounter=1

In 10 years communication technologies have abruptly entered into partnerships in the tourism sector, and are used not only, by the economically more prosperous population, not just the youngest but by all the socio-demographic groups that travel.
To study the impact of some APPs and sites in the spreading of tourism in residential areas of the city or at least non-tourist areas can be very useful for urban planners and the evaluation of the importance of these changes in the management of the city is the great value.
The APPs that give information about the weather are, in general, entirely credible on the extreme phenomena that with the climatic alterations are more frequent. This information, at the time, allows tourists to take the best options to occupy their time safely.

2. Importance of tourism in the region and the city

The tourist activity is more and more relevant; in Europe last year had 4% increase in overnight stays, and in Portugal, the tourism represents 12% of PIB, in 2017 (INE,2017).
It is an activity significant around all European countries as we can see in Fig.2, and with special relevance by the impact of many foreigners in some communities like the north of Scotland and the Algarve.

The activity is very relevant to regions and cities considering it, in functional terms, because of the importance of the economic and innovative activities linked with the tourists (Ahas et al., 2008) (Cavus, 2014)
The localisation of the activities used to be very limited because the centrality that foreign people need is well known by the planners.

The increasing number of people using the public spaces and their animation can be seen as a demographic challenge because some urban areas were desertified some years ago, but often the management of the territory goes to tow of new locations.
The new valorisation of tangible and intangible heritage connected with the economic importance of some places but also with the valorisation of the culture of each territory is empowering local population. The urban regeneration that is increased by the investment in buildings is also notaries in the cities.

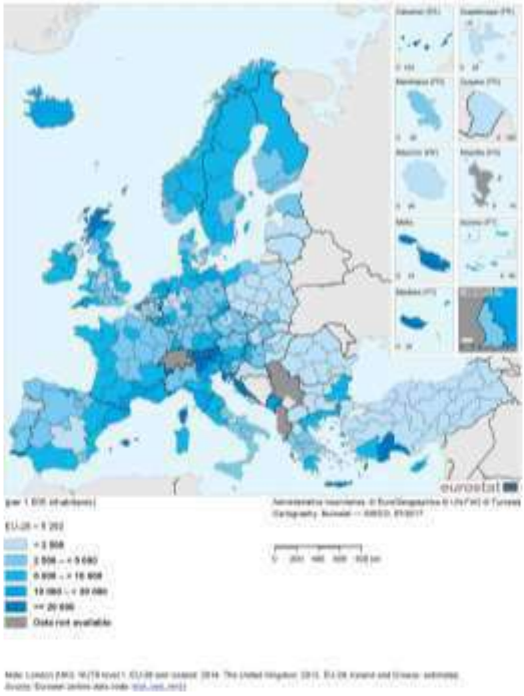

Figure 2 Number of nights spent at tourist accommodation establishments relative to population size, by NUTS 2 regions, 2015 (per 1 000 inhabitants)

Source: Eurostat

All these activities of tourism or leisure can be located anywhere since they are presented on the web, linked with a map APP. The GPS leads, customers or visitors, wherever you are to the point of attraction.

3. ICT and Tourism

The development of Information and Communication Technologies (ICT) in last two decades can be seen according to the development of the infrastructure and in special of the broadband, from analogical access, mostly offering static information only in some areas, to digital access with the exchange of information and services and mobile devices with ubiquitous access in the country and abroad.
Analyzing the evolution of mobile phones in the population, in Europe, we can evaluate the potential of users when people travel (fig.3) by the number of phones they have. For example, in Sweden, they have 2,210 subscriptions by hab. Which, that when travel will use it, but even Croatia has 1.1habitant, this means that everybody has a mobile phone.
The evolution of ICT from static information till relational one and the possibility of secure transactions have a very fast and interesting development, in particular, in the tourism area.

The development of internet infrastructure is spread around the cities, with many places like coffee shops and restaurants giving free access as a marketing element.
The development of the contents to tourism activities is increasing very fast, in the public sector with the information about urban life, cultural heritage and economic activities; in the private sector in economic activities like restaurants, hotels, transport services, recreation activities and weather.

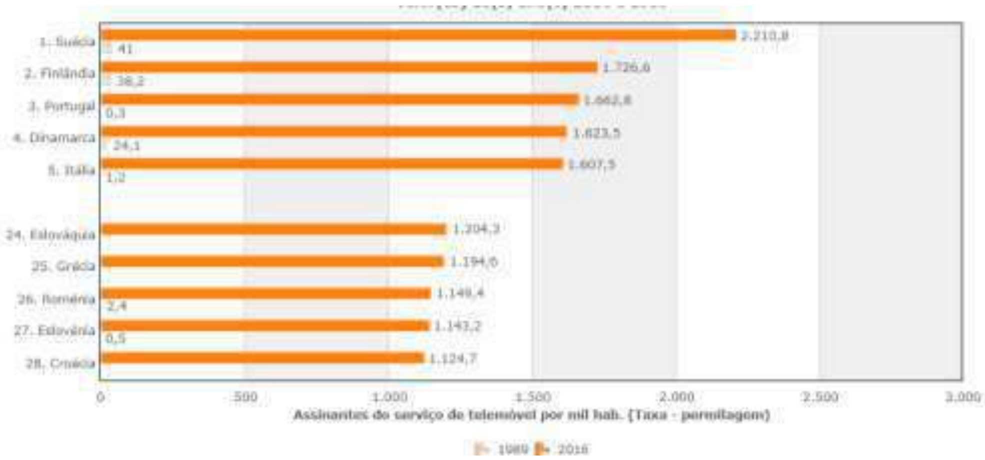

Figure 3 Mobile phone service subscriptions by Thousand ha. in Europe (1989 and 2016)
Source: Pordata

4. Tourism and ICT In Portugal

Tourism mobilises 82% of searches, on Portugal, made on the net, and this interest 52 times greater than shown by the information business (Turismo de Portugal, 2015).
Researching the access to internet by age in 2015, the data shows that till 44 years old, all the Portuguese of this group use it, in the group between 44 and 54 the use is more or less 65 %, the group 55 to 64 the use is 50%, and the older ones have a minimum of 30% (fig.4).

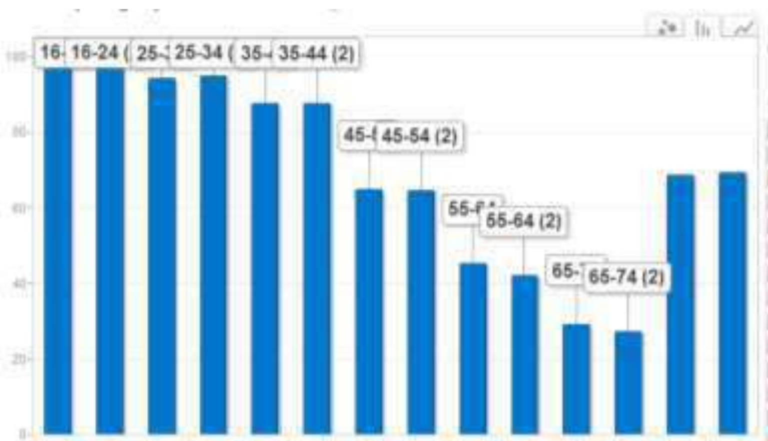

Figure 4 Individuals who use computer and internet in % of the total of individuals by age groups in Portugal 2015
Source: Pordata

If we cross this data with the penetration rate of smartphones that is 73.6% in Portugal in 2017 (Anacon, 2017) can be concluded that when they do tourism, they use it in a massive way.

The use of broadband in mobile devices, in Portugal, is mainly on mobile phones, 91% while in other types of handsets it is only 8.3%, in 2017(Anacon, 2017).

So the impact of ICT on the tourism covers several areas like:

- Cartography and GPS based mobile application making very easy access to big scale information with photographic recognition, which allowed the liberty of movements and independence from the knowledge of the language;
- Transports, with the possibility of self-organisation of the movements to a place and in the city;
- Touristic places allowing discovery of personal interest places, development of particular interests groups, but also the possibility of local authorities to do their marketing;
- Accommodations development in new urban areas where foreign people can stay with hotels out of the traditional touristic zone or new types like Airbnb, spreading tourists around residential areas and in peripheral neighbourhoods with the mix of local and foreign population in the same building;
- Restaurants with the equal opportunities than accommodations that allow the increase of publicity and clients

If the use of mobile phones is all around, the use of broadband is not homogeneous in the country (fig.5). The behaviour and information of tourists and local people can be entirely different.

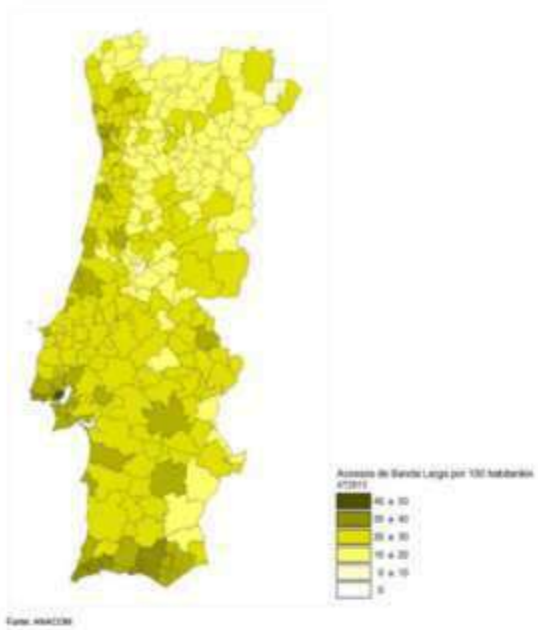

Figure 5 Geographical distribution of mobile broadband by 100 habs. in Portugal

Source: Anacon

Access to broadband and the information that is distributed by it is especially important when climate change brings unusual situations, that may be very relevant for tourism in rural areas and low-density territories, such as extreme temperatures or torrential rains, which may lead to less noticeable people.

Information on natural conditions can also be very relevant to the coast, such as sea conditions, such as ripples or water temperatures.

In a country that is affirming itself in sea sports, such as surfing and body boarding, the quality of information is very important.

By another side, organise tourism activities without disrupting urban life namely in public transports and housing, and prevent the resident population feels used for tourist purposes is more challenging for planner and territory management when the tourism can be ubiquitous.

Technological changes have been very rapid and profound, mainly in 10 years. Changes in population behaviour that are related to the current access to information, happen simultaneously in the world, and for the first time, there are no countries or regions that are pioneers in the effects of technology.

are always being challenged by technological evolution, and they need new tools, for example, with data from localisation of smartphones to be aware of the new flows of tourists and quickly create but adequate measures to a good quality of life for all.

5 Conclusion

The effect on tourism and leisure of climate change can be minimised or even exploited when ICTs and their APPs are applied to information for travellers, as for the general population

The introduction of ICT in urban life and in particular in tourism activity allows a wider distribution of economic benefits brought by tourism.

But at the same time developed unpredictable targeting tourism and the deregulation of services dissemination of tourism by not tourist areas.

Create difficulties for the resident population cope with the impact of tourists and also challenges for the public authorities to control the types of tourist offer.

There is a recognition of the need to use new methods and new data, more on the changes that are taking place in the planning and management of the territory.

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Research on Urban Spatial Structure in Shanghai from Human Mobility View Based on Cell Phone Data

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Abstract: With the development of traffic information technology and acceleration of life and work rhythm, in modern metropolises like Shanghai, the high frequency mobility of massive population has caused huge influence on urban internal structure. How to measure human mobility and explain its dynamic structure in the city is of great significance to understand the law of intra-urban population flow. Previous research has mainly focused on human mobility patterns. In this paper, we aim to go one step further from exploring how the whole structure look like when individuals' mobility are aggregated into spatial analysis units using relatively high-precision and large-scale cell phone data. Shanghai as a typical metropolis of China is selected for research. To address such question, we divide Shanghai into 5432 census tracts and calculate basic population in every spatial unit by identifying every user's stable location during 4:00 p.m. to 6:00 p.m. when human mobility is the lowest. Then we compare basic population with daily visit frequency to calculate the amount and the ratio of human flow in each spatial unit. Finally, we combine the strength of human flow with the influential range, the composition, and the temporal law of human flow to extract a dynamic structure of urban space in Shanghai. The result shows that People's Square enjoys the highest amount of human flow, approaching 2.95million visitors passing by per square kilometer, which is more than 10 times of its residents, while in suburban areas the average level of human flow is just 4.80 thousand visitors per square kilometer. Additionally, the dynamic structure of human mobility extracted from four dimensions of index is composed of four kinds of features: dynamic surface, from city center to subarea, shows the strength level of daily human mobility; dynamic center, including five center and eleven subcenter, becomes the most influential areas in the flowing network; dynamic cluster, can be divided into six groups according to the structure, influential range, and temporal variation of human mobility; dynamic corridor, strongly related to metro lines, highways, and Huangpu River, provides transportation supports for crowd flux. The findings of the paper help to illustrate a dynamic structure caused by human flow upon the static material spatial structure. The relationship between human mobility and urban structure can also be considered as s key issue which is continue focused on in housing, community development, and transportation field.

1. Introduction

With the development of traffic information technology and acceleration of life and work rhythm, the high frequency mobility of massive population has caused huge influence on urban internal structure, which has brought new challenge to urban spatial policy. How to measure the intensity of human mobility and explain its dynamic structure in the city is of great significance to understand the law of intra-urban dynamic structure and support real-time population management. Traditional population surveys such as nationwide censuses are conducted every 10 years. These survey data reflect only long-term changes. While human activities often result in large-scale population movements within a short period of time. Such rapid and irregular changes in urban space exceed the scope of traditional census data, which has become a shortcoming of population management in recent years. How to describe, measure and evaluate collective human mobility in urban space? Does the distribution of human behavior fit into the urban spatial form and structure? These problem are difficult to solve with the traditional urban structure model and static spatial analysis method.

The developing succession of urban spatial structure is influenced not only by the external influences of the region's natural and humanistic environment, but also by factors such as internal division of functions and land use. The structural laws behind it are constantly revealed by scholars. Relative researches has reached a considerable depth in the evolution and morphology of urban spatial structure with a series from classical theories such as concentric circle models, fan-shaped models and multi-core models Burgess (1925), Hoyt (1939), Harris and EL Ullman (1945) to Further empirical research by some scholars like Zhang Tingwei (2001), Wang Xufeng et al (2011), Bumsoo Lee (2007), Qi Feng et al. (2012). However, limited by the research data and methods, there is always a certain distance between macroscopic scale structure and the real human behavior. Whether our urban structure conforms to real law of urban life, there isn't a quantitative explanation that can be generally accepted.

In the era of big data, an increasingly broad array of user-generated data like cell phone data derived from location-based services and Global Positioning System (GPS) provides new possibilities to analyze human behavior and their spatial distribution. Mobile positioning big data have opened up the interaction between human behavior and urban spatial structure, which not only enables quantitative analysis of urban structure under greater spatial and temporal granularity, but also breaks the long-term research barrier of "interpreting space with space", revealing the spatial law behind complex form of the city from the perspective of collective human activity. Relative research has proved that the cell phone data can be used to identify these daily activities, such as commuting, traveling, and space-time path (Ahas et al., 2015; Widhalm, P et al., 2015; Phithakkitnukoon, S. et al., 2010; C. Song et al., 2010; John Doyle et al., 2014). However, cell phone data still have great potential that needs to be exploited to further advance human behavior studies. At the same time, it should be noted that along with the opportunities it brings, there exist many remaining challenges that need to be dealt with when taking the application of mobile phone data further (Csáji,B.C., et al., 2013).

Therefore, the paper aims to explore urban dynamic spatial structure from the perspective of collective human mobility by revealing the strength, structure, and spatial-temporal variation of daily human mobility, and describing the feature of its spatial distribution. Two-week cell phone data of 2G users in Shanghai are used as basic data. The remainder of this paper is organized as follows. Section 2 gives a panorama of relative research on urban structure and human behavior. Section 3 makes a detailed introduction to how cell phone data can be applied to urban spatial structure research. Section 4 illustrates the results of the case study performed, which shows collective human behavior in Shanghai. In Section 5, we make some discussion about the results, presents a conclusion of this paper, and provides insights for further research. The results can provide reference for the formulation of urban space policy and population management strategy.

2. Literature Review

This study, firstly, analyzes the spatial characteristics of urban population flow based on cell phone data, and then summarizes the urban spatial flow structure. In the end, recommendations on spatial policy are proposed after comparing the results with urban spatial structure. Before conducting such research, it is necessary to understand some basic theories through literature review: 1)The definition of human mobility in urban area and its relevant research 2) Previous research on human mobility with cell phone data 3) Measurement on human mobility, in other words, how to describe and evaluate human mobility and its spatial structure?

2.1 Definition

The Chinese household registration system makes population movement more complicated in cities of China compared with other countries, therefore, some general definitions are not applicable in China. However, some scholars have proposed their understanding on population movement in cities of China. Zhao(2005) compared population statistical stats of different countries and suggested to divide population movement into three types: "Population Migration" -- defined as movement that cross the boundaries of certain jurisdictions, which might bring changes in household registration; "Population Move/Movement" -- simply referring to the changing of residence within a certain period of time, including short-term, long-term and permanent relocation. It can also be classified into regional and inter-regional relocation; "Human Mobility" -- reflecting spatial positional changes in a short period of time. It usually occurs inside the city and continuously changes over time. In this research, we focus more on the human mobility in cities of China.

Dynamic spatial structure of human mobility is always an important topic in the field of Population Geography. Many scholars have visualized spatial and temporal patterns of human mobility based on traditional data such as survey and census (Qin et al., 2013). Some have stimulated dynamic spatial distribution of population (Wang et al., 2014), and analyzed the internal mechanism of population mobility and industry, land use and other related elements (Yang et al., 2015; Rao et al., 2015). However, due to the spatial and temporal limitation of conventional data, for example, there are missing data on temporary population who stay less than half a year as well as the data of short-term population changes; Besides, the research scale of previous study are mainly at regional level (Bian, etc., 2013), interprovincial level (Li et al., 2015) or city and county level (Wang Lu et al., 2014); and the data utilized are mostly in years (Pan et al., 2013). Few research are conducted in smaller scale and focus on the changes over several years. In addition, a small number of studies mainly use data such as census (Foley DL, 1952), population flow observational statistics (Foley DL, 1954), OD matrix (Akkerman A, 1995), travel survey data (Roddis SM et al , 1998) and high-resolution remote sensing data (Sleeter R et al., 2006) to visualize, estimate and predict the spatial distribution of human mobility (Mao et al., 2010; Qi, 2013; Kavanaugh P, 1990). In brief, few studies are able to analyze dynamic spatial structure of human mobility through agglomerating individuals' activities, thus, further research are needed, especially with the advent of big data.

2.2 Human mobility with cell phone data

In recent years, with the increasing availability of big data, cell phone data is widely used in the human behavior and urban spatial studies. The reliability of cell phone data on human mobility research has also been verified by many scholars.

In terms of identifying behavioral activities, Ahas et al. (2010) used one-year cell phone data of Estonia to construct a stop point recognition model so that to identify individuals' stop points (including residence, work place, other places, etc.), after which the population registration data were utilized for comparison and verification. Based on communication data from 100,000 people in Portugal, Csáji et al. (2013) simplified data through clustering and principal component analysis. He identified their residences and workplaces, and compared them with census data. Widhalm (2015) explored cell phone data and call detail (CDR) data in Vienna, Austria and Boston. Considering low accuracy of cell phone data, Widhalm constructed Markov network model and propose a method for identifying the behavior patterns of residents.

When it comes to the description of behavioral patterns, Phithakkitnukoon (2010) visualized and analyzed nearly one million cell phone data of users in Boston central region. He found that people from same workplace have strong correlations in their daily activities. Ahas (2015) defined four indicators: “midnight”, “morning start-time”, “noon” and “day length” based on the call details (CDR) data of three cities -- Harbin, Paris and Tallinn. By comparing those indicators within and among cities, he revealed the differences in the spatial and temporal behaviors of residents in different cities and in the central and suburban areas within cities. Yuan (2012) used cell phone data of Harbin to study the correlations among mobile phone usage and radius, eccentricity and entropy. The results proved that characteristics such as age, gender, social time and built-up environment had impact on the usage of mobile phone and residents' activities. Ran (2013) identified user's travel trajectory through call detail (CDR) data, and analyzed the distribution of resident population and employment population, commuting pattern, OD matrix, commuting pattern in specific regional and commuting characteristics of floating population.

At the same time, recently, some research topics have gradually shifted from the identification and description of behavior to the simulation of human mobility. C. Song (2010) explored the possibility and limitations of cell phone data for predicting human mobility. It is considered that irregular human mobility (except for commuting and leisure travel) is inherently unpredictable. In the same year, C. Song (2010) used cell phone data to construct a random walk (CTRW) model so that to quantitatively stimulate human mobility. John Doyle (2014) visualized population movements across Ireland with call details (CDR) data, by using Markov chain model to rank population hotspots, John found that the results are strongly correlated with census data. Till now, research on the simulation of human mobility are still in their infancy.

Existing research have proved the feasibility that cell phone data can be used to identify daily activities, such as commuting/leisure travel, temporal and spatial patterns, etc. Some studies have further explored the possibility of simulating human mobility with cell phone data. However, on the other hand, most of research focus more on the description or restoration of travel activities, while the explanation of influencing factors is insufficient in these research, as well as practical guidance on spatial policy, which will be the focus of this research.

2.3 Measuring human mobility

Measuring human mobility usually includes description and evaluation of spatial structure. Existing research are mainly from the perspective of spatial-temporal distribution and dynamic space of flows. The spatial-temporal distribution of human mobility mainly refers to the city's population density distribution of different periods. Akkerman A (1995) evaluated the densely populated areas of Saskatoon in Canada based on the matrix of residents' residences and workplaces; Qi (2013) Constructed a “population-day and night-land use” model based on the understanding of cities of different spatial-temporal behavior characteristics. He then used grid as the unit to estimate Beijing's day and night population and analyzed its spatial distribution characteristics; With cell phone data of Oregon, Sleeter R (2006) stimulated the population density of coastal communities, based on which these community space were evaluated. Zhong and Wang (2017) used cell phone data to build a dynamic "population-time-behavior" analysis framework and then explored the dynamic spatial structure of population and activities in Shanghai.

While the perspective of dynamic space of flows focuses on population OD flow and urban spatial network structure. Castells M 's (1996) research did not follow the proximity theory, which greatly promotes the study of dynamic urban spatial network; Shen and Gu (2010) defined space of flows based on the analysis of the flowing society. The concept of space of flows consists of three spatial elements: nodes, lines and surfaces; Cheng and Zhang (2016) used spatial data from branches of the Yangtze River Delta to analyze the spatial organization characteristics of urban agglomeration and quantified its evolution trend, indicators that they used includes centrality, inflow and outflow ratio, etc. Xi and Qi (2013) constructed the residential mobility index system, which covers four aspects: human flow, cargo flow, information flow and activity flow. They employed entropy to measure the mobility of residents.

All in all, three conclusions can be drawn through literature review. Firstly, based on research with conventional survey and census data, the intrinsic mechanism and spatial coupling relationship of population flow has already been deeply studied, but it is necessary to integrate big data and focus more on smaller research scope. Secondly, existing studies have proved that cell phone data could support the identification of human mobility, but for further analysis , most studies are still working on the description of the results, while the impact factors and application need to be further deepened. Thirdly, the measuring of human mobility has two perspectives: spatial-temporal distribution and dynamic space of flows. These two perspectives can be considered together with the support of big data. Therefore, this research will analyze the space of flows based on human mobility collected from cell phone data, which could provide some new perspectives.

3. Methodology

3.1 Data preprocessing

First, we address the station drift of cell phone location data to obtain the correct location for each user. Station drift has a specific characteristic whereby a personal movement trajectory drifts, in a short period of time, from one place to another place that is almost impossible to reach in that time interval. When the speed of a user is faster than 100m/s, we treat such point as a station drift. Moreover, if the lac cell ID of several points next to each other is the same, we merge these points and use the latest timestamp.

Next we change preprocessed data into travel-chain data which includes information like the location(longitude and latitude) and timestamp of every origin(O points) and destination(D points) in a user's travel trajectory. We use a distance threshold to judge whether users leave their O points. Considering the distance between two lac cells grows longer from city center to subareas, our distance threshold should change accordingly in order to maximize the identification of travel trajectory. Figure 1 shows the calculation of distance threshold: 1) divide 6 sectors with the base lac cell as the center, each 60 degrees; 2) calculation linear distance from the nearest lac cell in each sector, and get 6 distances; 3) choose the maximum value in these 6 distances as distance threshold. We use a time threshold which is 20 minutes(duration of two nearest timestamp should be longer than 20min) to judge whether users arrive their D points instead of just passing by. Table 1 shows the final processed travel-chain data which includes 14 days' travel-train information of 16.34 million users, this table is prepared for further analysis.

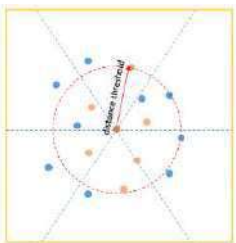

Figure 1: Calculation of Distance Threshold

User ID	O_lng	O_lat	O_timestamp	D_lng	D_lat	D_timestamp
48503	121.3809	31.1129	2014-0315-06:30	121.3885	31.1234	2014-0315-07:02
48503	121.3885	31.1234	2014-0315-09:20	121.4437	31.5324	2014-0315-09:33
48503	121.4437	31.5324	2014-0315-12:13	121.2487	31.2234	2014-0315-12:24
48503	121.2487	31.2234	2014-0315-17:35	121.3809	31.1129	2014-0315-18:36
64598	121.6897	31.0897	2014-0316-09:25	121.4578	31.1239	2014-0316-10:19
64598	121.4578	31.1239	2014-0316-18:20	121.2809	31.2908	2014-0316-19:02
……	……	……	……	……	……	……

Table 1: Travel-chain Data

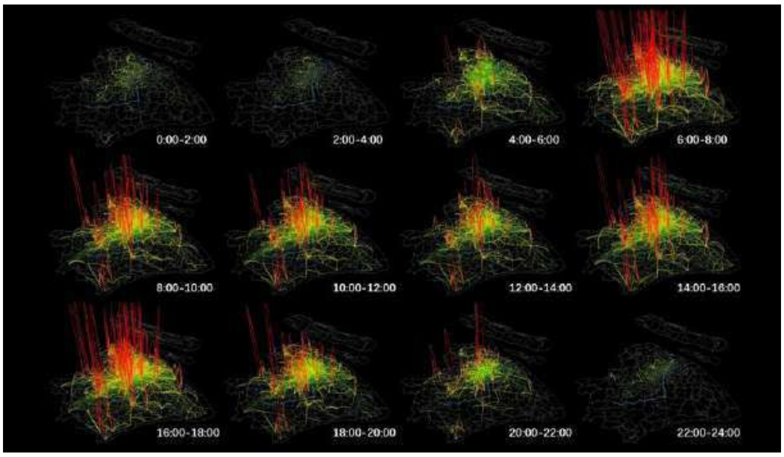

Figure 2: Travel-chain OD visualization

3.2 Description of collective human mobility

We describe collective human mobility from four dimensions, they are respectively mobility strength, mobility structure, influential range, and temporal variation. Figure 3 shows the indicator system of collective human mobility.

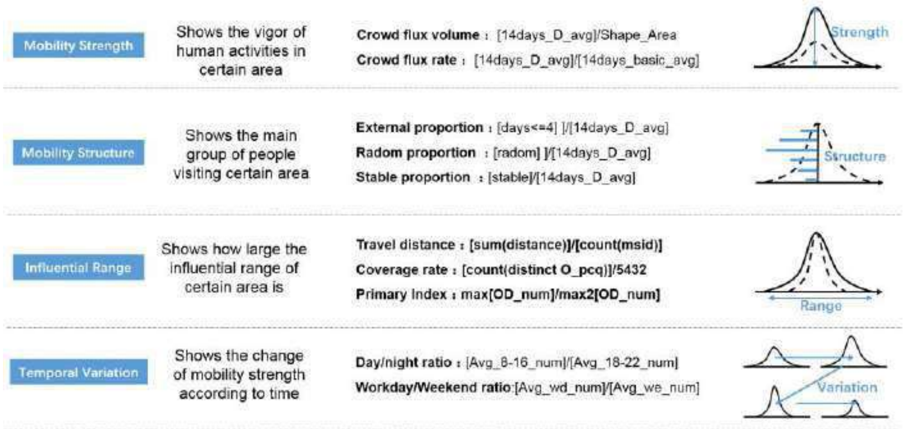

Figure 3: Indicator System

Mobility strength shows the vigor of human activities in certain area, including crowd flux volume. We aggregate D points into 5432 census units and calculate their density, so crowd flux volume reflects how many people per km2 choose a certain census unit as a destination every day. Since crowd flux volume is strongly influenced by population density, we divide it with basic population of each census unit(stay more than 3 hours here from 0:00 to 6:00) and get crowd flux rate which reflects how many times is every-day visiting population larger than basic population here.

Mobility structure shows the main group of people visiting certain area. We divide visiting population of each census unit into three parts. If a user have O/D points which are no more than 4 days in two week, he/she will be identified as external population since he/she maybe a tourist or come Shanghai for business. If a user choose a census unit as a destination only once in two weeks, he/she will be identified as random population since he/she won’t come here again in a relative long period of time. If a user choose a census unit as a destination more than 5 times in two weeks, he/she will be identified as stable population since he/she has a strong relationship with this place.

Influential range shows how large the influential range of certain area is. We calculate average travel distance of people visiting each census unit, the longer travel distance means the census unit can attract visitors from a larger range of area. Coverage rate presents the percentage of area a certain census has relationship with(more than 50 number of OD links). Primary index is introduced to judge whether travel from a census unit have a direction oriented connection with others.

Temporal shows the change of mobility strength according to the time. We calculate average crowd flux volume per hour from 8:00 to 16:00 as day volume and from 18:00 to 22:00 as night volume, then day/night ratio equals day volume divided by night volume. Also, we calculate average crowd flux volume in workdays and weekends, then workday/weekend ratio equals workdays volume divided by weekends volume.

4. Results

4.1 Mobility strength and structure

High mobility area in Shanghai can be divided into four grades according to their crowd flux volume (Figure 4-left): the first grade enjoys a visiting population larger than 100 thousand person per km2 such as the People's Square, Jingan Temple et al., the second grade has a visiting population between 60 to 100 thousand per km2 such as sub centers like , Daning, Wujiaochang, the third grade has a visiting population of 40 to 60 thousand person such as some community centers, and the fourth grade are several new towns like Songjiang, Jiading et al.. The distribution of basic population(stay more than 3 hours in a certain census units at 0:00-6:00) is similar to the distribution of resident population from the 6th National Population Census, with Pearson Correlation Coefficient reaching 0.699(Figure 4-middle). Employment center Lujiazui has the largest crowd flux ratio of nearly 12.0, indicating that the number of visiting population in Lujiazui is 12 times that of the basic population. Pudong airport, Hongqiao transportation hub and area along line 2 inside the inner ring road are obvious high value areas and crowd flux ratio in Chongming and the southeast of Shanghai is low(Figure 4-right).

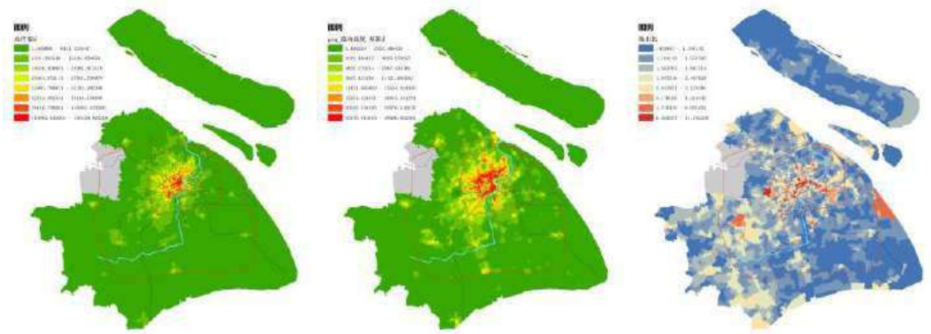

Figure 4: Crowd Flux Volume, Basic Population, and Crowd Flux Ratio

Combine crowd flux volume and ratio we can get comprehensive mobility strength of these census units in Shanghai(Figure 5). The areas with highest mobility strength in Shanghai are in turn: city center > sub center (high volume) and transportation hub (high ratio) > regional center > new town. Songjiang has higher mobility than other new towns, followed by Jiading, Baoshan, and Jinshan, while Nanhui new town has a low mobility.

Figure 5: Comprehensive Mobility Strength

Hongqiao transportation hub has the highest external proportion, 27% of the visiting population is external population, external proportion of transportation hubs is obviously larger, and the second is the main employment center(Figure 6-left). The random proportion city center, employment center and transportation hub are relatively high, for example random proportion of the People's Square, Lujiazui and Hongqiao hubs are all over 55%(Figure 6-middle). Residential areas and outer suburbs with small visiting population have relatively high stable proportion. For example, Nanhui new town has extremely high stable proportion of 60%(Figure 6-right).

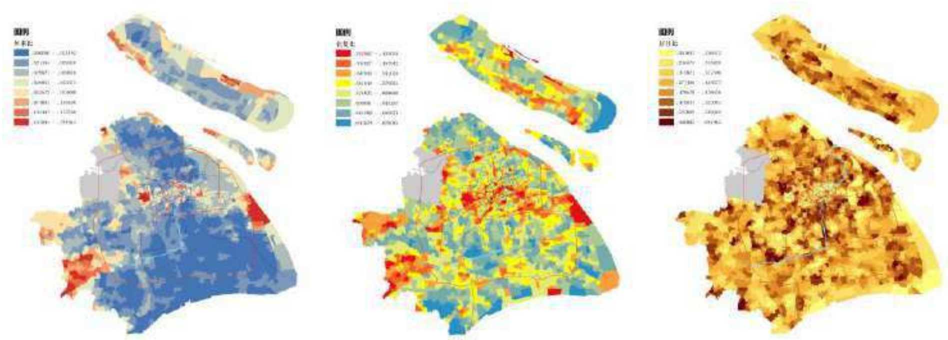

Figure 6: External, Radom and Stable Proportion

According to the proportion of the three groups of people, 5432 census units can be divided into random oriented type, stable oriented and basic oriented three types(since average external proportion in Shanghai is low compared with other index, we put external population into random population). The Figure 7 shows the distribution of these three types. It can be seen that there is almost no basic dominant in high mobility areas, so for these high mobility regions visiting population should be taken into consideration as well as resident population.

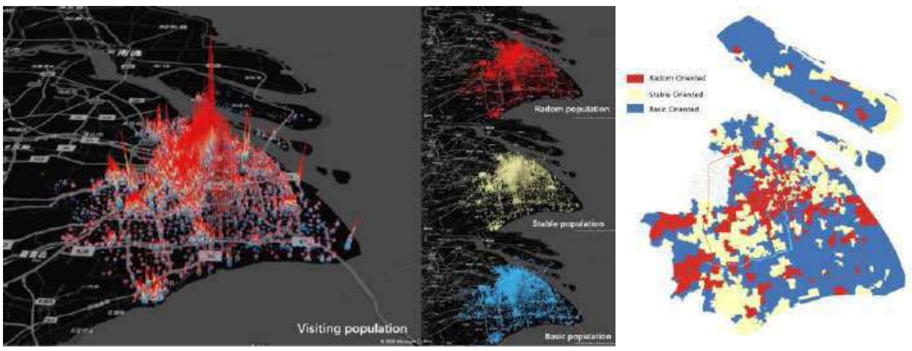

Figure 7: Comprehensive mobility structure

4.2 Influential area and temporal variation

The travel distance of transportation hub is longer, with Pudong airport reaching 18.8km. Areas inside the inner ring road have relatively short travel distance, while there are some exceptions such as the people's square, Tiantong road, Lujiazui, and Xujiahui. These areas can attract visitors from an average distance of 5.5-6.5km(Figure 8-left). When it comes to the coverage rate, areas along Line 1, 2, 8 form a "cross high value area", Lujiabang Road has the highest coverage rate reaching 25.7%, which means it connects a quarter of census units in Shanghai(Figure 8-middle). Nanhui new town, Pudong airport and Changxing island have a high primary index, reaching 6.0, that is, the crowd flux of the largest OD link is 6.0 times the second large OD link(Figure 8-right). Primary index of employment zones is relatively high, indicating that the attractiveness of employment has a clear direction. Since primary index shows the special link between two areas, we won't put it into the calculation of comprehensive influential range.

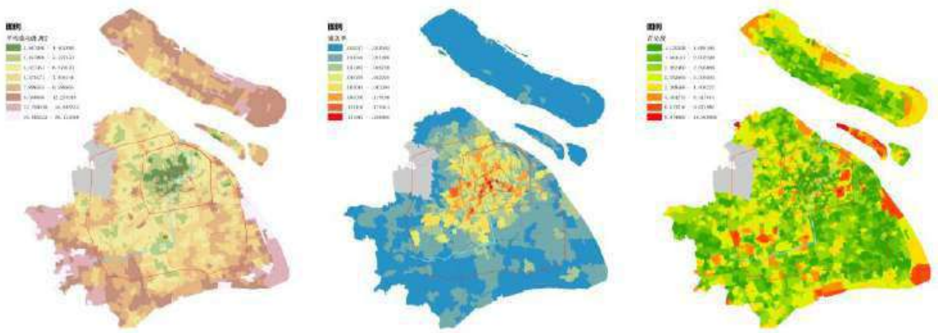

Figure 8: Travel distance, coverage rate, primary index

Combine travel distance and coverage rate we can define whether the influential range of a certain census unit is large or small. We can see from Figure 9 that influential range of suburban areas are the most extensive. The people's Square, Lujiazui, Xujiahui, Shanghai Railway station inside the inner ring road have large influential range. The high value zone is banded and has strong coupling with metro lines, indicating that the metro station can indeed expand the influential range of areas nearby. Moreover, transportation hub and employment zones have a larger range, while the residential areas and community centers have a smaller range.

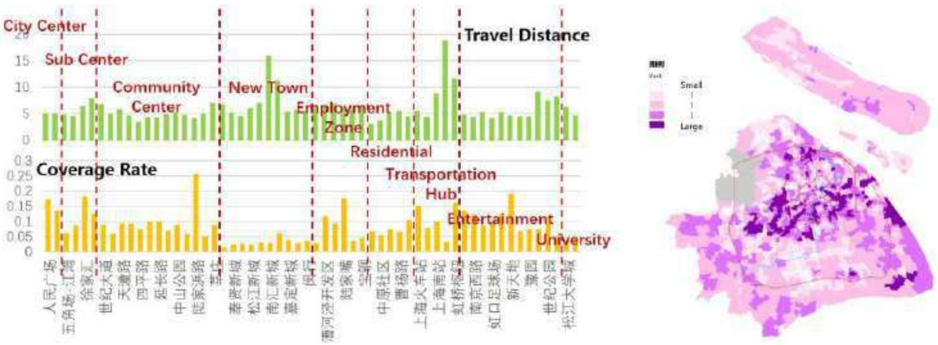

Figure 9: Comprehensive Influential Range

Caohejing Development Zone, Gucun Park, Town God's Temple (employment center, view spot with opening time) are high in day and night, reaching 2.2 respectively, day/night ratio of city center is about 1.5, and day/night ratio of residential areas is about 0.9. Day/night shows a "high-low-high" distribution pattern from the central city suburb to outer suburbs(Figure 10-left). Workday/weekend ratio of Caohejing was the highest, its visiting population in workdays is 2.1 times as large as that of weekends. While workday/weekend ratio of sub centers and view spots is lower, such as Wujiaochang and Gucun park reaching 0.8(Figure 10-right). On weekdays, visiting population in the center city is slightly higher than other areas, and visiting population in employment zones are much higher than those of others. The comprehensive temporal variation of the central city and outer suburbs is relatively high, that is, the mobility strength of these regions varies greatly with time(Figure 11).

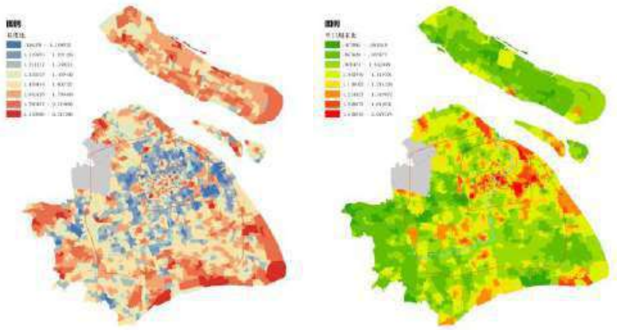

Figure 10: Day/Night Ratio and Workday/Weekend Ratio

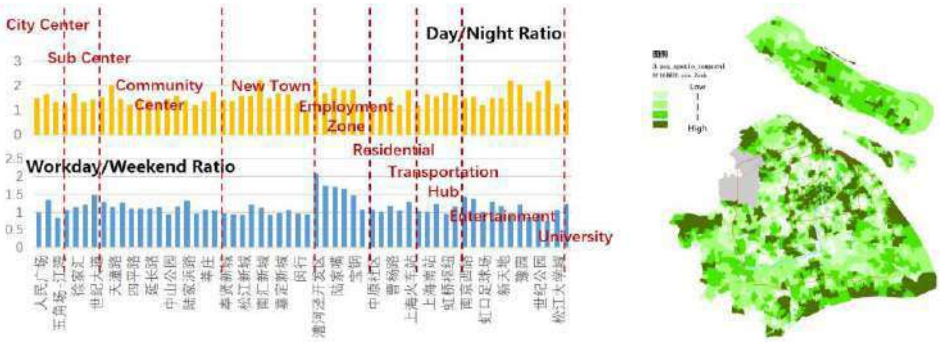

Figure 11: Comprehensive Temporal Variation

4.3 Spatial structure under view of human mobility

Figure 12 shows how we extract spatial features from four dimensions of indicators. The spatial structure under view of human mobility extracted from four dimensions of index is composed of four kinds of features: dynamic surface, from city center to subarea, shows the strength level of daily human mobility; dynamic center, including five center and eleven subcenter, becomes the most influential areas in the flowing network; dynamic cluster, can be divided into six groups according to the structure, influential range, and temporal variation of human mobility; dynamic corridor, strongly related to metro lines, highways, and Huangpu River, provides transportation supports for crowd flux.

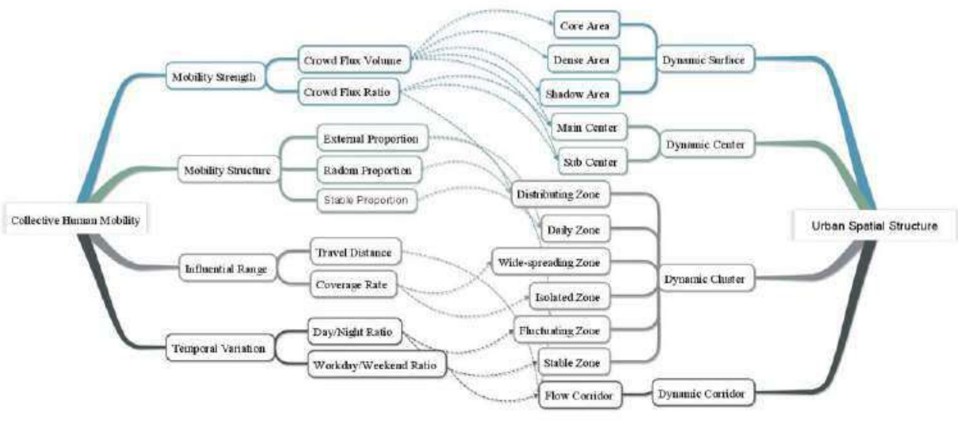

Figure 12: Spatial Elements Identification

Figure 13 shows the final spatial structure under the view of human mobility, we can see that the central city is mainly covered by core area, six dynamic clusters mainly distribute between the outer ring road and the beltway. New towns like Jiading, Songjiang and Qingpu are main mobility centers, other local community centers in suburbs compose sub mobility centers. The spatial distribution of dynamic corridor has strong relationship with metro lines and Huangpu river.

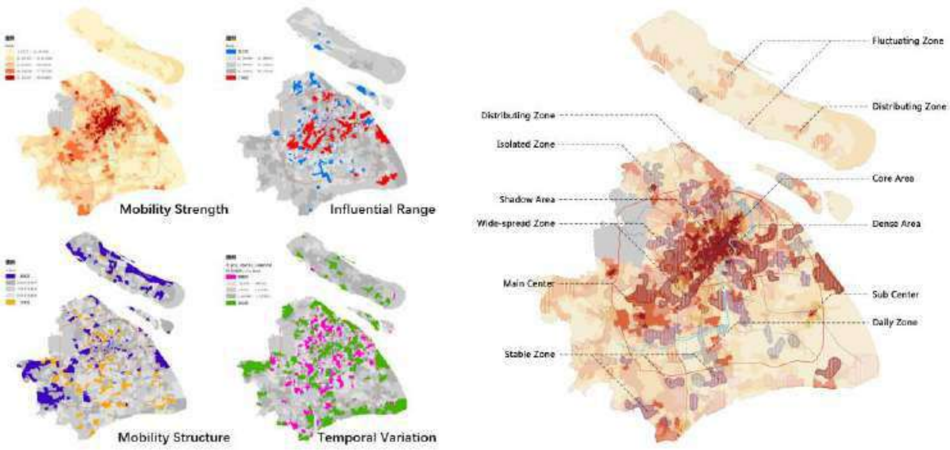

Figure 13: Spatial Structure under View of Human Mobility

5. Discussion and Conclusion

Urban spatial structure has been widely discussed in studies with conventional data. Recently, more and more scholars have used big data to conduct similar research. However, in Shanghai, the findings are mostly focus on human mobility pattern instead of the whole structure from collective human mobility view. In this study, we used cell phone data to provide some new findings about urban spatial structure, especially dynamic spatial distribution from crowd flux perspectives to make up the research gap in the context of Shanghai.

Four dimensions of indictors are employed to illustrate collective human mobility. New findings of this study suggest that:
(1)The visiting population associated with a census unit is about 5 times that of the resident population. The characteristic of collective mobility can be revealed using mobility strength, mobility structure, influential range, and temporal variation.
(2)The spatial distribution of mobility strength in Shanghai is in the form of "central hard core + suburb mobile center". Radom and stable population obviously larger than basic population in high mobility areas, so for these high mobility regions visiting population should be taken into consideration as well as resident population.
(3)From location perspective, influential range of suburb areas is the most extensive, high value zone is banded and relationship with metro lines is strong, temporal variation of edge areas in Shanghai is more obvious, and its spatial distribution presents "high-low-high" from the central city to outer suburbs. From function perspective, residential areas and local community centers have a smaller scope of influential range, mobility strength of employment centers and view spots varies greatly with time.
(4) Spatial structure can be extracted from four dimensions of indicators, which is composed of four kinds of spatial elements: dynamic surface, dynamic center, dynamic cluster, and dynamic corridor. The results can be further drawn into a spatial structure under mobility view showing the general rule and classification characteristics of urban space.

However, there are still some limitations exist and could be discussed in future work. Firstly, due to the limitation to data source, we only used two-week cell phone data in 2014 for study. The results may not have great significance to reflect current situation. Secondly, the predefined rule that we used to identify travel chain need further proved, different time and distance threshold may brings certain difference in results. Thirdly, the relationship between spatial structure under mobility view and traditional view needs to be analyzed quantitively. For further work, it is necessary to discuss the reliability and rationality of this measurement whether it is the most appropriate way to characterize different groups of visiting population. Moreover, detailed comparison should be conducted to find relationship between spatial structure under mobility view and traditional view in order to provide reference for the formulation of urban space policy and population management strategy.

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The use of Living Lab in some Italian urban settings to test the feasibility of the Smart City.
Making the needs of communities compatible with applications of new technologies

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Synopsis

Since 2007 several Italian Municipalities have tested the Smart City model. With reference to the EU Helsinki Manifesto which outlined the Living Lab in 2006, some Municipalities have worked to verify harmonization of the Smart City model with the need to focus on citizens. The Living Lab cases examined by this paper concern experiences in the Municipalities of Varese, Bologna, Turin and Padua between 2011 and 2018.

1. The European Union and Living Labs for checking the effects of a Smart City

Through the Helsinki Manifesto in 2006 the European Union showed how its commitment to the introduction of new technologies both in the productive sectors and in the Institutions should meet the need to put European citizens at the centre of these technological innovation processes. These processes should be favourable for European citizens.

Living Labs are a pragmatic and flexible tool to reach this objective. They can be defined as aggregations of public bodies, small and medium-sized ICT companies, Universities, research centres and groups of citizens who work to make sure that the implementation of projects for technological development and innovation in services are based on the need of end users supporting their contribution and participation in the main steps of the process.

In 2006 the UE was aware that new technologies could develop beyond control thus bringing huge advantages for specific productive sectors, especially those connected to ICT and real disadvantages for some segments of productive sectors in EU countries as well as some groups within the European society: low-income groups, old people with a low education level, young people with insecure jobs, groups at the margins of society.

2. Recent criticism about the Smart City in the USA

According to some recent critical approaches towards the Smart City in 2018 such as “From Disruption to Dystopia: Silicon Valley Envisions the City of the Future” by Joel Kotkin and “Stop Saying Smart Cities. Digital stardust won’t magically make future cities more affordable or resilient” by Bruce Sterling we can identify some dangers connected to the new urban development dynamics summarized using the attractive concept of Smart City.

These two writings show how several big US companies operating in the ICT sector, such as those in the Silicon Valley, have proposed communication, production models and ways of life which abandon the idea of a society characterised by residential settlements with low or medium population density. As a result, they give up the Fordist approach which allows the separation of working life in a company and private life. These new models seem to be based on an urban system with low or medium population density characterised by housing types with limited dimensions for single people, couples or small families.

The new settlement model is an urban system inhabited by people focused on the Internet environment and where the work-life balance is not well defined. Close to consumers who have a low cultural level and mainly buy products on the Internet, we can find a minority of people with high professional skills who put their job at the centre of their life and are the milestone of a production and social system dominated by the big and medium-sized US companies in the ICT sector which employ a growing number of young people from emerging countries who are ready to spend all their life time in the company.

This scenario clearly shows what is happening in some areas of California such as San Josè, San Francisco, San Diego as well as in other US cities. With reference to this issue, it is useful to read a book published in 2004 by Richard Florida “Cities and the creative class”.

In the most recent analysis which tried to analyse how ICT companies see the development of our society and therefore our urban organisms, we can’t find a theorisation of these trends but a reality which is spreading in several cities worldwide. It seems that a new form of city is partly outlined by the new communication models and by artificial intelligence, as explained by Andrea Granelli in his book “Città intelligenti?” published in Italy in 2012 and by Nick Bostrom in his book “Superintelligence. Paths, Dangers, Strategies” published in Oxford in 2014.

3. Smart City and Living Labs in Italy

In Italy a constant redefinition of urban life models outlined by ICT and the most recent forms of artificial intelligence has spread in several urban settings, although this situation is quite different from the one in the US cities.

According to the National Association of Italian Municipalities ANCI in 2016 more than 158 Italian Municipalities with 15 million inhabitants worked, in different ways, on the Smart City to introduce in their urban systems some new technologies which can contribute to the a more efficient, balanced and inclusive development.

These Italian projects on the Smart City have been defined, in some cases, using a sectorial approach which deals with one or more sectors of the urban system such as mobility, environment, energy, economy and in other cases a holistic approach based on the interactions between new technologies and the whole urban system.

Together with the development of these initiatives, the first tests have been carried out through the activation of several Living Labs. According to an unofficial survey, to date about 50 Living Labs have been implemented in Italy which focus on problems caused by technological development in several sectors: institutions, services, industry and many more.

Some of these have been developed to analyse urban regenerations programmes for specific quarters or urban quadrants as well as for limited parts of the urban system which shows critical aspects.

The case studies below concern urban regeneration programmes developed in Italy between 2011 and 2018 in Varese, Bologna,Turin and Padua.

4. The Living Lab on Repubblica square, Varese: 2011-2013

In May 2011 the Ministry of the Interior signed a Pact on Security with the Municipality of Varese regarding Repubblica square, a central area hosting several events and commercial activities as well as the Apollonio theater. Moreover, this square hosts an unde rground carpark with five floors which made it difficult for the municipal administration to guarantee adequate security.

According to the Municipal Administration of Varese it is fundamental to sign Pacts on Security which allow cooperation between the Municipal Police Department, the National Police Force and Carabinieri together with the use of images recorded by camera systems with the aim to guarantee security. The Pacts on Security were funded by the Italian Ministry of the Interior. This framework includes the “Sinecura” project proposed and funded by Finmeccanica an important public holding.

This project was implemented in 2011 by the company Electron Italia - Elsag Datamat and later by Selex ES Italia owned by Finmeccanica (today Leonardo spa) specialized in security.

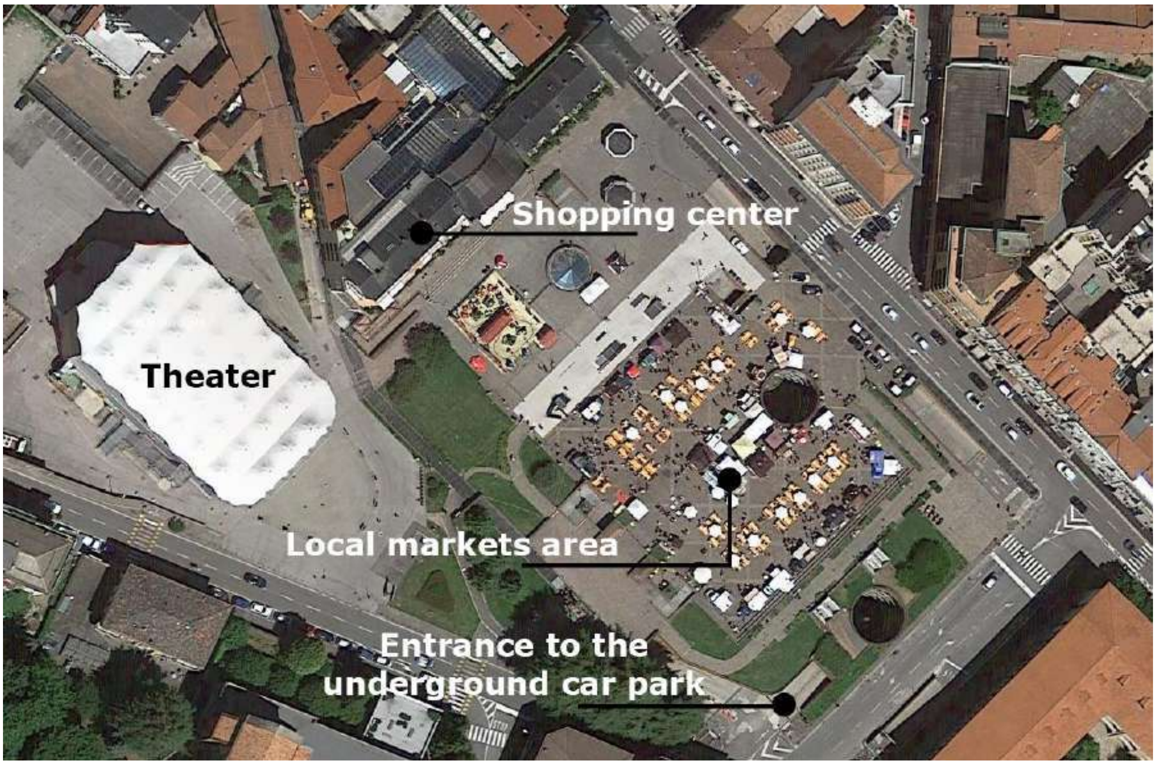

Figure 1: Varese, view of Repubblica square. Source Google Maps

This project was presented to the Municipal Administration as a Living Lab because it had been outlined by public Institutions and companies which use advanced technologies in cooperation with representatives of the Municipal Administration and associations of citizens and economic operators

The system used to guarantee security on Repubblica square is based on the use of Bluetooth technology which allows citizens and economic operators to download a specific application if their smartphone supports the Java software, otherwise another application is available on the municipality website for other types of smartphone.

If a citizen feels in danger, he/she can push a button of his/her smartphone and sends a signal which activates the eight new cameras provided by the Sinecura project: five with fixed optics and three Dome cameras with moving lens. These new cameras improve the system which already included four cameras. This system would be managed by a control room attended by the Municipal Police Department.

A camera, following the signal emitted by the smartphone would orientate towards the affected citizen and a member of the Municipal Police or policeman could observe his/her movements. Besides the camera-based control, an audio analysis system was installed based on optical sensor able to interpret several types of noises such as that of a broken glass or an unusual noise.
In this way the citizen could require in real time the Municipal Police Department to immediately intervene. It was clear that the citizen who felt in danger and decided to send a signal to the Control Room of the Municipal Police using his/her smartphone would be an express form of consent to be localized in case of call. Substantially this procedure would ensure the compliance with the legislation on privacy. The Municipal Police Control Room including two video terminal boards would represent the Focal Point of the whole project.

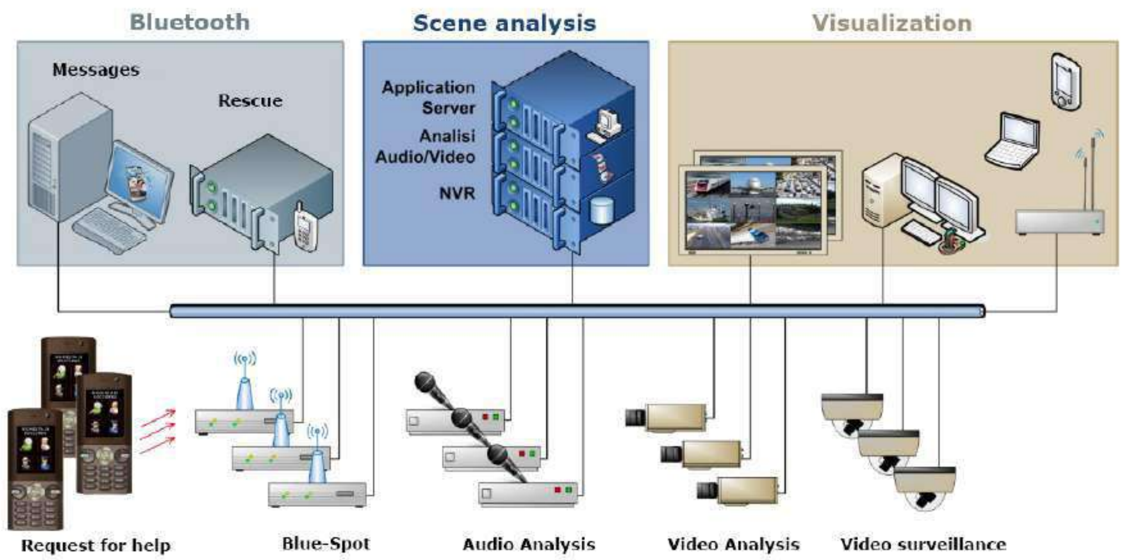

Figure 2: Varese, architecture of the system proposed for Repubblica square. Source: Municipality of Varese and Selex Elsag "Progetto sperimentale Sinecura di Sicurezza partecipata" (Experimental project Sinecura on Safety with the involvement of citizens) 2012

This pilot project was funded by the Finmeccanica holding with the aim of creating an experimental laboratory called "Dictum Factum" which is an example of how artificial intelligence can be used to safeguard an area such as Repubblica square. This place, due to mistakes in the urban planning process, was characterised by clear difficulties in ensuring security. This initiative aimed at combining connectivity via the web with sensors and civic participation to show the role technological components can play to guarantee security in specific urban quadrants.

This project did not have a follow-up phase because of political, economic and administration reasons and technological problems since it was not possible to use this system with all smartphone models available in that moment on the market.

5. The Living Lab of Liber Paradisus square and Fioravanti street in Bologna: 2013-2016

In 2013 the National Council for Research CNR published a call for tenders addressing Italian Municipal Authorities and called "Smart Cities" as well as "Energy from Renewable Sources and ICT for Energy Sustainability".

Figura 3: Bologna, view of Liber Paradisus square. In the middle of the picture we can see one of the smart posts installed. Photo by G.Sergi 2018

This call for tenders aimed at studying and testing a range of innovative solutions to make cities sustainable from an energy and environmental point of view.

Afterwards CNR started some tests according to the Living Lab model applied to the issue of Smart City in some Municipalities with different levels of population such as Agordo, Riccione and Siracusa.

The implementation difficulties pushed CNR together with the Municipality of Bologna to focus all available resources on a project "Smart Cities Test Plan" applied to Liber Paradisus square in Bologna which hosts an important building complex and a part of municipal offices. This complex was designed by the local firm Mario Cucinella Architects.

The square is located in the Bolognina quarter close to the High-Speed train station.

The lampposts placed between Liber Paradisius square and Fioravanti street were changed into smart terminals with several tasks: the implementation of some public wi-fi hotspots, the control over the use of parking places in Fioravanti street and security control for citizens through cameras.

This project ensured also the functioning of five touch screen totems in 2016 which provide citizens and tourists with information and services. These totems were placed along the route from Liber Paradius square to Rizzoli street in the city centre. Some expertises related to this project was used for EXPO in 2015 in Milan.

6. The Living Lab for the Campidoglio quarter in Turin: 2016-2017

In 2015 Municipal Authority of Turin decided to implement the first Turin Living Lab to verify the possibility to integrate a range of new technologies in the Campidoglio quarter and reach the goals set by the Municipality in terms of strategic and urban planning. The Turin Living Lab was useful to verify whether a semi-suburban quarter, in this case Campidoglio quarter, where 30,000 people live, could become a smart quarter.

Figure 4: Turin, the Campidoglio quarter. Source: Municipality of Turin, 2016

In January 2016 the Mayor Mr. Fassino presented the Turin Living Lab project for the Campidoglio quarter. The experimentation started in September 2016 and ended in March 2017.

This Living Lab refers to the Masterplan SMILE Smart Mobility Inclusion Energy implemented in 2013 for the city of Turin by the Smart City Foundation together with the Torino Wireless Foundation.

The Masterplan SMILE includes 45 ideas-projects which identify sectors where the Smart City vision can be implemented. These 45 ideas-projects refer to four fundamental sectors: mobility, inclusion, life and health, energy.

The Municipal Authority set three main objectives by implementing the Turin Living Lab for the Campidoglio quarter:

1. use the already acquired expertise in the Smart City sector and enrich them by implementing and testing new initiatives;
2. urge private companies working in the field of new technologies to test new products within real situations in Turin;
3. support professionals and innovative businesses capable of integrating themselves into the objectives of Turin Smart City.

The Campidoglio quarter was chosen because it is a complex urban quarter and therefore represents the suitable environment to test new technologies and show how these can contribute to the development of a consolidated urban quarter.
The Municipality of Turin considered a call for tender addressing the operators in Piedmont, Italy as well in some other countries (UK, Israel etc.) in the field of new technologies as a central element of the Living Lab.

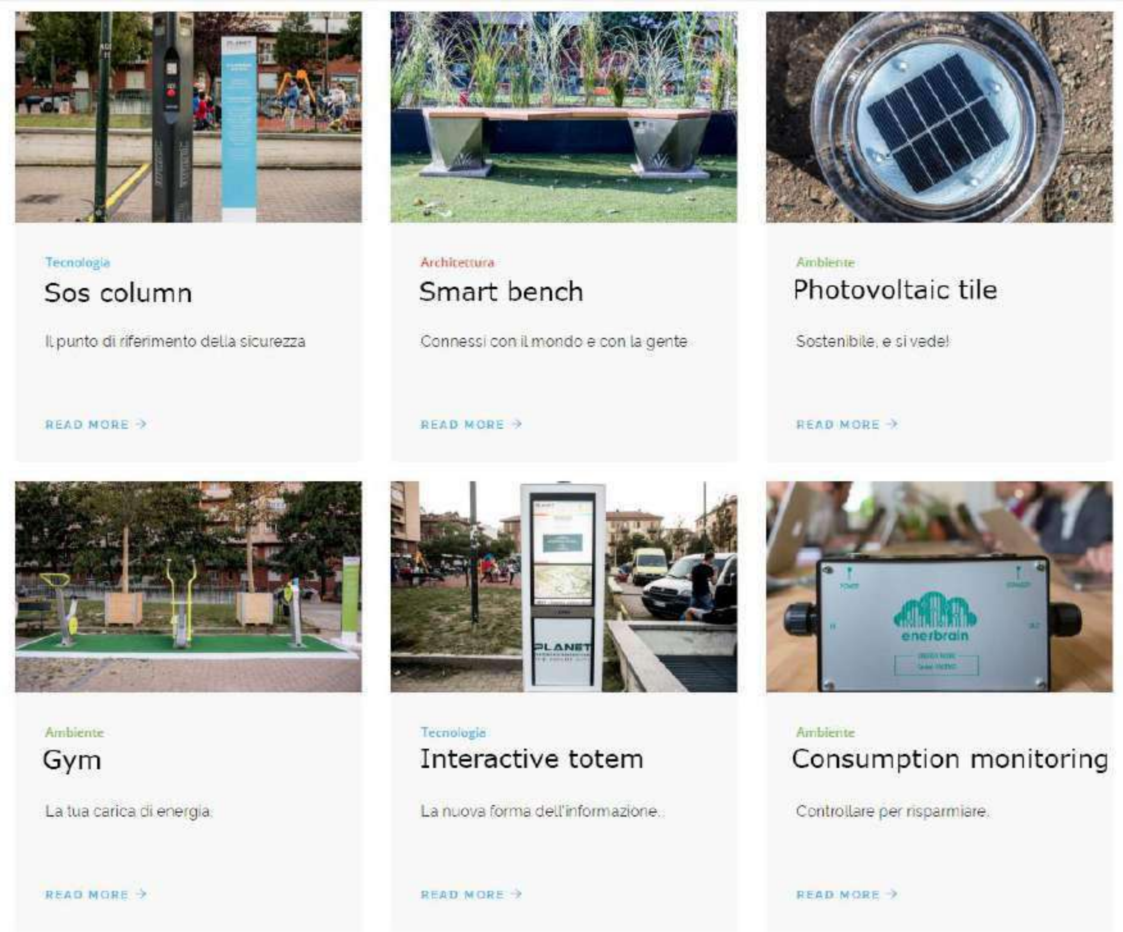

Figure 5: Turin, Risorgimento square in the Campidoglio quarter. Some of the technologies integrated into Risorgimento square as a smart square. Source: www.planetidea.it

As a result the Development, European Funds, Innovation and Smart City Department of the Municipality of Turin published in January 2016 a Notice for the search of parties interested in the project Turin Living Lab for the Campidoglio quarter. The call for tenders specified the Municipality's interest in selecting parties capable of developing technologically advanced products, testing them and using such participation to promote themselves.

Private and public parties were allowed to take part in the call for tenders in an associate form, too. After the call for tenders had been published, more than 50 experimentations were selected to be implemented between the Campidoglio quarter and Risorgimento square.

The smart square Risorgimento was opened in September 2016 using a surface of 5,300 square meters until March 2017.

Several companies took part in the Living Lab such as Tim, Vodafone and other small and medium-sized companies in the field of advanced technologies. The University of Turin and its IT department as well as some important professionals from Piedmont specialized in urban sustainable and smart transformations were part of the project.

The Living Lab created on Risorgimento square an interesting range of technologies which can contribute to change a semi-suburban area into a smart and inclusive quarter. The IT department of the University of Turin launched in 2016 a georeferenced social network called FirstLife to support citizens, economic operators, non-profit companies and so on.

Figure 6: Turin, Risorgimento square in the Campidoglio quarter. Parking area for sharing 5 electric cars built after the end of the Living Lab. Photo by G. Sergi, 2018

FirstLife is a civic social network developed to create, share and exchange information among all private and public parties involved in social, economic and recreational activities as well as in the management of local services, at different levels within the city and beyond. It is a platform based on an interactive map where contents regard activities and projects linked to these places and where users can interact by taking part in discussion, theme groups and events. The project was developed by the research group "Social Computing" which is part of the IT Department of the University of Turin and obtained important acknowledgements from the EU.

The project to set up Risorgimento square was implemented by Planet Idea srl, an engineering company founded in 2015 led by Giovanni Savio. Moreover, it was outlined in cooperation with Recs Architects, the engineering firm Francesco Tresso in Turin as concerns ecological sustainability, Daniele Alberti of the ICT and IOT team, the company SocialFare from Turin as concerns social innovation.

7. The Living Lab for the urban regeneration project of Gasparotto square in Padua, Railway Station quarter: 2014-2018

In 2016 the Unipolis Foundation, belonging to the Unipol group, published a call for tender “Culturability – Regenerating areas to be shared” to support innovative projects with a high social impact that can regenerate abandoned or underused areas. Five projects out of 522 presented projects were selected. Among these five projects, the project for Padua “LAB+: piazza Gasparotto Urban Living Lab” coordinated by Elena Ostanel researcher at IUAV.

This experience represented an interesting example of inclusive design aimed at social and urban regeneration of an area which was excluded from the most recent real estate development processes.

Figure 7: Padua, Gasparotto square, entrance from Popolo street. We can set both the entrance of the underground car park, the proposed urban garden of 380 square meters and the community theater. Photo, G. Sergi 2018

In Padua Gasparotto square is located within in the Railway Station quarter and close to the large area included in the real estate project called PP1, abandoned in 2005. The modern buildings which outline Gasparotto square are part of an urban area close to the railway station to host private and public offices.

The area belonging to the real estate project PP1 was an unbuilt area with a surface of 48,000 square meters. It is the largest abandoned area in this city. This area began its decay in 2005 when the PP1 project was abandoned by a group of local real estate companies. The events connected to this failure caused the closure of the building site and then worsened the state of deterioration of the whole PP1 area. Today this area is affected by petty crime.

For some years the buildings that face Gasparotto square have had vacancies on different floors. Over the past few years, the square has become a critical area characterized by social marginalization and illegal activities at night. After the closing time of offices, the area is no more crowded and dangerous to attend.

Since 2014 groups and associations have committed to recover this area which is on the one side attended by people who work here in this business district during the day and people living in this quarter, especially aged people, and on the other side groups of immigrants and people involved in petty crimes who use this area for illegal activities.

The Co-operative EST Educazione Società Territori was the first to settle down on the ground floor of the square and created a co-working area CO+ with seat on the ground floor of one of the buildings in Gasparotto square. EST has become the leader of some associations such as Gasparorto which deals with the creation of an urban garden and the Hub – Culture Food and Sport which promotes an urban regeneration process with the participation of citizens.

The EST co-operative supported the development of the urban regeneration project LAB+ whose promoters were CO+, Hub-Culture Food and Sport and the Association Parkour Wave.

"To achieve this objective, some actions for the reclamation of public spaces have been given an overall perspective: involvement of inhabitants through the social and community theater, creation of public art works, enlarging of the urban garden, a weekly organic farmer's market. The project aims at improving the quality of life of local inhabitants, by combining several fields such as public art, community theater, sport, urban agriculture to make the square a social and cultural hub for the community" extract from the website https://culturability.org, 2016.

There are ten partner organisations of the LAB+ project. The institutional partners are the Municipality of Padua, Banca Popolare Etica and the IUAV University of Venice.

The work carried out within this co-working project led to a regeneration project of the square which can't be defined as ordinary because it focused on some potential actions: 1) a project on urban gardens 2) a community theater 3) the reuse of nearly 10,000 vacant square meters which face Gasparotto square.

This project has the following critical aspects: 1) difficulties encountered by the Municipality of Padua in using 4,000 vacant square meters owned by the Municipality for social and health services both on the ground floor and on the floors above ground 2) the problem of petty crime which is difficult to deal with because of situations of degradation in the nearby and in the Railway Station quarter 3) difficulties in involving the local population comprising aged people and commuters 4) difficulties in developing sport and recreational activities, especially street sports and parkour.

We can mention the following positive aspects: 1) the establishment of a cultural club called Nadir which promotes several initiatives 2) a co-working space on the ground floor of Gasparotto square which attracts the interest of several young professionals 3) the success of urban gardens which led to the creation of an urban garden with a surface of 380 square meters. The urban regeneration process supported by the LAB+ project has also been promoted by the Municipal Administration which has recently taken office.

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Evaluation of Built Greenway Network in Beijing Based on Big Data Analysis

(Evaluation of Built Greenway Network in Beijing Based on Big Data Analysis)

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1. Abstract

As a multifunctional public space network deep into city, urban greenway network plays an essential role in the urban renewal process with the improvement of living environment and slow mode transportation, which can promote green lifestyle and reduce carbon emissions as an adaptive strategy responding to climate change in high-speed urbanization process. The purpose of the research is to evaluate the built greenways in Beijing based on the spatial analysis of the big data acquired from people's daily life to make a suggestion for promotion strategies.

Compared to traditional methods like questionnaire and interview, big data analysis can provide more objective information especially in large scale and complicated areas. 8 typical built greenways in different regions of Beijing was chosen to be studied in our research. The method used in our research is based on two types of big-data: location data from bike-sharing mobile applications like OFO Bike, and the point of interest data from Micro-blog. Firstly, spatial statistics tools is used to analysis the kernel density estimation of bike use in Beijing. The relativity between the spatial location of the greenway and the clustering feature of people's travel trajectory was gained from the research to evaluate the utilization rate of the greenway. Secondly, a method called NLPIR was used to extract the information related to the emotion and evaluation from the text data in blogs. Thirdly, the comprehensive ratings of different sections was gained through overlay analysis, from which the low scored sections can be visible in maps. Finally, a site investigation was used to revise the results and find out the reasons from 5 aspects including trace choice, resources connectivity, integrity, facility and social promotion. Strategies for improving the built greenways and suggestions for future urban green network construction were provided.

2. Introduction

2.1 Background

Urban greenway, as a multifunctional public space network deep into city, plays an essential role in the urban renewal process with the improvement of living environment and slow mode transportation, which can promote green lifestyle and reduce carbon emissions as an adaptive strategy responding to climate change in high-speed urbanization process. In recent years, mega cities in China have gradually built an urban greenway network, hoping to improve the urban ecological effectiveness. However, the complex land use and diverse public demands often make the use of greenways different from the planners' expectations and the already built network are not adapted to the changing and complicated environment. Because the greenway users are dispersed and the surrounding land use environment is complex and varied, traditional research methods are difficult to carry out. While the research and analysis of network big data can acquire, identify and analyze huge data volume, obtaining more accurate and objective results through deep mining and machine learning to make up for the shortage of traditional research methods.

2.2 Data Sources

The big data used mainly includes the spatial location of shared bicycles and the big data of Micro-blog texts. Since 2015, shared bicycles such as OFO and MOBIKE have become more and more popular in Beijing, and have become one of the important modes of travel for residents. Bike-sharing mobile applications are non-pile shared bicycle using platform in China. Users only need to enter the license plate number in the mobile phone app to get the password unlocking the bicycle, which can be used anytime and anywhere. The shared bicycle itself has its own real-time location information. Through the network big data crawling, researchers can obtain real-time bicycle spatial location information in a certain area. With the fast spread of non pile bike-sharing modes in China, an increasing number of citizens pay close attention to the greenway system and are calling for a healthy and safe travel environment at present.

Weibo is a Chinese microblog platform for sharing, disseminating and acquiring information based on user relationship. Users can set up a personal community through various clients such as WEB and WAP, update information with 140 words (including punctuation marks), and realize real-time sharing. Weibo has a large number of users in China, so its text data volume is huge, which is a good representative for research about people's post-use evaluation.

2.3 Research object

The government has announced eight completed greenway projects by 2018. This paper selects eight typical built greenways in Beijing as the research objects, whose names are shown in Table 1. For the convenience of description, the eight greenways are named after U1-U4 and C1-C4. ‘U’ represents urban greenway, which is in the urban area, connecting the parks, squares, recreation space and scenic spots in the city. ‘C’ represents country greenway located in the countryside area of the city. The spatial relationship with Beijing of the eight greenways is shown in Figure 1.

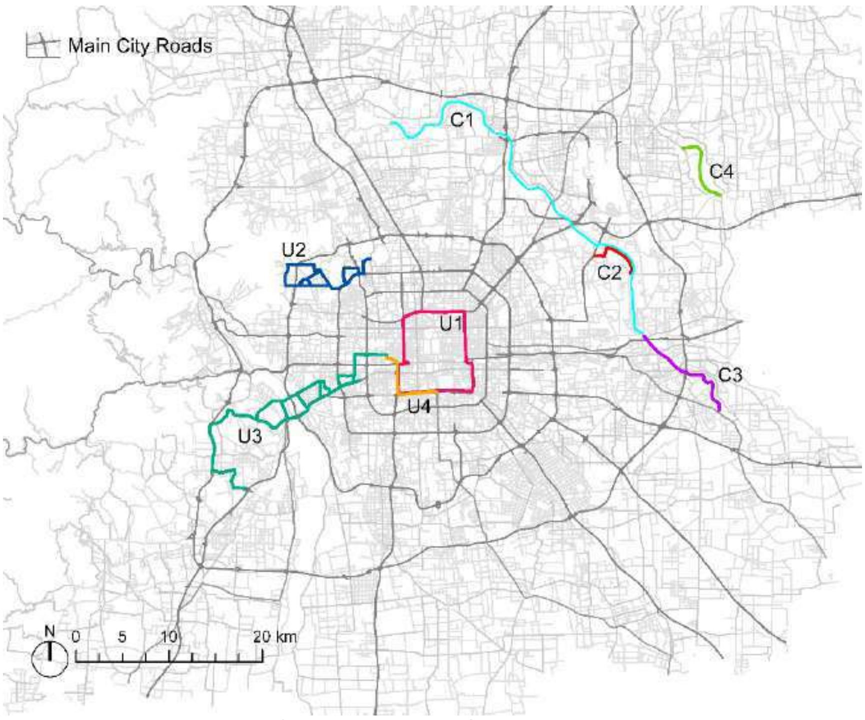

Figure 1: Site of the Built Greenways in Beijing

As of 2016, these greenways have completed the construction of the entire line. Among them, some greenways were completed in phases, and the completion dates of the whole line are shown in Table 1. The relevant research in this paper is based on the completely built greenways, and the relevant data are collected after the completion of the entire greenway.

As the responsible groups and construction plans of greenway construction in different regions are different, some greenways have different names but share overlapping line. In the selected greenway, there is partial overlap between U1 and U4, C1 and C2. Since the text analysis of this study is based on the search for greenway names, each greenway is still considered separately in order to obtain more data.

Number	Name of Greenway	Type	Built time	One-way length
U1	Greenway around the second ring city	Urban type	2014	35km
U2	The 'three hills and five gardens' region greenway	Urban type	2014	36.1km
U3	Garden expo garden greenway	Urban type	2014	64.5km
U4	Yingchengjiandu greenway	Urban type	2013	9.2km
C1	Wenyu river greenway	Country type	2015	78km
C2	East suburb forest park greenway	Country type	2013	7.7km
C3	Tongzhou north canal greenway	Country type	2016	15km
C4	Shunyi new town riverfront forest park greenway	Country type	2013	13km

Table1: Greenways in the Research

3. Methods

The research of this paper mainly includes three parts, the evaluation of greenway usage based on the spatial distribution analysis of shared bicycles, the evaluation of user emotion based on microblog text analysis and the overlay analysis and comprehensive evaluation of these two analysis results.

3.1 the evaluation of greenway usage based on the spatial distribution analysis of shared bicycles

The data used for analysis was derived from OFO shared bicycles. Data was extracted at 10:17 am on July 3, 2018, containing 630,000 shared bicycles real-time spatial location big data in Beijing (Figure 2).

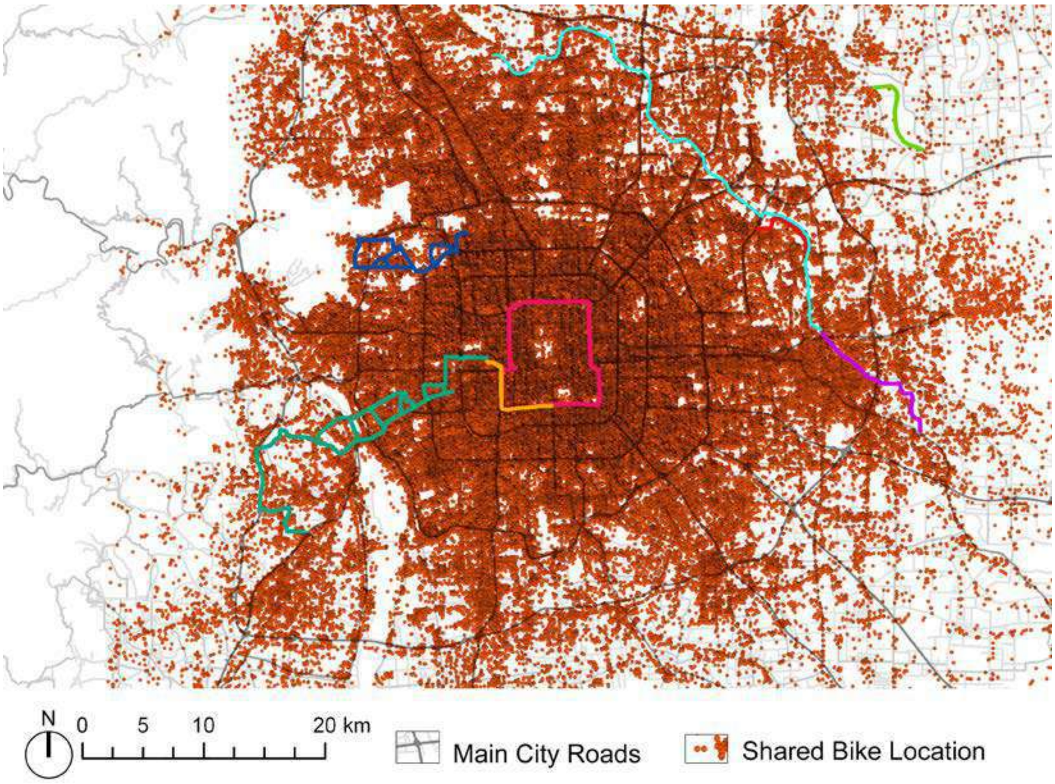

Figure 2: Shared Bicycles Real-time Spatial Location

Based on ArcGIS 10.2, the paper uses the Kernel Density Analysis (KDE) method to analyze the spatial position of shared bicycles and explore the hotspots along the greenway. Kernel density calculates the density of point features around each output raster cell. The kernel function is based on the quartic kernel function described in Silverman.

The analysis includes two dimensions: city scale and block scale. The city scale is the urban area of Beijing that contains all the greenways in order to explore the relationship between greenway's space distribution and kernel density. Figure 3 shows the kernel density of shared bicycles in Beijing. It can be seen that the density of shared bicycles is concentrated in the central urban area. There is a large difference in the kernel density between different greenways. Among them, the U1 and U4 greenways which are in the central city have the largest kernel density, which means that the potential utilization rate is higher than other greenways. The kernel density gradually reduced from city central to suburbs near U2 and U3 greenways. The usage rate of the C1~C5 greenway is relatively low. It is obvious that the level of greenway usage has an obvious relationship with its location in the city. In addition, other areas where nuclear density is concentrated review the high demand for slow-moving systems. These areas do not currently have a good greenway system and will become the important choice of greenway selection in the future.

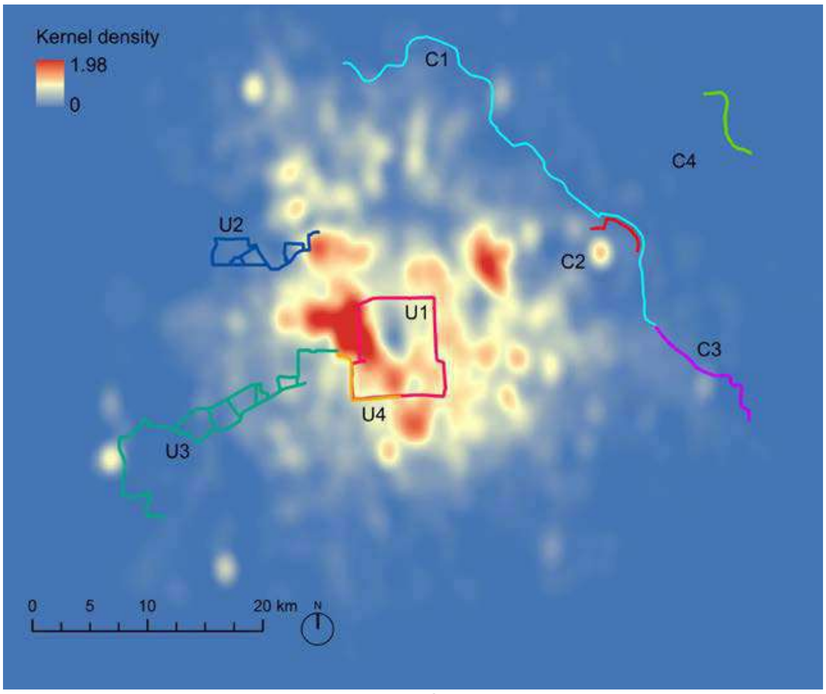

Figure 3: Kernel Density of Shared Bicycles in Beijing

At the block scale, it is mainly expected that the size of the kernel density reflects the usage rate of different sections of the greenway, thereby exploring potential and problem areas. In order to make the difference of kernel density in different sections more prominent, we firstly construct a 500 meters buffer in ArcGIS, and only calculate the kernel density inside the buffer. The kernel density distribution map of the 500m buffer of the eight greenways in Figure 4 is obtained. There are two possible reasons for the aggregation of nuclear density. One is that the use rate of the section is high, which is an important potential area of greenway construction. Another possibility is that there is a centralized parking space for the shared bicycles.

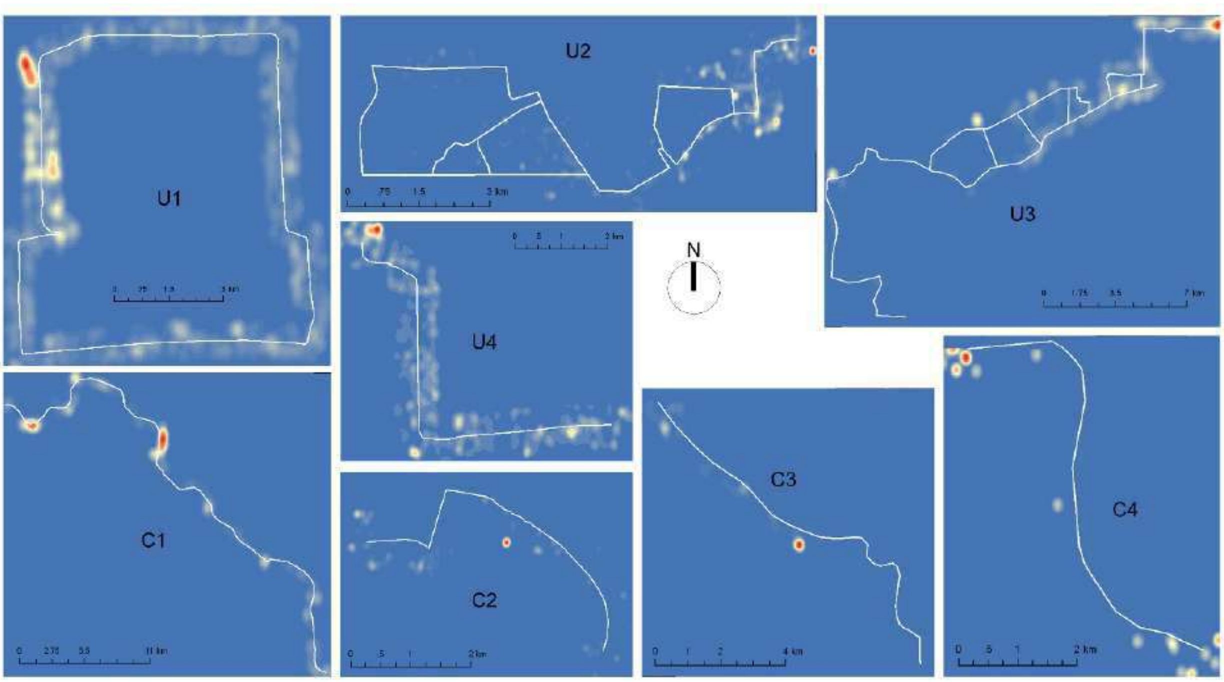

Figure 4: kernel density distribution map of the 500m buffer of the eight greenways

3.2 User's Emotional Evaluation Based on Weibo Text Analysis

The text used for analysis comes from 'Sina Weibo'. Micro-blog text with eight greenway names as related keywords was gained through big data crawling. This research has crawled 2019 related micro-blogs. In the relevant micro-blogs, some location and content are inconsistent with the research object and some are the promotion microblogs from the government and related institutions. After removing these microblogs, 310 microblogs are reserved for analysis, which includes 20,326 Chinese characters. The amount of text for each greenway is shown in Table 2. Among them, the data volumes of U3, C3, and C4 are relatively small, indicating that the surrounding residents are not highly aware of them. Due to the small amount of text, the evaluation of its objectivity is poor.

Number	Total quantity of related microblogs	Effective quantity of related microblogs	Quantity of propaganda microblogs	The quantity of valid text words
U1	551	84	415	5457
U2	434	50	325	2884
U3	184	4	60	207
U4	324	87	189	6012
C1	340	60	184	3964
C2	120	13	68	956
C3	51	8	24	686
C4	15	4	8	160

Table 2: Text Quantity of 8 Greenways

This paper adopts text emotion analysis technology based on deep neural network and word frequency statistics based on perfect double array TRIE tree.

Sentiment analysis mainly adopts two kinds of techniques: 1.The automatic identification and weight calculation of emotional words are iterate by using co-occurrence relationship and adopting the tactics of Bootstrapping and finally generate new emotional words and the weight. 2. Deep neural network for emotion discrimination: based on deep neural network, emotional words are expanded and calculated for synthesizing the final result. The whole analysis process was completed in NLPIR（Natural Language Processing & Information Retrieval） big data search and mining platform.

The results of emotional analysis are shown in Figure 5. The study divided the analysis results into positive emotions and negative emotions, positive emotions include happy and like while negative emotions include angry, sad, fear, nausea, and scare. The pie charts reflect the proportion of users' emotions in different greenways.

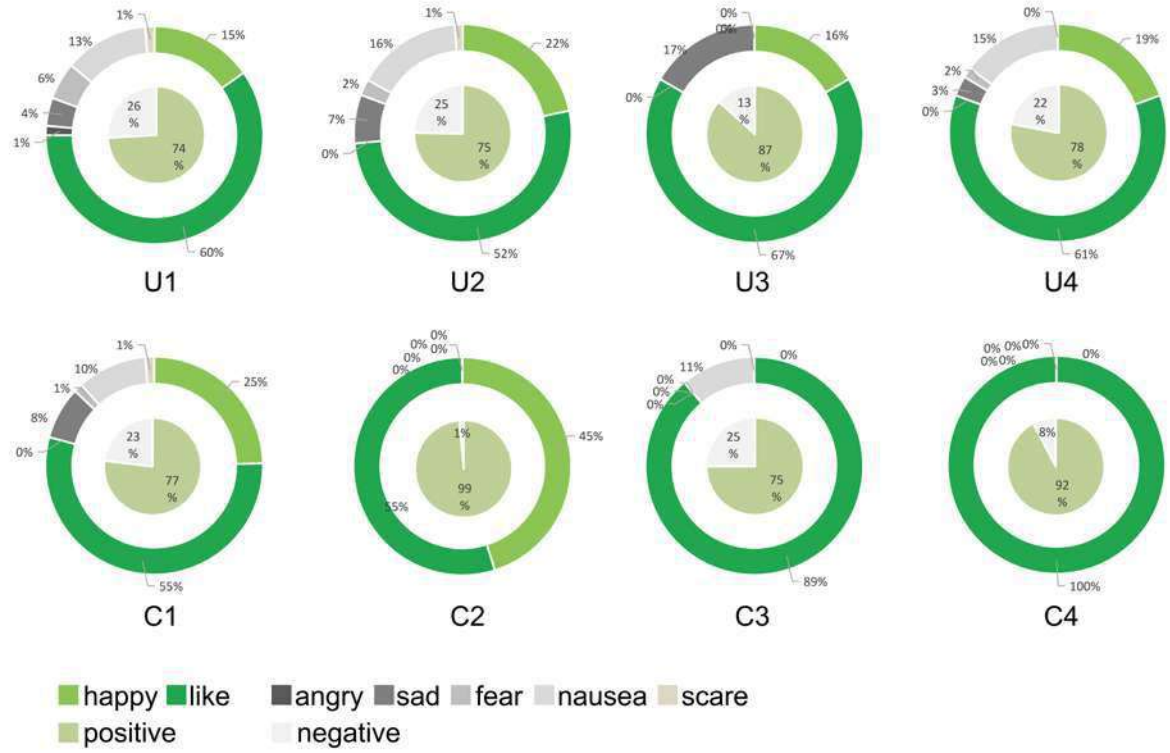

Figure 5: the Proportion of Users' Emotions in Different Greenways

The word frequency statistics based on the perfect double array TRIE tree are provided by the NLPIR platform, and its word frequency statistical algorithm is ten times more efficient than the conventional algorithm. The efficiency of the algorithm does not increase exponentially with the increase of the number of pending statistics, but generally grows sub-linearly.

This research extracts nouns, verbs and adjectives in the text, and counts the top 10 words with the highest frequency respectively. Among them, the statistical results of nouns reflect the attention paid to different nodes of the greenway, and the results can correspond to the spatial position of the greenway, as shown in Figure 6. Statistics about verbs reflect the types of activities people do on the greenway, and the top 3 types of activities are shown in the Table 3. The adjectives' statistical results evaluate the green lane mood reflects people reasons. Among them, the top 3 negative emotions in the evaluation are "crowded" , "dangerous" and "where", and top 3 positive emotions are "health", "happy" and "beautiful".

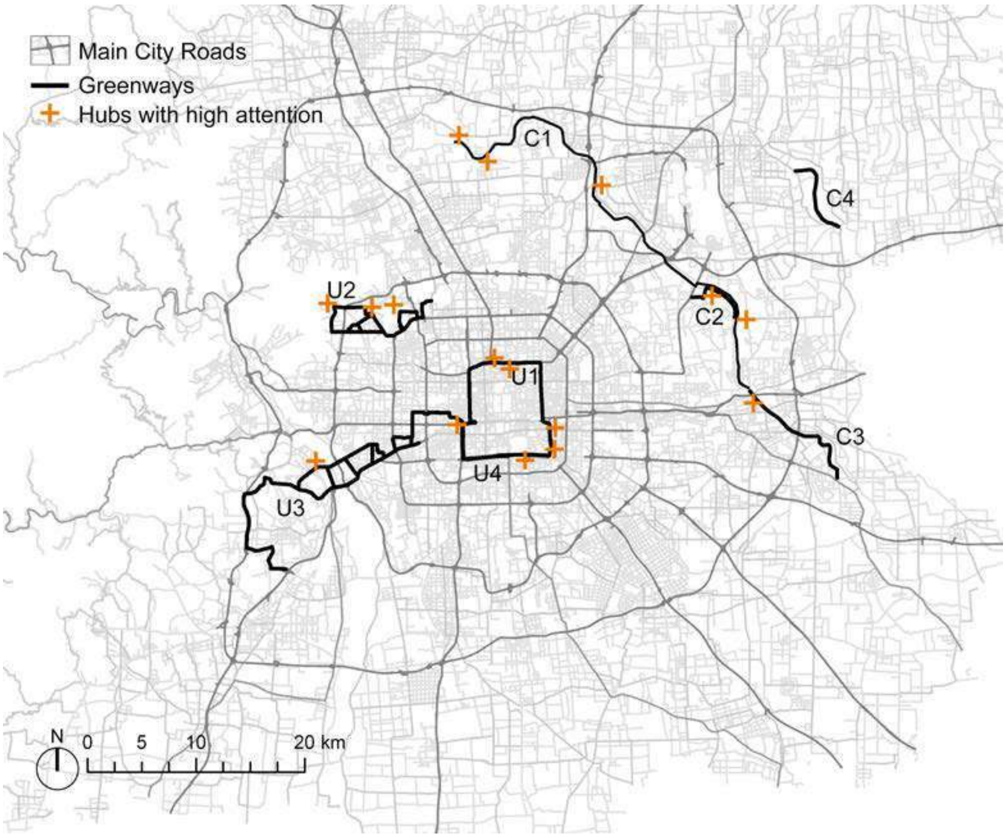

Figure 6: Hubs with High Attention

	U1	U2	U3	U4	C1	C2	C3	C4
1st	discovery	Walking	Travelling	Seeing	Bicycling	Bicycling	Accomplishment	Connecting
2nd	Passing-by	Running	Connecting	Trees shade the street.	Enjoyment	Open	relaxation	Morning exercise
3rd	relaxation	Experience	Souvenir	Exercise	Accomplishment	Accomplishment	Bicycling	Sharing

Table 3: Top 3 Types of Activities in Different Greenways

Through field research, we verify the usage of each greenway, which basically conforms to the results of text analysis. However, the C2, C4 and U3 greenway have many problems in infrastructure, continuity and identification system, which is quite different from the results of text analysis possibly due to the small amount of text.

3.3 Overlay analysis and comprehensive evaluation

This part is mainly to supplement and verify the two research methods. We overlay the kernel density distribution map of the 500m buffer of the eight greenways (Figure 4) with the greenway focus heat map of the text analysis section (Figure 6). The results are shown in Figure 7, which reflects the potential areas of these built greenways.

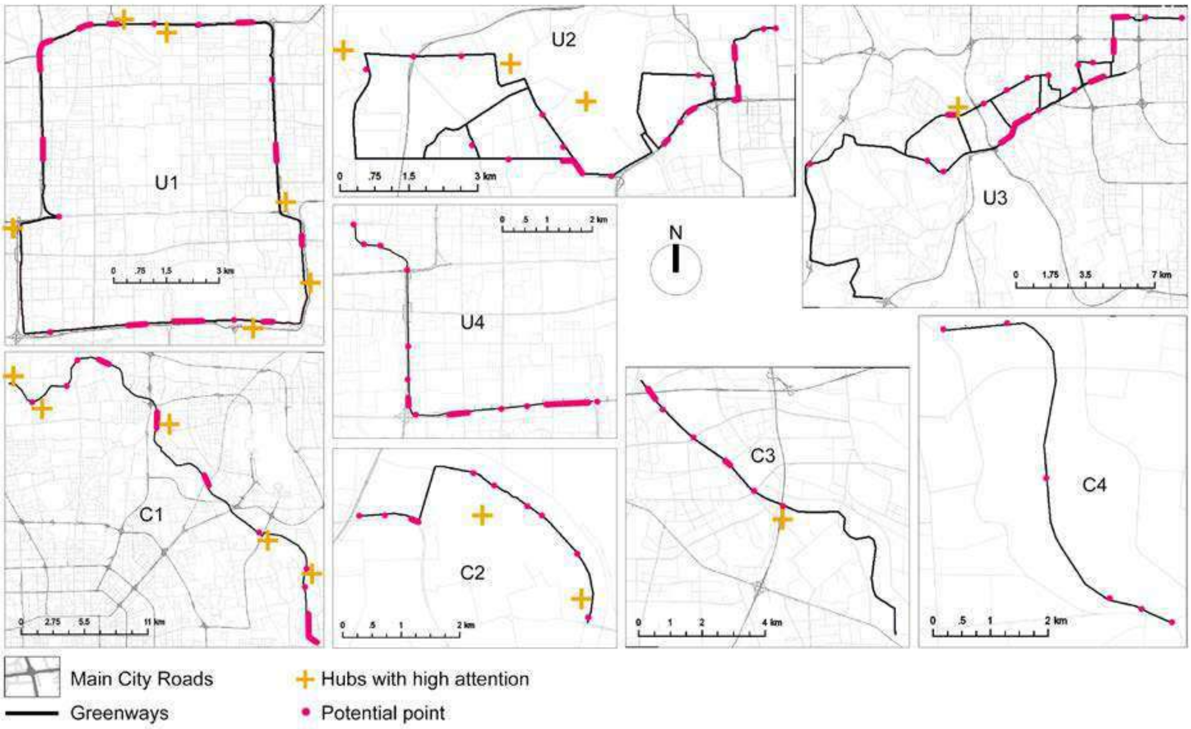

Figure 7: Potential Areas of the 8 Greenways

4. Conclusion

4.1 trace choice

According to the analysis of Beijing city shared bicycle kernel density (Figure 3), it can be seen that there are many areas in the city with large bicycle utilization rate, but there is still no greenway system. These areas are potential areas for future urban greenway system selection. By improving the riding environment through targeted green roads, it can provide people with a better slow-moving experience.

4.2 resources connectivity

The potential areas obtained by the superposition study (Figure 7) present important surrounding areas which have better landscape resources or a l arge number of people. However, in the actual survey, the design and planning of most of the potential areas are built like other areas, and the surrounding resources are also separated. It is recommended to improve the design quality of these potential sections in the future greenway construction, especially to connect the surrounding resource nodes, such as increasing the greenway branch line, better combining the resources with the greenway.

4.3 integrity

Through analysis and research and demonstration, we found that an important issue in Beijing's built greenways is the integrity of the greenway. Although the government has planned a continuous greenway system, in the actual construction process, many greenways will be affected by urban roads. There are many problems that greenways are cut off by urban roads or lack of land, only to occupy roadways or crosswalks. "crowded" , "dangerous" and "where" in emotional analysis often reflect such problems. It is suggested that in the future greenway construction and transformation process, these problem areas will be treated in a targeted manner by gradually adjusting land allocation and constructing a three-dimensional transportation system.

4.4 facility
According to the results of sentiment analysis, the problem of greenway facilities is concentrated on the recognition of greenways. It is suggested that through the improvement of paving and marking system, the recognizability of greenways can be increased, and people who are riding can better find greenways locations and directions for their travel.

4.5 social promotion
We found that although some green roads have the same construction time, the related terms have great differences in the microblog platform (such as U2 and U3). The statistical results show that there are also large differences in the number of publicity microblogs between the two. It can be s peculated that the government's online publicity also has a certain role in promoting people's use of greenways. It is recommended that the government and relevant agencies increase relevant social propaganda, and actively build and open up network platforms such as Weibo to provide a better foundation for future feedback research.

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Integration of Green Infrastructure into Transportation Planning in African cities

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1. Abstract

Green infrastructure concept emerged as a solid tool in all areas of specialization in town planning development projects. Transportation planning is an important sector that has significant influence on effectiveness or functionality of all sectors of the environment. The concern lies on how countries can make development in this sector more sustainable and efficient. However, there exist a gap in literature for an integrated framework to aid engineering organization, the planners and the government in planning the start-up of new transport efficient projects in the context of greening and sustainability in African cities. This study attempts to identify existing framework that have been proposed by major cities in Africa that ensure green transportation projects and review frameworks used by developed countries. This review identifies several approaches that have been employed by developed nations and recommends a ready-to-use framework of sequenced tasks that will aid proper integration of green infrastructure in transportation development. This research also reviews GI. literature with a focus on transportation development and including methods and techniques adopted in these reviewed approaches in African cities.

Key words: Green Infrastructure, Transportation planning, Sustainability, Environment

2. Introduction

Most environmental professionals have started incorporating different ecological integrated concepts that supports design of liveable and sustainable environment. However, in the area of transportation planning, planners and policy makers seem to be lagging behind in providing such an ecological integrated concept (Beatly, 2010). Contemporary studies focuses on a unified approach to design of sustainable system that integrates all scales including the transportation sector ranging from molecular to global (Van Der Ryn and Cowen, 2007). Green infrastructure has been proposed by most professions as an approach to designing sustainable city systems in transportation planning in developed nations. Although, the principles and concepts underpinning are not and can be traced through the beginning of environmentalism, landscape architecture and planning in the 19th century Europe (Pankhurst, 2010). Then it was termed concepts as sustainable environment, liveable cities, smart growth, compact cities etc. However, the G.I concept is being paired with other mitigative tools that will aid in achieving a sustainable environment. Due to the cost implications associated with the provision of the infrastructure required for the implementation of sustainable (mitigative) tools, developing nations has been encouraged to first employ adaptive measures as G.I infrastructure (UNCCC, 2015). As this is an efficient way to solidify the resilience of cities to the effects of climate change and encouraging sustainable development.

In African cities most of the effects of climate change are as a result of mans uncontrolled and indiscriminate activities and this can be managed. The disparity between land use and mobility has been an issue in the implementation of a sustainable transportation infrastructure. The transportation sector contributes immensely to greenhouse gas emissions in the world and in major African countries like South Africa, transportation has grossly its own share in the total emission from 32% from 36 016 Gg CO2 eq in 2000 to 47 607 Gg CO2 eq in 2010 (Peters, 2017). As a result they have set targets in line with the Paris agreement at COP 21 to reduce the emissions by 34% in GHGs by 2020 and a 42% reduction by 2025 (Peters, 2017) with the formulation of the Green Transport Strategy. In Nigeria, steps are still underway but there is still a gap in a policy framework that supports green infrastructure in transportation planning. The draft transportation policy strategy has little or no framework that support integrating green planning. Generally, in transportation planning, this concept is relatively new as underlying factors supporting its implementation has a great deal of gray infrastructure. This is one of the reasons why most cities are still have not developed an integrative policy framework that supports green infrastructure approach

However, green infrastructure have been defined using the adaptive management approach and this has been designed primarily to support managers in dealing with highly connected systems like transportation (Wietske and Jeffrey, 2005). This approach is instrumental to developing economies as there are no massive funds required in its implementation. Therefore developing a new standard of measuring, or technique and analytical framework that will make integration easier for cities (Jeffrey & Geary, 2004) in the transportation sector with both developed and developing economies is very much required. This is due to disregard of the 'green' and concentrating on energy efficiency in public transportation infrastructure paying little attention to improving livability and urban happiness through expanding the dimensions of nature (Beatly, 2010).

The aim of this paper is to provide a comprehensive review of green infrastructure in transport planning as could be seen in African cities. It is noteworthy that a number of studies on green infrastructure over the last decade with little focus on the transportation sector. There also exists a gap on finding an integrating framework on green infrastructure to transportation development in African cities. This paper suggests steps that can be taken to address this gap. This paper builds on existing literature in developed countries. This is followed by a discussion of existing general practices approaches that could be employed in integrating the concept of green infrastructure in transportation planning. The research concludes on selecting an adaptable approach to the geography of African cities. On that note, the current challenges, on-going progress and sectors that need further research are outlined and discussed.

3. Methodology

The paper is a desk-based review of a number of articles focused on green infrastructure transportation development in African cities with emphasis on Nigeria and South Africa in order to identify salient issues in green transport infrastructure with relation to the concept and why integration into policies have proved challenging till date. This paper also reviews different conceptual framework for green infrastructure that has been designed by developed countries and that could be adapted into the Nigerian transportation sector. It further recommends a framework(s) or a guide to develop one to be adapted into cities in Africa in their transportation policies to ensure sustainability.

The review begins by defining green infrastructure and analyzing the cost and benefit of this approach to its counterpart, traditional infrastructure. It further reviews the concepts and theoretical framework supporting the green infrastructure generally and relating them to the transportation sector. The review concludes with a short summary of the lessons learnt.

4. Overview

a. Defining Green Infrastructure

The concept of green infrastructure has been defined by many authors and professionals but before attempting to define this, it is imperative to understand, an understanding of its counterpart, the traditional or gray infrastructure. Thus, gray infrastructure refers to the sub-structure system such as aqueducts, traditional road pavements, pipelines on which the development of a city depends (Mell, Roe & Davies, 2009). Whereas green infrastructure is a network of multi-functional green spaces, both new and existing, both rural and urban, which supports the natural and ecological processes and is integral to the health and quality of life of sustainable communities (TCPA, 2008) Simply put, green infrastructure can be said to be the concept of adapting traditional infrastructure respecting and paying attention to nature, ecology and its principles. The term 'green' may mean different things to different people. It can be grouped into two forms, green (nature, trees) and the engineered structural part such as bicycle parts, public transportation infrastructures using renewable energy sources, viaducts etc that are designed to be environmentally friendly (Benedict & McMahon, 2006).

Also, green infrastructure on transportation sector follows some outlines which includes low carbon infrastructure, climate resilient, transport infrastructure, public transportation systems, renewable energy, water conservation infrastructure with improved irrigation systems.

b. Cost Benefit Analysis of Green & Traditional Infrastructure

There has been reluctance by cities especially in Africa to attempt the integration of G.I into policies (Rohde and Muller, 2015). Due to the doubts on the positive implications on economic development. However, the question of the feasibility of green infrastructure as a good instrument for economic development is not debatable as it does not only save the environment, it helps achieve sustainable development and promote urban happiness. As could be seen in Gauteng city-region, South Africa and some other cities where G.I was used to address local transportation challenges in South Africa.

The European commission posited that the main feature of the Green Infrastructure Strategy is its integration into relevant policies through: ecosystem-based adaptation into climate change policies; nature-based solutions into research and innovation policies but the onus lies in providing an adaptable framework that will support such integration sustainably.

A recent study shows that the there is only an increase of between 0% and 7% construction costs per year (see table 1 below). The table further showed that in the transportation sector, the global increment cost of switching from traditional infrastructure projects to green infrastructure projects is would be between US$ 0 billion to US$ 400 billion per year between 2015 and 2020 which is insubstantial compared to the cost of rehabilitation and reconstruction projects for a city to recover after a climate change hazard. Also for Sub-Saharan Africa, North Africa and South Africa where the level of infrastructure is already low, even though measurement of such data is challenging due to lack of adequate research in that area. Also even with the inadequate data, it is seen that the additional cost of adapting infrastructure is minimal. World Bank (2010), noted that only cost between 5% and 7% more than would have otherwise have been spent, whilst maintenance costs would be 30% for traditional structures for climate resilient structures.

Table 1: Global Traditional vs. Green Infrastructure Costs 2015 - 2020

Sector	Traditional Infrastructure Cost (US$ Billion / year)	Green Infrastructure Cost (US$ Billion / year)
Power Generation	320	380
Electricity Distribution	270	260
Buildings	320	620
Industry	280	310
Water	772	772
Telecoms	646	646
Road	245	< 245
Transportation Vehicles	3,300	3,370
Rail	120	120
Airports	120	< 120
Ports	40	40
Oil & Gas Distribution	155	< 155
Total	*6,590*	*6,500 - 7000*

Source: OECD (2012)

Generally, it is important to rethink the way infrastructure provision and development are envisaged in African cities through green infrastructure. This is because it has the ability to deliver such services using a flexible planning approach that could be tailored to address pecific challenges unique to African cities (Culwick and Bobbins, 2015). Moreover, it can be said to require less capital budget and provide additional benefits compared with the use of sole traditional engineered infrastructure. In other words, the concept can aid in the enhancement of services delivery and minimizing disaster risks and protecting the environment. Due to the effects of climate change on the environment, African cities are in need of a more resilient approach to adapt to these effects. Also, with the contribution of the transportation sector, the encouragement of integrating green infrastructure is very important.

c. The State of Urban Sustainable Transport in African cities

Urban population has been rapidly growing and with the galloping urbanization therein, the growing demand for urban transport services, facilities has also been simultaneous. The existing transport facilities are inadequate to support the current population, let alone the future (Pirie, 2013). Previous study shows that the population of Abuja (Nigeria), Accra (Ghana), Kampala (Uganda), Johannesburg (South Africa), Dar es Salam (Tanzania), Kumasi, Nairobi (Kenya), etc., are predicted to double more between 2000 and 2025 and to triple by 2050 (InHabitat, 2010).

The inadequacy in transportation services and infrastructure has a major contribution on the slow growth of the economy as congestion slows down efficiency and economic growth (Piere, 2013). In Dakar, for instance, it is estimated that 1 million working hours are lost per day due to congestion (Kunieda and Ganthier, 2007). And with the population growth and the effects of climate change, major Africa cities will have their economies suffering more economic issues in the nearest future. The existing transport infrastructure is insufficient and inefficient as the low capacity in government hinders efficiency in service delivery, increasing the growth of private transport. Moreover the existing infrastructure are seen to be more socially exclusive, environmentally unfriendly and economic promoting (United cities and local governments, 2009). Generally, urban mobility is seen to be very low as it varies from 1.7 trips per person per day in Morogoro (Tanzania) to 1.9 in Dar es Salam, 2.2 in Kinshasa and Nairobi (Pirie, 2013). In this regard, due to the effects of low mobility on the economy, the normal response to this is to construct more road space, buy more vehicles. This is the frequent encouragement of the traditional infrastructure without much focus on the effects on the environment. This frequent response of government to the transport needs of people addresses the symptoms, abandoning the root causes of these issues. Over the years, focus has been always pointed at promoting traditional infrastructure through motorized mobility. However, gradually, a wake has been seen in most African cities as there is seen to be a shift to affordable, socially equitable accessibility using appropriate technology in line with the principle of sustainable development (Pirie, 2013).

Although this shift is gradual and limited to few cities, a challenge presents itself in filing the gap of providing a formidable framework that will aid the integration of this green infrastructure concept into transportation planning policies as an adaptive tool to the effects of climate change.

d. Green Infrastructure

Green Infrastructure emerged after various attempts to incorporate climate change issues into international political agenda in the 2000s brought energy (Irek and Thomas, 2008) and resource efficiency to the center of the discussion on sustainable development and city sustainability. With the population growth, urbanization and uncontrolled expansion of cities into urban sprawl, discussions have been ongoing in international communities in the search or new concepts and methods to define and measure city sustainability. The above mentioned further led to the development of the concept green infrastructure. From the 1990's other concepts such as sustainable city, green urbanism, liveable city and compact city among others were propounded. While most of them are still current, and are very much in the center of most debate, this term with regards to transport infrastructure due to its major contribution to climate change. Hence, it also borders on energy use and resource efficiency prompted this focus on 'green'. This is because it has a bearing on sustainability and eco-friendliness. In South Africa a framework for assessing and valuating green infrastructure was designed by Groot et al, (2012) to support the different strategies designed and also ensure successful integration of this concept into different sectors especially the transportation sector. This could also serve as bedrock for most cities in developing their own indigenous frameworks (figure 1).

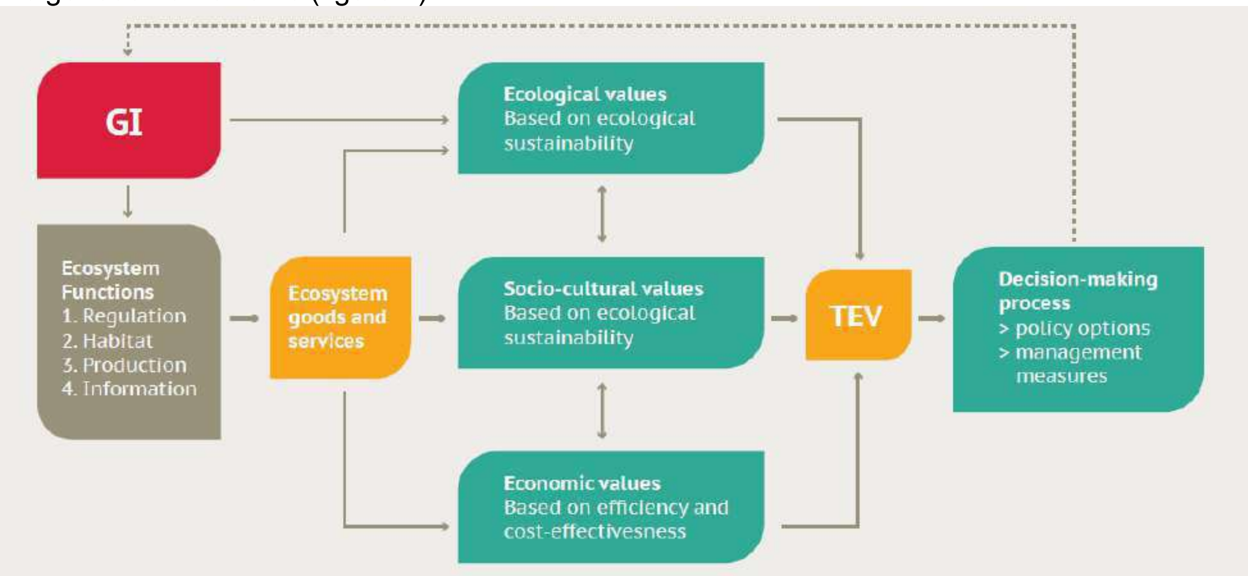

Figure 1: Framework for assessment and valuation of green infrastructure
Source: Based on De Groot et al. (2002:394).

5. Concepts and Approaches

a. Specific Frameworks

Major groups like professional associations and world leaders have realized that the current infrastructures and urban planning paradigms have been an hindrance to achieving sustainable urban development and living (Novotny et al, 2010). Even though the role of green infrastructure is well documented, it is difficult to integrate spatial planning approaches and green infrastructure planning in urban contexts let alone transportation planning. This is because land use decision making takes place within a broad framework driven by the demand for housing and other services. In South Africa for instance, as well as many African cities, green land uses generally are always competing against other urban land uses (Cilliers et al, 2011) and a proper understanding of the purpose of 'green' to our environment, has not been very relevant during planning decisions. Most sustainable projects and related researches deal with environmental processes at a regional scale which finds it difficult to be translated in a practical way to the local government level that has the task of implementing such projects (Cilliers and Cilliers, 2016). Globally green infrastructure in transportation development has limited conceptual framework which has made it challenging for its adaptation by most countries even in Africa. However, in the developed societies, many green concepts and approaches have been developed generally and will be further stated below

b. American Society of Landscape Architects (ASLA) Sustainable Sites Initiative Benchmarks and Performance Guidelines

This initiative is an interdisciplinary efforts established by landscape architects in the Lady Bird Johnson Wildflower Center at The University of Texas at Austin and the United States Botanic Garden to create voluntary national guidelines and performance benchmarks for sustainable land design, construction and maintenance practices (Cilliers and Cilliers, 2016). This Sustainable Sites Initiative was funded by the Meadows Foundation and Landscape Structures (ASLA, 2009). The framework is presented in nine topics as represented in Figure 2. This is to show the plan outline starting from the selecting of site to the monitoring and innovation. The framework showed a detailed presentation of how the sustainable land design is integrated.

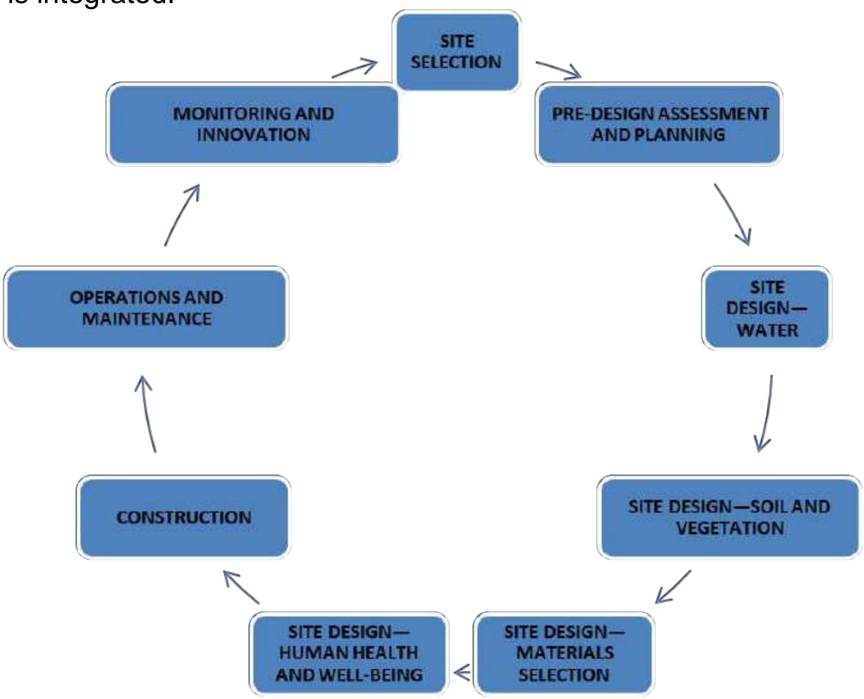

Figure 2: Sustainable Sites Initiative Framework
Source: ASLA, 2009 Benchmark and Performance Guidelines

This framework focused on achieving sustainable land design and landscaping functions which was limited to transportation development.

c. BREEAM

''BREEAM (building research establishment environmental assessment method) is a building certification system established in 1990. It is a method of environmental auditing, providing a set of standards for best practice in sustainable development for the design, construction, operation and environmental performance of buildings'' (Cilliers and Cilliers, 2016); The main criteria for calibration include measures affecting energy, water use, indoor environment, pollution, transport, materials, waste, ecology, and management processes (BREEAM,2012). In transportation, its aim was to ensure transport and movement strategies reduce the impact of the development upon the existing transport infrastructure and improve environmental and social sustainability through transport (BREEAM, 2012). In this framework, there was a breakdown of the assessment requirements and detailed activities but with limited considerations of how the local community and relevant stakeholders can take part in the different stages.

d. The LEED Concept

LEED is an internationally recognized green building certification system that provides third-party verification that a building or district was designed and built using strategies aimed at improving performance across all metrics (LEED 2012). It is preferred by urban development professionals in developed countries (Novotny et al, 2010). These metrics include energy savings, water efficiency, CO2 emissions reduction, improved indoor environmental quality, and stewardship of resources and sensitivity to their effects (USGBC). There are six categories of certification: (1) new construction; (2) commercial interiors; (3) core and shell; (4) existing buildings; (5) homes; and (6) neighborhood developments. In the US, the USGBC manages the certification program while the Canada Green Building Council (CaGBC) manages the program in Canada even though both organizations are independent (Beauchamp and Adamowski, 2013).

As LEED is mostly dedicated to buildings, the USGBC has developed the LEED for neighborhood development (LEED ND) rating system to guide and assess sustainable community development (Beauchamp and Adamowski, 2013). The 2009 LEED ND, for example, is a set of performance standards for certifying the planning and development of new neighborhoods. The intent is to promote healthful, durable, affordable, and environmentally sound practices in building design and construction. Prerequisites and credits in the rating system address five topics: smart location and linkage, neighborhood pattern and design, GI and buildings, innovation and design process, and regional priority credit. The system was created as a partnership between the USGBC, the Natural Resources Defense Council, and the Congress for the New Urbanism (CNU) and registration opened in April 2010 (Beauchamp and Adamowski, 2013).

The CNU is the leading organization promoting workable, mixed-use neighborhood development, sustainable communities, and healthier living conditions and is one of the major leaders of LEED. The CaGBC has developed the Canadian Alternative Compliance Paths (ACP) for the LEED ND 2009 rating system (Beauchamp and Adamowski, 2013).. The ACP are formally approved approaches that provide clarity and guidance for Canadian projects, addressing sections of the rating system that contain US-specific standards or wording (CaGBC, 2012). The approach herein was designed using a rating system where projects are accredited. Following the registration of such project, the design team begins to collect information and perform calculations to satisfy prerequisite and credit documentation requirements. The basic steps outlined in this approach includes site analysis and programming, preliminary planning and final design. However, transportation networks were fully incorporated during the preliminary planning and its interaction with land use before the final design. This approach is much more used in the United States of America (Sarte, 2010). However, the lop sides to this approach is that it focuses mainly on new development and cannot be adapted to brownfield development and initiating a project form these criteria remains very tedious. Despite all these, it could serve as a benchmark for similar societies to develop their own strategies and frameworks therein

e. US Environmental Protection Agency Green Approach; Municipal Handbook

The EPA has developed a *Municipal Handbook* (USEPA, 2012), a series of documents aimed at helping local officials implement GI in their communities. The documents cover specific terms to help municipalities introduce GI in the design of storm management facilities. (Beauchamp and Adamowski, 2013). One chapter identifies and discusses the most common funding options available to communities for funding green storm water infrastructure, storm water fees, and loan programs. Another chapter covers street design and various other topics are also discussed. Additionally, the EPA has developed the *Water Quality Scorecard* (USEPA, 2009). This approach does not address the local communities' integral participatory roles in green infrastructure development and has little focus on transportation sector.

f. The British Columbia Approach

In BC, the Rainwater Management and Green Infrastructure seminar was initiated by an inter-governmental partnership (IGP) on 11 June 2007. The Water Sustainability Action Plan for British Columbia provides a partnership umbrella for an array of on-the ground initiatives that promote a "water-centric" approach to community planning and development (Beauchamp and Adamowski, 2013). One of the tools developed under this umbrella is the water balance model for BC. Developed by an IGP (BC and Fisheries and Ocean Canada) as an extension of *Storm Water Planning: A Guidebook for British Columbia,* the water balance model enables users to visualize ways to implement GI solutions to achieve rainwater runoff source control at the site level. The Water Sustainability Action Plan for British Columbia is sponsored by the province of BC, and its elements are delivered through partnerships. Under the Action Plan umbrella, the Water Sustainability Committee of the BC Water and Waste Association is the managing partnership and is responsible for providing leadership, facilitation, and organizational services for program delivery (Beauchamp and Adamowski, 2013). Basic information is provided in a guidebook, refocusing the approach to sustainable ecosystem management. The use of the term "storm water" suggests there is a problem, whereas "rainwater" is seen as a resource (BCWWA, 2005). The past two decades has seen an evolution to an integrated approach.

The approach introduced the concept of performance targets to facilitate implementation of the integrated strategy for managing the complete rainfall spectrum (BCWWA, 2005). Rainfall capture means include measures such as rain gardens and infiltration soak ways, runoff controls (which delays overflow runoff by means of detention storage ponds), and flood mitigation (which reduces flooding by providing sufficient hydraulic capacity to "contain and convey") (BCWWA, 2005). Defining rainfall tiers simply enables a systematic approach to data processing and identification of rainfall patterns, distributions, and frequency. The integrated approach proposed (BCME, 2013) is presented in seven steps:
(1) Secure political interest and support;
(2) frame the watershed problems and opportunities through a land use working session, drainage working session, ecology working session, and interdisciplinary roundtable session;
(3) develop objectives and alternative scenarios through flood management scenario modeling and source control scenario modeling;
(4) collect meaningful data and refine scenarios according to concurrent rainfall and stream flow data, data on soils and groundwater, water quality data, and data on fish and their habitats;
(5) evaluate alternatives and develop component plans;
(6) develop an implementation program;

(7) refine through adaptive management.
BC's approach is one of the frameworks used for analysis and some of its proposals will serve as a platform or guide to developing a more efficient framework for green infrastructure.

g. Sustainable Infrastructure and Water Centric Sustainable Communities Approach

Contemporary studies have specifically examined the engineering of GI: in 2010, S. B. Sarté who conducted a research on 'Sustainable Infrastructure and Water Centric Sustainable Communities which was published by Novotny et al. (2010). Also Ahern (2010), who developed a six methodology water-centric approach to green planning. Sarté offers several forms of guidance for project planning, creating a unique approach for each project by combining different philosophy or development frameworks. Sarté identified 13 frameworks, the most popular being LEED and BREEAM which has been briefly discussed above. However four approaches were identified to analyze sustainable infrastructure and four existing frameworks to organize green projects were suggested as stated by (Beauchamp and Adamowski, 2013):

1. Framework 1: pillars of sustainability. This approach presents an analysis based on five elements: water, energy, materials, ecology and community. Analysis of the project is formatted in these terms and it is proposed to proceed with a development evolution of the design following five levels of progression.
2. Framework 2: the scale density framework. The approach is defined in four words: water, wastewater, energy, solid waste. The needs analysis is defined according to four levels: the city, the district, the block and the building. The organization becomes a pyramidal structure and presents an overall picture of the final proposal.
3. Framework 3: the transect. This approach defines territory into seven areas: T1 (natural), T2 (rural), T3 (suburban), T4 (general urban), T5 (urban center), T6 (urban core), and SD (special district). This approach is a form of territorial organization to establish a balance between each of the zones and to identify needs. The overall plan is determined based on a progression from one area to another by introducing measures of sustainable development.
4. Framework 4: the built form-ecology framework. This approach interconnects human actions with natural ecological systems. The method uses drivers to guide development. On the horizontal axis are biodiversity, water, air, land and energy. The vertical axis is divided into habitation/settlement, industry/resource extraction and recreation. The principle consists of establishing an equilibrium balancing all these elements according to the criteria in the appropriate box. All these approaches or developmental frameworks are elements of reflection appropriate to define a development project and to define a sustainable strategy.

However, none of these outlined frameworks define a formula to initiate a project and carry through to final detailed engineering.

Also, Ahern examined best practices for planning the urban environment in a sustainable manner. The proposal was on a water-centric approach to sustainable planning (Ahern, 2010). Ahern proposed this using a six step methodology: 1) ecosystem services (goals and assessments); 2) resilience factors; 3) resilience planning strategies; 4) developing scenarios; 5) urban resilience-sustainability planning; and 6) planning implementation–adaptation. (Beauchamp and Adamowski, 2013). However, this approach did not give a detailed description of how to achieve this, to the local institution level. It focused more on integrating the work of many professionals.

This study showed the various approaches and frameworks that have been developed for green planning and sustainable development but no framework has been developed with the

Green infrastructure in transportation development were more detailed in cities strategies which will be illustrated below

h. The Green Transport Strategy (GTS)

Due to the greenhouse gas emissions produced by the transport sector in South Africa and climate change issues, the department of transport in South Africa developed a strategy on how to reduce these emissions. This will contribute significantly to the national effort to reduce emissions as agreed to by the South African government at COP21 in Paris through the Nationally Determined Contribution (NDC). This will in turn reduce the environmental and human health impacts associated with the transport sector and result in a more resilient sector (Staatskoerant, 2017).

Following the Research undertaken by GIZ, SANEDI and a host of other research organizations on behalf of the South African government some conclusions that led to the establishment of the strategy arose. This focused on reducing the need to travel and avoiding unnecessary trips through walk able communities, integrated land use planning or transit oriented development and improving vehicle occupancy rates. Given that the road transport sub-sector is responsible for 86% of direct emissions from transport, shifting of passengers to public transport and freight to rail is a necessity (Staatskoerant, 2017). Finally, Biogas and solar powered electric mobility outstrip any other cleaner fossil fuel in terms of GHG reductions. In their strategy key measures to facilitate the modal shift from road to freight and private to public transport was identified. The strategy also stressed on the promotion of non-motorized transport and development of the associated infrastructure to support this plan

The GTS has identified and proposed key measures to facilitate the modal shift from road to freight and private to public transport. There also exists an important need to promote non-motorised transport and develop the associated infrastructure to support this. The strategy focused on 4 implementation themes and 8 strategic pillars (Table 2) and the implementation tools to support it was very comprehensive and the various stakeholder duties were outlined and addressed (Staatskoerant, 2017).

Table 2: Strategic Pillars of the Green Transport Strategy

Green Roads	1. Shift passengers from private to public transport, including rail 2. Shift freight transport from road to rail 3. Provide infrastructure to promote non-motorized transport
Green Rail	4. Extend the rail network to provide reliable, safe and affordable high-speed transport
Green transport technologies	5. Reduce the carbon footprint of fossil fuels 6. Promote alternative fuels such as compressed natural gas (CNG) or biogas, liquefied natural gas (LNG), fuel cell and liquid biofuels as transport fuels. 7. Promote electric and hybrid-electric vehicles 8. Explore the option of Fuel cell/ hydrogen technology
Green Fuel Economy Standards	9. Provide norms, standards and regulations that promote fuel

	economy in vehicles and improve emission standards of fuel in South Africa

Source: The Draft Green Transport Strategy, 2017

This strategy employs the use of measuring, reporting and verification (MRV) framework which is required to be developed by the person and team responsible for implementing each project on this strategy (Staatskoerant, 2017). This plan could be used as a platform for other African cities to adapt to their communities but focus was more on the engineered part of green infrastructure and little emphasis on the 'green' part of this concept. This neglect affects most strategies as it is assumed that it is an integral part without making it form a part of their strategy. Also at the local authority level, there was not a comprehensive breakdown regarding how they intend to be fully part of this strategy which when future frameworks are designed, that part should be addressed.

5. Conclusion

Most of the above listed frameworks were tailored specifically to satisfy the needs of designated professionals and public servants. Most of these frameworks focused on storm water control, landscaping, waste water etc. and the approaches to guide the design of these areas. But no designed framework on how to integrate green infrastructures into urban transportation planning when creating urban development. Also most of these concepts were focused on the engineered aspect of green infrastructure and little structure for the 'green' part of green infrastructure. The main thrust lies on individual countries to develop strategies and frameworks to support green infrastructure in their transportation planning design just as South Africa has done through mainstreaming as their draft green transport strategy. Nigeria is yet to develop a green transport strategy and their transport policy is yet to be reviewed as the 1993 transport policy is still in use and does not support the integration of green infrastructure. If this is neglected, transportation sector will continue to be a major contributor to greenhouse gas emissions and their contribution will keep increasing which is not good for the environment. Lagos state government has proposed an action plan for sustainable transport planning but has not been fully publicized for adaptation.
Borrowing a leaf from Cilliers, as done for planning green spaces in rural South Africa, there are areas that should be considered for a framework to border on. Hence this study recommends that to develop a framework for green infrastructure in transport development the following should be first considered,

a. Identifying the value of the green infrastructure proposed. This should be done within the local context, outlining the challenges and opportunities present in the specific areas and in Africa, the unique cultural needs of the people
b. Identify the framework to interlink both the traditional and green infrastructure in a sustainable manner. This is in order to defeat the fear that the later has come to remove the former totally from existence.
c. Identifying methods and beneficiaries of green infrastructure in those transportation sectors. This is one of the lacking issues in earlier frameworks. The beneficiaries for each transport infrastructure and mode should be identified and integrated fully in the design process.
d. Quantifying the value of green infrastructure design. This is very vital in the design process, and also in the decision making process. These issues will be quantified with regards to the indirect benefits which include the social values, environmental values, child and aged friendly transport networks and the direct benefits which include the economic values. This is to ensure that the projects are more sustainable.

Finally, this research shows that the proposal of green infrastructure in transportation design will meet the challenges of climate change and make the African environment more resilient to these effects. However, developing a framework based on these recommendations would form another topic of empirical study.

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Study on the Optimized Strategies of Resilient Spatial Pattern from the Perspective of Sponge City -Taking Garden Street Historic Block in Harbin City as an example

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Abstract
Sponge city is a type of strategies to cope with stormwater management under the rapid urbanization in China. It intends to naturally improve water quality with infiltration while drawing lessons of Low Impact Development (LID) and Green Infrastructure (GI) from European and American Countries. Old districts in China now are faced with more obvious and urgent issues including excessively large of construction intensity, much population, insufficient area for implementation and old infrastructures, which call for the targeted approaches and methods to coordinate and conserve the original historic buildings and features. This paper will select Garden Street historic block , a representative historic block in Harbin, to determine its control goal of total annual runoff adapting to its problems and status quo. The space will be hierarchically managed and controlled and buffer zone is applied to avoid the foundation of historic buildings. Meanwhile, the green LID facilities are combined with Gray Infrastructure to design the invisible LID infrastructures, which are coordinated with the features of traditional blocks. The space of old district is optimized in a resilient manner to establish spatial system of stormwater management, which contributes to the theoretical exploration for sustainable and resilient development of old districts in China.
Keyword
Sponge city; old districts; hierarchy management and control; Garden Street Historic Block; Harbin

1. Introduction

As urbanization speeds up in China, social economy booms rapidly with significant achievement of city construction. Although city numbers increases and city scales expand and development, the extremely strong development density also leads to the excessive hardening of the original natural underlying surface and alters the original city natural ecology background and hydrological characteristics and other issues (Zhang, 2015). City is challenged with frequent water logging, runoff pollution, heavy loss of rainwater resources, deterioration of ecological environment, loss of water culture and other issues. The traditional drainage model of city rainwater is hardly to follow and to cope with the more severe stormwater problems, China has drawn lessons from foreign counties worldwide and, in sight of our national conditions, further propose the rainwater solutions and strategies: sponge city. The core of sponge city is to realize the comprehensive objectives of pollution control, disaster prevention, utilization of rainwater resource and city ecological remediation. The coordination and control are applied during the entire process by multidisciplinary from mechanism construction, planning regulation and control, design and practice to construction operation and management. It aims to conserve and utilize city Greenland, waters and other spaces as well as prioritize to combine green infrastructure with Gray Infrastructure to jointly establish the resilient rainwater infrastructures and realize five aspects of rainfall runoff: infiltration, blocking, reservoir, purification, utilization and drainage.

The construction of sponge cities is in full swing in China. Its construction and research mostly focus on outskirts areas and new cities with less serious issues, not even mentioning the old districts with frequent water logging. As old districts afford much of the city population and more important functions, their stormwater problems are more server. The sponge city is therefore imperative in old districts. In sight of the excessive hardening of the original natural underlying surface, insufficient space for implementation of sponge city and more strict of features' management and control, this paper will attempt to put forward the targeted and resilient controlled indices and implementation strategies in space with the aim to improve the stormwater issues in old districts. At the same time, the author also has discussed the coordination between the construction of sponge city and the historic features of old districts as well as the heritage and continuation methods of local culture in China.

2. Difficulties for implementation and construction of Sponge City in old districts

2.1 Large construction density and insufficient implementation space

One of the main difficulties for implementation and construction of Sponge City in old districts in China lies in the insufficient space of implementation, resulting from high construction intensity, crowded environment and excessively hardening of underlying surface. Old districts are always located at the core area of the city and the area with the largest construction intensity. Therefore the commercial atmosphere from the excellent geographical location and history accelerates the population agglomeration and the growth of construction intensity, which thus hardens the underlying surface with infiltration and permeability.

As indicated from the research, the hardening ratio of underlying surface in old districts nationally could peak at 65% and the public green land area per capita is less than 5 m^2 and the common green rate usually is between 7%-12% (Li, et al., 2017). Compared with the regulated green land ratio for newly constructed communities, 30%, the area of green land is seriously in sufficient with unevenly distribution, leaving less public space for the construction of Sponge City. And all these are contrary to the connotation of Sponge City to reconstruct the stormwater facilities through the extensively and largely demolish the harden pavement or rigidly occupy the limited space resource. Ultimately, the spatial layout and features are destroyed in old districts, challenging the construction of Sponge City in old districts.

2.2 Old and obsolete drainage system and low bearing capacity of pipes' network

Urban drainage system of Harbin, initiated in 1904, witnessed the preliminary construction during tsarist Russia, Japan and pseudo-ruling periods, sped up in the later period of the founding of the People's Republic of China and was generally improved nationally after the reform and opening up. It has been over a century of history from the establishment of drainage system. Old districts are mostly dominated by the drainage of confluence of rainwater and sewage. However, the drainage facilities for these old districts are already overwhelmed with seriously insufficient drainage capacity of flooding due to their long construction periods and increasing construction and population density.

The initial drainage system, in old districts, basically set the runoff coefficient, ϕ, at 0.5, comparing with the actual runoff coefficient, 0.7. Part of the construction standard of pipes' network set the recurrence period at 0.5 years (Xue et al., 2011). The drainage efficient is much far from the national standards. The area with drainage system is 216.05 km^2, accounting up 66.36% of the planned area. According to national standard, the coverage of drainage pipes' network should be over 80% for the cities , equal to the same scale of Harbin. As regulated, the density of pipes' network for the system of confluence of rainwater and sewage should be 8 km/ km2. The density for Harbin City is only 5.68 km/km2. The service coverage of network is only 69%, hardly satisfying the standard, 95%, enforced by Ministry of Housing and Urban-Rural Development. In 2016,the total length of drainage pipes was 1,242 km in old district in Harbin and among about 49.6 km was constructed in 1940s or 1950s. 5.3% was constructed in 1960s. It's 217 km in 1970s, also the peaking point. appropriate one in third length of pipes has already far exceeded the 40-year lifespan, an national standard. The over-aged service is also one reason for urban rainwater issues and also endangers the stormwater safety. If the drainage system are reconstructed to satisfy the current flood control in old districts, it will not only be time-consuming and laborious, but also badly have influence on daily lives.

2.3 Management and control of historic features and huge reconstruction difficulties

Old district, formed during certain periods, has already developed and evolved for hundred of years to represent the original of a city. With abundant historic culture, old districts have generated their unique city features based on their characteristic material environment and civilization. They can't be regenerated and replaced. City features and buildings'culture in Harbin is extremely valuable in their conservation. Firstly, as a colonial city, Harbin is both the experiment site of modern construction for European sovereign countries and the platform for integration of Chinese and Western architectural styles. The unique buildings' features in old district were the results of collision between local building design and international trends, such as Art Nouveau, Russian style, Baroque, and eclecticism. Meanwhile, as rising from railway, the earlier buildings were basically constructed to service railway system and the architectural styles also have been strongly marked during the aided period by the former Soviet Union. In 1994, Harbin was approved as one of the third list of National Historic and Culturally-Significantly Cities by the State Council of China and its historic conservation blocks also was increased into 23 from 19 in old districts.

The reconstruction and renovation in old districts all should prioritize the conservation of historic features ahead of the development and construction. The Sponge City also should obeys the requirements of traditional features' management and control in old districts. The existing construction of Sponge City calls for large-scale reconstruction and design in its control methods. The construction of sunken lawn, permeable pavement, grass ditch, wet pong and rainwater detention tank will inevitably affect the features of old districts. How to coordinate the construction of Sponge City and traditional features is a huge challenge faced by Sponge City in old districts, especially under the strict features' control and management of historic blocks.

2.4 Low construction quality and limited construction conditions

The buildings are newly constructed, renovated and improved during each period historically. The temporal construction is divided into four ages: Qing Dynasty to the early Republic of China, the middle and late period of the Republic of China, 1950-1970 and 1980-now. The buildings from Qing Dynasty to the early Republic of China are the main bodies for most of old districts in our country with the oldest construction time. In the current designated buildings in old districts, the number or area of the buildings before early Republic of China accounts for about 50% of the total buildings. Within the old districts, the buildings are damaged naturally and artificial to some extent due to the long time after construction. Their quality are also weak because of the limited construction technology and technique and insufficient construction material when they were built. Most of the buildings in old districts in Harbin were built at the beginning of last century and therefore are faced with issues including roof leakage, structural aging and foundation damage due to frozen in winter.

The buildings and their surroundings are the important space for the implementation of Sponge City, which calls for the high quality of buildings or is greatly challenged otherwise. For instance, the structure and roof waterproof , for some less qualified buildings, hardly satisfy the construction of green roof and infiltration, blocking and technology might lead to the foundation erosion by rainwater.

3. Optimized implementation strategies of resilient space for Sponge City in old districts

3.1 Layout of three-dimensional sponge facilities

Different from the goals-oriented pattern of new districts for the construction of Sponge City, the old districts should integrate the controlled objectives and indicator system into the design requirements at the very begging of the planning and design. The built-up area is high in old districts, leaving less space for Sponge City. Therefore the construction of Sponge City should better orient in problems and the controlled rate of annual total runoff and storage capacity and other objectives are decomposed into the facility type and number for each plot, realizing three-dimensional layout with maximized utilization of each space *(Xue, et al., 2017; Xue, et al., 2015; Xue, et al., 2014)* (see Figure 1).

From the earlier field research, it's concluded that the green land space is less with fragmented distribution, depending on which some large sponges are decomposed into sponge cells to rationally use green land space system with landscape design. The roof greening is feasible for flat roof with good roof loads and waterproof conditions or the sloping roof with the angel less than 15%. The roof greenery should be carefully selected in historic blocks. Historic buildings and the less-qualified buildings could apply rainwater tank to collect the roof rainwater. The total underlying area of the roof in old districts possibly accounts up to 30%. if the rainwater runoff is well blocked and utilized on the roof, annual runoff could be reduced by one third. The permeable pavement is applied in squares and road space as much as possible with permeable design for ground parking in old districts. The less-qualified buildings should be avoided rationally for implementation. By utilizing the cracking space in old districts, we intends to carry out the controlled objectives, construct resilient and three-dimensional spatial system of Sponge City to further achieve the development requirements of Sponge City: natural reservoir, natural infiltration and natural purification.

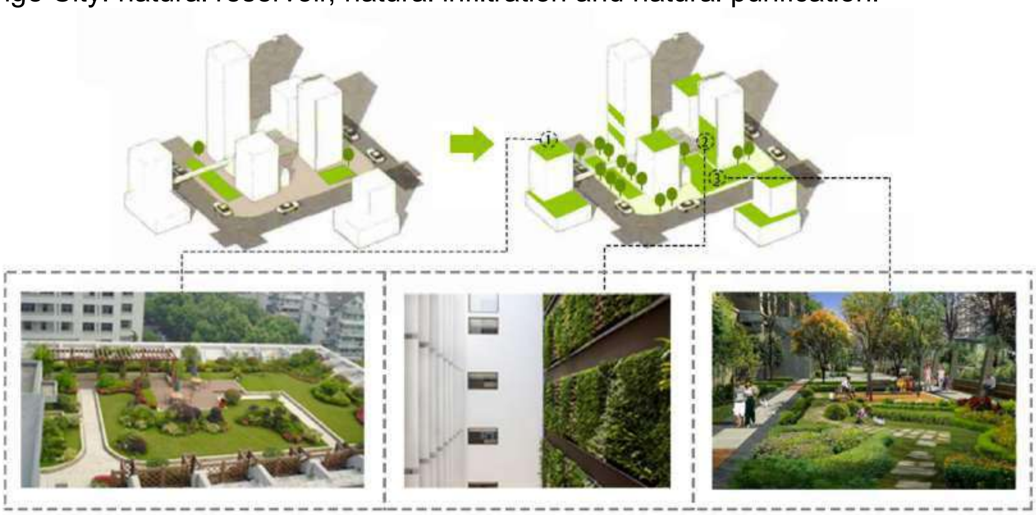


Figure 1: Layout of three-dimensional sponge facilities in old districts
Figure sources: drawn by author.

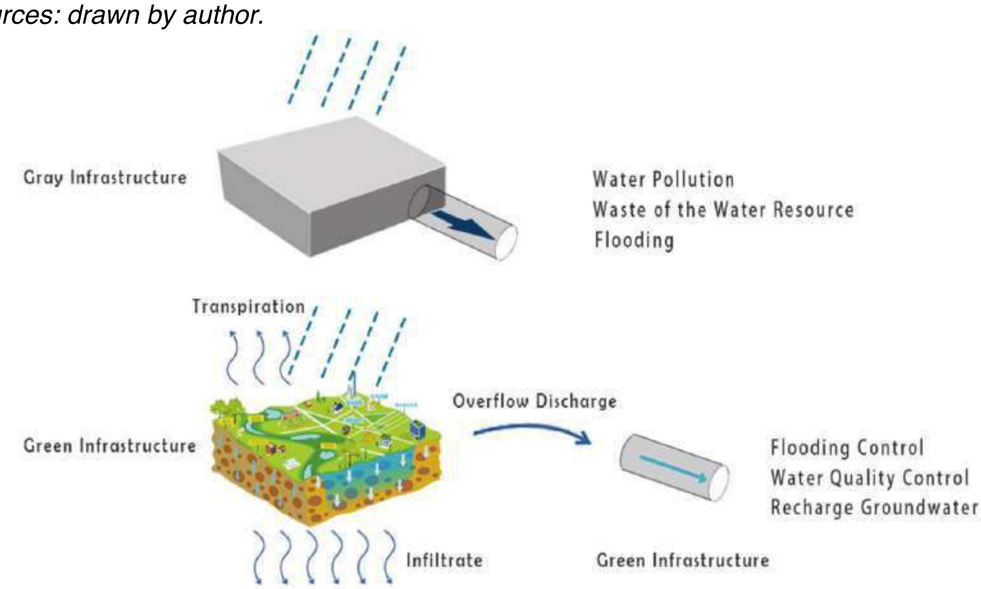


Figure 2: Combination of Gray and Green rainwater drainage pattern
Figure sources: drawn by author

3.2 Combination of Gray Infrastructures and green infrastructures

The flooding is more serious in old districts with obsolete Gray Infrastructures and less bearing capacity, leading to the definite flooding when it rains. Gray Infrastructure, as a way of fast drainage, will waste water seriously , in particular when the underground water level decreases year by year. Additionally, the bearing capacity of drainage, set at the early period of construction, only cope with low intensity rainwater (Yan et al., 2013). Meanwhile, the green land is less in old districts and the construction space for green infrastructures is also less. It’s hardly to solve the stormwater issues just depending on green infrastructure. The difficulties also lie in the reconstruction the old district whose original permeable area is not large. In conclusion, the stormwater in old districts must apply the combination of Gray and green, underground and ground and origin and ending point with rational economy (Zhang, et al., 2012). When the rainfall intensity is high and the green infrastructures are already saturated or there is no time for absorption, the Gray Infrastructures will discharge the extra rainwater .The combination of green and Gray and rapid and slow have realized the effective drainage of sponge in old districts(see Figure 2).

	No.	**Area （ha）**
Old districts	322	298.68
Harbin City	923	2312.84
Percentage	34.89	10.62

Table 1: Urban water environment layer during the period of city siting
Table sources: drawn by author.

Green Infrastructures layout of Sponge City almost depends on public area, especially that the green land space network serves as its implementation carrier. Based on green land pattern, city green land space can be divided into spot green land, parcel green land, belt green land and wedge-shaped green land. ArcGIS is applied to analyze the green land in old districts and the areas are selected within the fourth ring of Harbin, namely the wide-recognized Harbin City, as the comparative research area. From data comparison through NDVI (see Table 1), it’s clear to compare the characteristics of green land space for old districts. Two in thirds of single green land area is less than 0.5h with fragmented layout (see Figure 3). Spot green land , as the most one in old districts, should serve as the source controlling facilities to absorb rainwater, which can be used as the support space for sunken green land , simple bioretention ponds and rainwater wetland and others. Belt green land can be used as transport space on halfway and transport rainwater connecting with spot green land, which can be used as the support space for transporting grass ditches, dry/wet grass ditches and plant buffer zone and others. Parcel and wedge-shaped green land, as the less large green land space in old districts, function as ending treatment and rainwater management and control, which can be used as the support space for infiltration ponds, wet ponds and large rainwater wetlands with concentrated disposal.

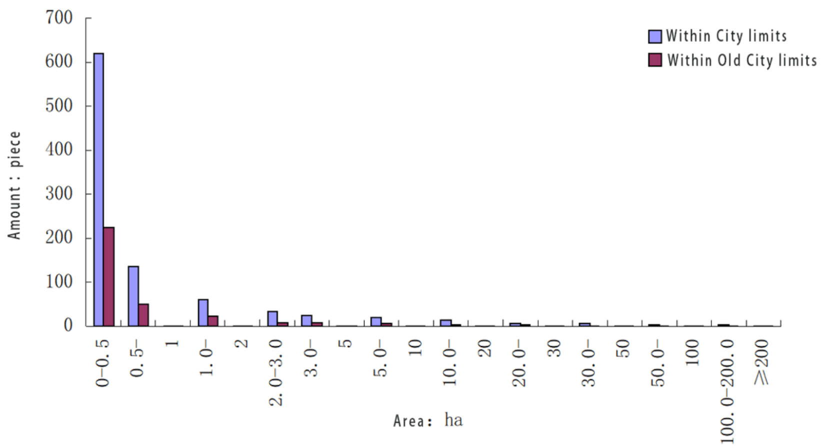


Figure 3: Area statistics of each type of green land
Figure sources: drawn by author

3.3 Quantitative design and hierarchy management and control of space

In old districts, the runoff pollution and controlled total runoff is relatively higher than that in new districts. The construction of Sponge City in old districts sets the total runoff and runoff pollution as the controlled objectives. The design of facilities within should be quantitative according to the volumetric method.

The construction number of sponge facilities is quantitative based on the above results. Meanwhile, limited under Sponge City in old districts, it's particular important to quantitatively and hierarchically plan and design the space. Different rainfalls are designed to generate varied rainwater absorbing and reservoir space with hierarchical management and control. The spaces are divided into rainfall density every 0.5 year, 3 years and 5 years. Difference space is launched under different rainfall intensities (see Figure 4). without the threat of rainfall, the sponge space functions as landscape and urban use.

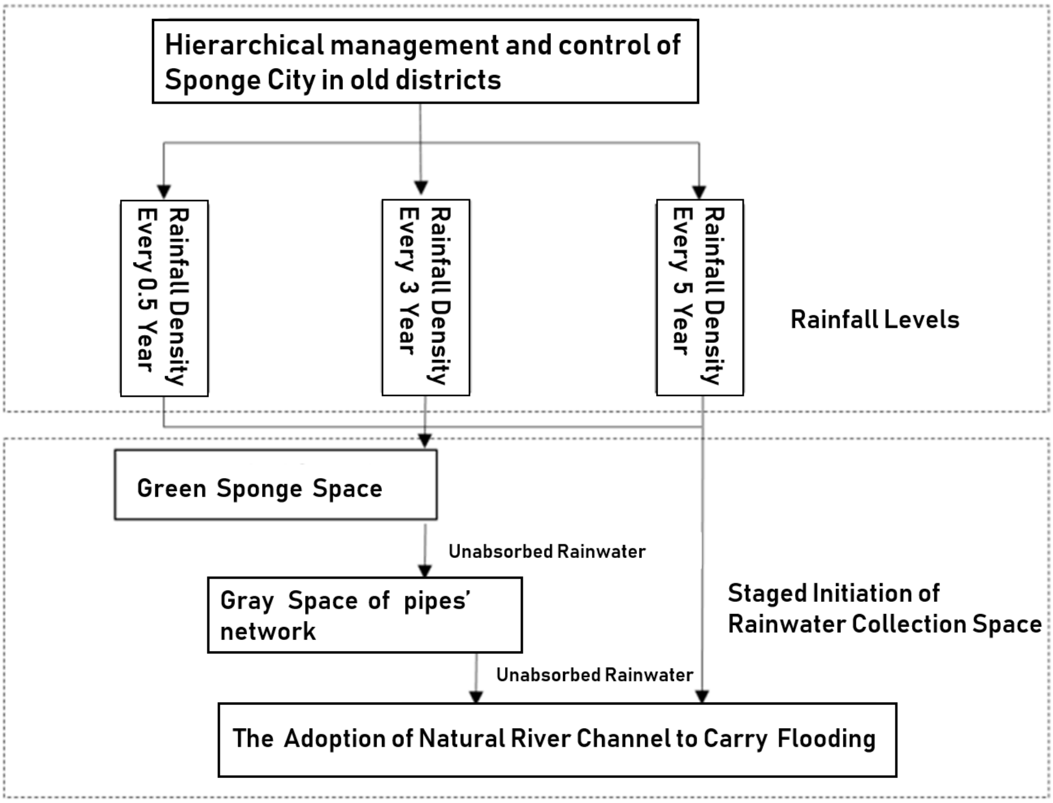


Figure 4 : Illustration of hierarchical management and control of Sponge City
Figure sources: drawn by author.

3.4 City features' coordination based on status quo

Old districts have witnessed city development and mitigation and its features should be planned and designed as coordinated elements whenever in any plannings and designs. The construction of old districts should not affect city landscape features, especially the construction of Sponge City in historic conservation areas should also be based on the features of historic blocks. The construction of Sponge City in old districts should be resilient according to the status quo. The sponge measures are selected with minimized influence as well as technology facilities. The appropriate local reconstruction of Sponge City facilities is possible combined with the features of old districts.

The features conservation coordinated areas are divided hierarchically. The purple line range for historic blocks and historic buildings serves as the 1st level feature conservation area, where the construction of Sponge City should strictly adheres to the conservation of historic features. The single sponge facility is strictly constrained with large influence on city features with coordination and conservation of the landscape elements within the range of purple line; the historic block or one block scale surrounding the single building serves as the 2nd level feature conservation area, where the sponge facilities with less influence are selected. If the selected facilities has large influence on features for rainwater construction, the appropriate resilient landscaping reconstruction could be conducted with the guarantee of implementation function of single facility; the view range of historic blocks serves as the 3rd level feature conservation area, where the requirement for the selection of sponge facilities is low and the historic landscape feature can be coordinated with certain ornamental value.

4. Practice of Sponge City in Garden Street Historic Blocks in Harbin

4.1 Status quo

Garden Street Historic Block was initiated in 1899 in Harbin new city planning. new city plan considered railway administration as the main body during the construction period of Chinese Eastern Railway by Tsarist Russia. The most advanced Howard Garden City was introduced at that time. Garden Street Historic Block , as the residential community for Russian senior railway staffs, represents high-level Russian style of architectural blocks in early times and also the only existing area in Harbin which maintains the basic appearance during the period of business with foreign countries. The spatial layout of Garden Street Historic Street was was originally organized in groups. Single residence was set up in surrounding style with wide internal public space within the blocks, integrating with the greenery including elms in the blocks. Buildings' layout was relatively loose and every residence had its own independent courtyard with high greenery rate and completed landscape, becoming the representative of garden residential blocks at that time. However, since 1950s, due to the lack of management and maintenance , unified planning of large-scale construction, free construction, house and warehouses expansion inside the block, the blocks' texture has been badly damaged and the green area is constantly encroached with the increasingly serious of underlying surface (see Figure 5). This also has led to the emergence of stormwater in Garden Street as well as the severe water logging issues. The construction of Sponge City is imperative.

Figure 5: Texture changes of Garden Street Historic Block
Figure sources: drawn by author.

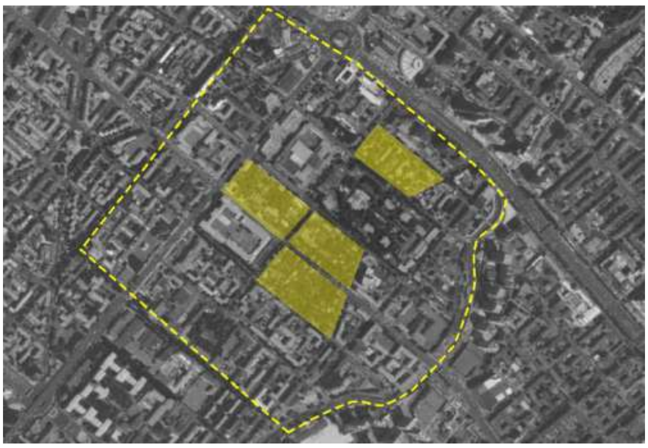


Figure 6 : The selected research range and the range of Garden Street Historic Block
Figure sources: drawn by author.

According to the zoning of water collection area, the practice of Sponge City usually set the area of 1-2 km^2 as a zoning of water collection area. In this practice, to better control the features of historic blocks and sponge construction, Garden Street Historic Block is set as the center to expand one block outward. As shown in Figure 6, the yellow area is the historic conservation blocks. The selected research range is yellow dotted area with the area of 1.13 km^2.

4.2 Construction principles

4.2.1 Conservation principles of elms

A large number of elms were planted in four blocks in the early stage of the construction. According to the survey, there are 258 elms, including 13 with a breast diameter of l00cm, over 100 with a breast diameter of 66cm and 188 with the breast diameter over 50cm. The conservation of elms with hundred years of history should be prioritized over the construction of Sponge City. The conservation hierarchy is determined to further divide the conservation range and clarify the prohibited area of construction for facilities of Sponge City. The elms with the breast diameter over 100 cm are designated as the 1st level of conservation, which should be strictly avoided by the construction of Sponge City. Within the vertical projection of the canopy and its 5.0 m outward, the construction sponge should not damage the topsoil and change the surface elevation; the elms with the breast diameter of 66 cm are designated as the 2nd level of conservation. Within the the vertical projection of the canopy and its 2.0 m outward, the sponge facilities are strictly forbidden which could soak the elms' root such as bioretention ponds and rainwater garden. The elms with the breast diameter over 50 cm are designated as the 3rd level of conservation. Within the vertical projection of the canopy and its 1.0 m outward, the construction demands are relatively flexible and the construction of the sponge facility requires the anti-soak design of the root.

4.2.2 Principles of features' coordination

The coordination between the construction of Sponge City and historic features is the first principle to abide by the construction of historic blocks in old districts. The historic features are well conserved in Garden Street Block. The sponge facilities with the minimized influence will be selected in sight of the coordination and conservation. The source control facilities should be coupled with the traditional green land in Garden Street. The spot green land is depended on to take the scattered layout with damage to its spot historic distribution pattern. Meanwhile, the sponge facilities are reconstructed according to the status quo to adapt the scale and layout of LID space to that of historic blocks. Additionally, the material, texture and color of rainwater collection facilities also should be coordinated with the surrounding historic buildings. The plants should obey the context and landscape styles of the edge of traditional architectural style to continue the historic atmosphere. The concealed principle is adopted to reduce the influence on historic features and optimize the reservoir and purification of rainwater.

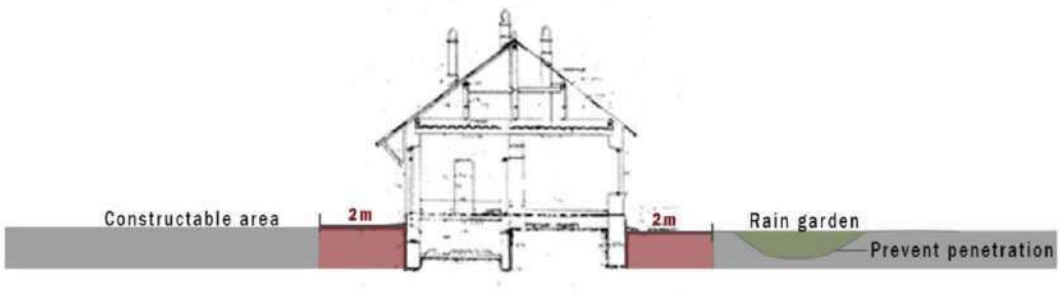


Figure 7 : Illustration of avoiding Historic architectural foundation in Garden Street Historic Block
Figure sources: drawn by author.

4.2.3 Principles of avoiding buildings' foundation

The quality of each building should be surveyed as well as the foundation situation for the construction of Sponge City in Garden Street Historic Block. The foundation, structure and roof condition are determined. And then during the construction of Sponge City, the architectural foundation should be avoided by 2 m , according to the conservation regulations of historic buildings. The sponge facilities, involving the rainwater penetration, such as rainwater garden and sunken green land, require the water-proof on part of their foundations nearby the architectural foundation(see Figure 7).

4.2.4 Resilient design principles

A lot of factors need to be coordinated for the design of Sponge City in Garden Street Historic Blocks, which has more difficulties comparing with the construction of new city. Being at the preliminary stage of development, the construction of some sponge facilities still simply draws the lessons from the United States for implementation. And many facilities and methods still lack local absorption and utilization, causing the difficult implementation of Sponge City in old districts, especially the historic blocks with more difficulties, such as Garden Street Historic Block (Xue, et al., 2012). The design of Sponge City here must uphold the resilient principle and make resilient exploration into sponge facilities and construction methods according to the status quo with the aim to successfully solve the contradictions between increasingly serious stormwater issues and blocks' features.

Single facility	**Influence on features**	**Landscape value**	**disposal**	**involved landscape elements**
permeable pavement	weak	weak	scattered	Pavement
green roof	Strong	Strong	scattered	Plants, vegetation and garden structures
sunken green land	Strong	Strong	scattered	topography, plants
bioretention pond	weak	Medium	scattered	topography, plants
infiltration pond	weak	Medium	Relatively concentrated	topography, plants and water
infiltration well	weak	weak	Relatively concentrated	—
wet pond	Medium	Medium	Relatively concentrated	topography, plants and water
rainwater wetland	Medium	Strong	scattered/Relatively concentrated	topography, plants, water and structures
Reservoir tank	Medium	Medium	Relatively concentrated	—
Adjusting tank	Medium	weak	Relatively concentrated	topography, plants and garden structures
grass ditch	weak	Medium	scattered	plants
filtration pipes/ditches	Medium	weak	scattered	—
vegetation buffer zone	weak	Medium	scattered	topography, plants
rainwater flow facilities	weak	—	Relatively concentrated	—

Table 2: Comparison and selection of sponge facilities in historic blocks

Table sources: drawn by author.

4.3 Facilities' comparison, selection and quantification

4.3.1 Facilities' comparison and selection

Sponge facilities usually function as the supply of underground water, reservoir and utilization,

peaking runoff reduction and rainwater purification with multiple-objectives of total runoff amount, runoff peak and pollution. When selecting the sponge facilities in historic blocks, the economics and applicability of water collection area and facilities' function should be combined along with their influence on features, landscape and space disposal, generating flexible selection ways of sponge facilities and their combination system.
Within the 1st feature conservation areas, the combination of sponge facilities is implemented, which include permeable pavement, bioretention pond, infiltration pond, grass ditch, vegetation buffer zone and rainwater flow facilities. Within the 2nd feature conservation area, the added facilities cover filtration well, wet pond, adjusting tank, filtration ditch and rainwater wetland. Within the 3rd feature conservation area, green roof is added surrounding the well-qualified buildings and the sunken green land is also available.
4.3.2 Quantitative facilities
The quantitative facilities adopt the volume method. ArcGIS is used to supervise the classification of underlying surface, which is divided into green land, roof and road. The proportion for each type is concluded (see Table 3).

Types of underlying surface	Runoff coefficient	Mean value of runoff coefficient	Proportion
Buildings' roof	0.85~0.95	0.90	0.565
Roads' pavement	0.55~0.65	0.60	0.168
Green land	0.10~0.20	0.15	0.267

Table3: Comparison and selection of sponge facilities in historic blocks
Table sources: drawn by author.

The specific calculations can be referred to that in Technical Guidelines for the Construction of Sponge City issued by the Ministry of Housing and Urban-Rural Development. Calculated as follows. The calculation formula is shown as follows.
$V=10H\varphi F$
Where: V - design pondage volume, m^3;
H - design rainfall, mm;
Φ——runoff coefficient of integrated rainfall , calculated according to the weighted average of the runoff coefficient of the underlying surface of the study area;
F——the collection area, hm^2;
The pondage volume, V, is concluded at 19,639.65m^3 according to the rainfall density every 0.5 years in Garden Street Historic Blocks; it's 28,990.12 m^3 according to the rainfall density every 3 years and 31,652.25m^3 every 5 years. Then the implementation space is hierarchically designed based on the above results.

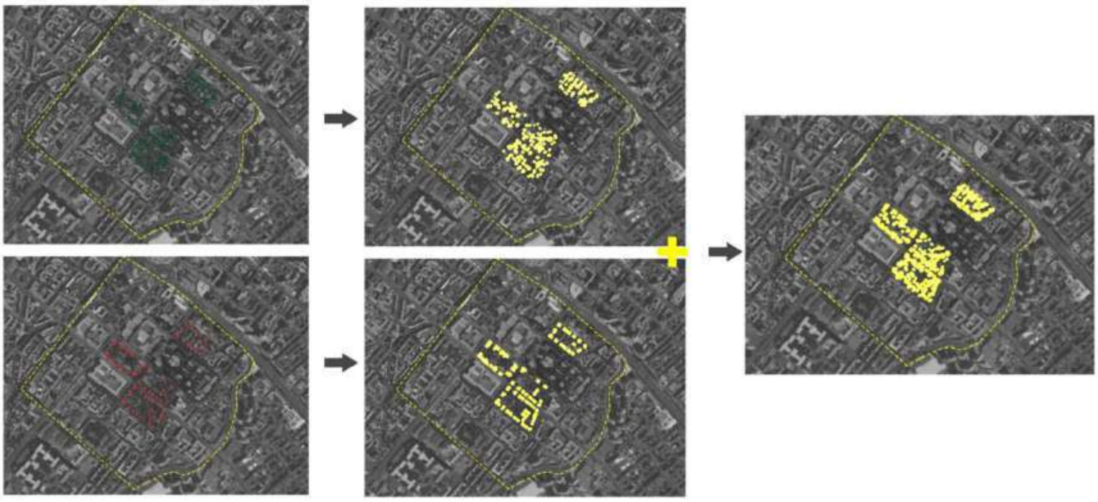


Figure 8 : illustration of non-construction area in Garden Street Historic Blocks
Figure sources: drawn by author.

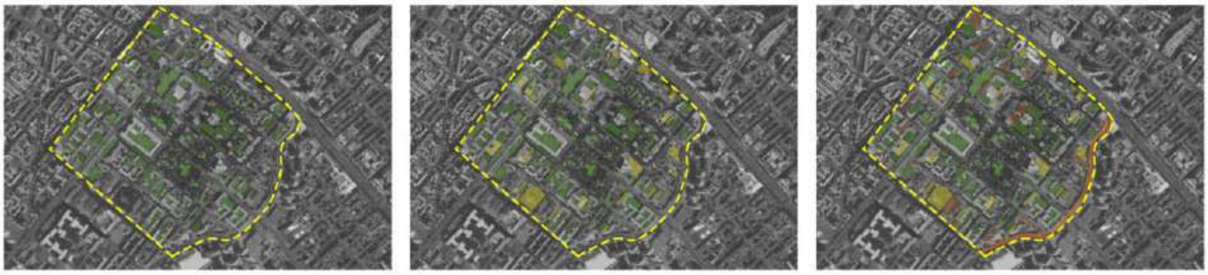
4.4 Design strategies of implementation space

4.4.1 Determine the construction range

According to the construction principles of Sponge City and the field research, the location of historic buildings and conserved elms are determined with the conservation range of buildings and elms within historic blocks. The Sponge City is strictly forbidden within 2 m away from the historical buildings' foundation. Elms are avoided according to their conservation levels. The avoiding space of historic buildings and the non-construction space of elms are overlapped and matched to determine the ultimate construction management and controlled range of historic blocks. As shown in Figure 8, the yellow area is the non-construction range , which should be strictly avoided in the construction of Sponge City in historic blocks.

4.4.2 Resilient hierarchical management and control

Volume method is used to quantitative the construction of sponge facilities with the resilient layout in space. In sight of different rainfall density every 0.5 years, 3 years and 5 years, the three-dimensional sponge facilities are set up in scattered manner in the construction-available range (see Figure 9). The hierarchical management and control of sponge space depends on the rainfall density. For 0.5 year, the green sponge space with the pondage volume of 19,639.65m^3 is turned on to collect and reserve the rainwater; for 3 years, the yellow sponge facilities' space is additionally used besides the green space with the sponge facilities' pondage volume of 28,990.12m^3 collect and transfer the rainwater. Meanwhile, the grey rainwater pipes' network is used to rapidly discharge the rainwater which can't be collected timely to prevent city water logging. For 5 years, the orange sponge space is added with the sponge facilities' pondage volume of 31,652.25m^3 collect the rainwater, mitigating the speed of flowing into low-lying areas. The gray rainwater pipes' network dominates with its rapid drainage. The flooding space of river channel is used to discharge the rainwater which can't be absorbed by the design plot along with the gray pipes' network space.



a Space for rainfall every 0.5 years b Space for rainfall every 3 years c Space for rainfall every 5 years

Figure 9 : illustration of hierarchical management and control for historic space of Garden Street

Figure sources: drawn by author.

5. Conclusion

Oriented in problems, this paper has deeply analyzed the implementation difficulties of Sponge City in old districts and put forward the targeted and resilient optimized strategies for the construction of Sponge City with the quantitative design of the implementation of Sponge City; Garden Street Historic Block in Harbin is taken to explore the old districts with insufficient implementation space and more serious stormwater issues with the possible three-dimensional space design in each small space. To coordinate with the historic features in old districts, the hierarchical management and control ways are put forward in sight of different rainfall densities; ultimately this paper aims to offer the reliable foundation for the future research and construction of Sponge City in old districts.

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Study on Vegetation in Haidian District of Beijing Based on Heat Island Effect

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Abstract: With the development of the city, the city's underlying surface has been heavily eroded by gray infrastructure such as buildings and roads. The degree of vegetation coverage has dropped, the heat island problem has intensified which weakened the quality of urban residents' life.

The study chose Haidian District of Beijing as the research object, using four different periods Landsat remote sensing images from 2000 to 2018 as the basic data, extracting vegetation information and inverting surface temperature, and summing up the spatial-temporal evolution of surface temperature and vegetation coverage in Haidian District. Mesh analysis method was used to study the correlation between land surface temperature and vegetation coverage. On this basis, 20 plots were selected to analyze the cooling effect, in order to study the relationship between greenspace elements, including morphology, area and so on.

Finally, by studying the data combined with the law of cooling effect of green space, we found that the cooling effect of green space can be improved by controlling the green area, perimeter, shape coefficient and community structure. Based on this, we will guide Haidian District to design, renovate and expand urban green space and build a highly efficient ecological green network.

Key words: Surface temperature ; Vegetation coverage ; Spatio-temporal evolution ; Correlation

With the development of the city, the underlying surface of the city has changed. The gray infrastructure such as buildings and roads have eroded the green space in the city, the vegetation coverage has decreased, the ecological landscape function has been lost, and the heat island problem has gradually increased. The hot and dull temperature has caused the urban residents' outdoor living quality to decline.

The urban heat island effect is a very important topic in the study of urban landscapes. In the traditional study of the heat island effect, the method of meteorological site measurement is often used to reflect the ground temperature of a specific area, but this method has great randomness and incompleteness. After the 1970s, the acquisition of satellite data made it possible to use remote sensing methods to study the spatial pattern of surface temperature and heat islands.Since then, with the advancement of remote sensing technology, high-resolution satellite heat data has been widely used to detect mesoscale or large-scale surface temperature, which can effectively depict the spatial pattern of urban thermal environment. The sources of these satellite heat data are mainly AVHRR, MODIS, Landsat TM / ETM + and ASTER images. With the change of surface land use status by human activities, the surface heat island effect also has spatial continuity changes. This change can be observed based on the time series of satellite thermal data to understand the temporal and spatial processes of land use and heat island effects and the correlation between the two. The use of time-series remote sensing images is more likely to produce more detailed and persuasive results than studies based on remote sensing images for a specific period of time.The focus of this paper is based on Landsat remote sensing imagery, summarizing the temporal and spatial evolution of surface temperature and vegetation coverage in Haidian District. On this basis, 20 plots were selected to analyze the cooling effect, and the relationship between the green form and area and the range and amplitude of green space cooling was studied.

1. Research area

The research area of this paper is Haidian District, Beijing. Haidian District is located in the southwest of Beijing, covering an area of 430.8 square kilometers. The boundary line is about 146.2 kilometers long, about 30 kilometers long from north to south, and 29 kilometers wide from east to west, accounting for 2.6% of the total area of Beijing. The regional geographic coordinates are between 39° 53′ -40° 09′ north latitude and 116° 03′ - 116° 23′ east longitude. The resident population is 3.593 million.

Haidian District is located in the northern edge of the North China Plain and is part of the ancient Yongding River alluvial. It has a mountain plain, the terrain is high in the west and low in the east, and the west is a mountain above 100 meters above sea level. The area is about 66 square kilometers, accounting for about 15% of the total area. The eastern and southern parts are about 50 meters above sea level, with an area of about 360 square meters. Kilometers, accounting for about 85% of the total area.

Haidian District is located in a warm temperate semi-humid semi-arid continental monsoon climate zone with four distinct seasons. It is hot and rainy in summer and cold and dry in winter. The annual average temperature is 12.5 ℃, the average temperature in January is -4.4 ℃, the extreme minimum temperature is -21.7 ℃, the aver age temperature in July is 25.8 ℃, and the highest temperature is 41.6 ℃. The specific scope of the study area is as follows (Figure 1).

Figure 1: Research area

2. Heat Island Effect and Spatial and Temporal Evolution of Urban Green Space

2.1 Research methods and data sources

The basic data selected in this paper is derived from four remote sensing images of the Landsat ETM satellite. The imaging time is July 28, 2003, September 11, 2008, September 25, 2013, September 28, 2017. The numbers are all 123, the line number is 32, and the spatial resolution of the satellite imagery is 30m*30m. After acquiring the satellite image, the thermal infrared remote sensing image data is subjected to atmospheric correction and thermal radiation calibration by ENVI5.1 software, and then the remote sensing image with each band data is used to calculate the surface temperature and vegetation coverage. The corresponding data was processed by ArcGIS 10.2 software, and the correlation between surface temperature and vegetation coverage was compared and calculated.

2.2 Calculation method

2.2.1 Vegetation coverage calculation

In order to calculate vegetation coverage, the normalized vegetation index needs to be calculated first. The expression is:

$$NDVI=(NIR-R)/(NIR+R) \quad (1)$$

For landsat7 satellite remote sensing images, NIR is the luminance value of the TM4 band (near-infrared band, identifying water-related geological structures), and R is the brightness value of the TM3 band (red band, distinguishing plant species and coverage).

Based on the results of the normalized vegetation index calculation, the vegetation coverage is calculated, and the expression is:

$$F_V = (NDVI - NDVI_S) / (NDVI_V - NDVI_S) \quad (2)$$

In the formula, $NDVIv=0.7$ and $NDVIs=0$; when the NDVI of a pixel is greater than 0.7, its FV is 1; when NDVI is less than 0, its FV is 0.

2.2.2 Surface temperature calculation

In order to calculate the surface temperature, it is first necessary to calculate the surface specific emissivity. Among them, the specific emissivity of the water body is 0.995, and the specific emissivity of vegetation and buildings is calculated by the expression:

$$\varepsilon_{green}=0.9625 + 0.0614\, F_V - 0.0461\, F_V^2 \quad (3)$$

$$\varepsilon_{building}=0.9589 + 0.086\, F_V - 0.0671\, F_V^2 \quad (4)$$

In the above formula, εgreen represents the specific emissivity of the vegetation, and εbuilding represents the specific emissivity of the building, and the surface specific emissivity is obtained by inversion calculation.

Based on the results of the surface emissivity, the radiance of the black body in the thermal infrared band is calculated. The expression is:

$$B(T_S) = [L\lambda - L\uparrow - \tau\cdot(1-\varepsilon)L\downarrow]/\tau\cdot\varepsilon \quad (5)$$

Where ε is the surface specific emissivity, B(TS) is the thermal radiance of the black body derived from Planck's law, and τ is the transmittance of the atmosphere in the thermal infrared band.

After obtaining the radiance of the black body in the thermal infrared band at a temperature of TS, the true surface temperature is obtained according to the inverse function of the Planck formula. The expression is:

$$T_S = K2/\ln(K1/ B(T_S)+ 1) \quad (6)$$

For Landset7 remote sensing images, take K1 = 666.09 and K2 = 1282.71K. The calculated TS is the true surface temperature value in degrees Celsius.

2.3 Results and analysis

2.3.1 Surface temperature evolution characteristics

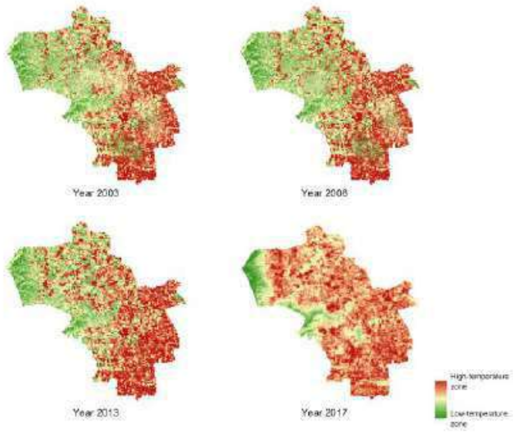


Figure 2.3.1 Temporal and spatial evolution of surface temperature in the study area from 2003 to 2017

2.3.2 Vegetation coverage evolution characteristics

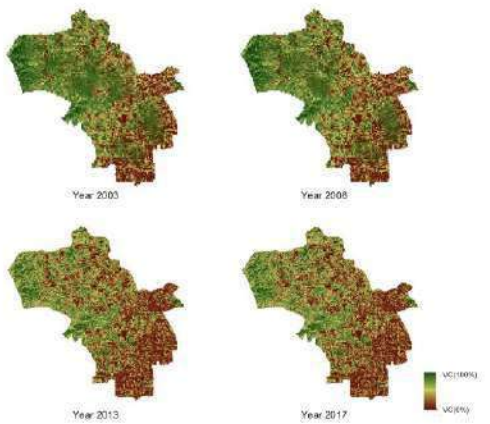


Figure 2.3.2 Time-space evolution map of vegetation coverage in the study area from 2003 to 2017

2.3.3 Study on Correlation between Surface Temperature and Vegetation Coverage

In this paper, the research area is analyzed in detail by grid analysis method, and the surface temperature and vegetation coverage information are extracted comprehensively to calculate the correlation between the two. The spatial resolution of Landsat satellite imagery is 30m*30m. ArcGIS 10.2 software is used to average the grids in each grid to express the surface temperature and vegetation coverage information in the grid. The correlation between surface temperature and vegetation coverage was studied with a single grid as the statistical unit, and the regression analysis results between the surface temperature and vegetation coverage in the four periods from 2003 to 2017 were obtained.

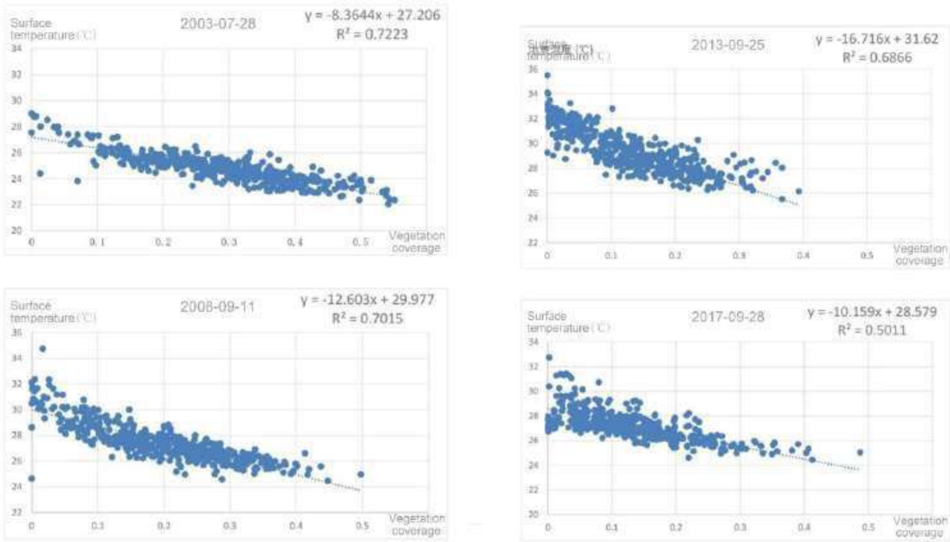


Figure 2.3.3 Analysis of regression relationship between vegetation coverage and surface temperature in the study area from 2003 to 2017

From the regression analysis results, there is a significant negative correlation between surface temperature and vegetation coverage. In 2003, 2008, 2013, the coefficient of determination (R2) of the regression equation for 2017 was 0.72, 0.70, 0.69, and 0.50, respectively, indicating a strong correlation between the two. From the slope of the regression equation, the slopes of the regression equations of 2003, 2008, 2013, and 2017 are divided into -8.3644, - 12.603, -16.716, -10.159, and the absolute range is 8.3644 to 16.716. This indicates that for every 0.1 increase in vegetation coverage index in Haidian District of Beijing, the surface temperature can be reduced by 0.84 ℃ to 1.67 ℃.

3. Study on Green Form and Cooling Effect

Summer green space cooling is the result of a combination of direct and indirect effects. In addition to the direct cooling effect of the green space, the green area reaching a certain area is a natural ventilation corridor in the city. And due to the direct cooling effect of the green space, local temperature difference will be generated to form natural ventilation. The ventilation of urban green space is much larger than that of construction land. Natural wind will take away most of the heat and play an indirect cooling effect on the green space. The cooling range will be affected by the green area's own area and greening configuration.

3.1 Research method data source

In the study area, 20 plots were selected and distributed as evenly as possible. The green space covers various green land types such as park green space and affiliated green land, and the green land has various shapes. Based on the remote sensing image of 2017, Acr GIS10.2 software was used to set buffers for selected urban green space samples, and the average temperature in each green space and its buffer zones was extracted. The difference was used to study.

Figure 3.1 Overview of Greenland Basic Data

Number of green space	Name of green space	Green area (ha)	Green space perimeter (m)	Green space shape coefficient
1	Phoenix Valley natural scenic area	1062	8700	0.1221
2	Yuanmingyuan Ruins Park	315	9100	0.0346
3	the Summer Palace	232	7300	0.0318
4	Beijing Botanical Garden	124.9	5700	0.0219
5	Yuyuantan Park	67	9600	0.0070
6	Haidian Park	30.6	3800	0.0081
7	Zizhu Park	47.35	9300	0.0051
8	Green Space of Beijing Institute of Technology	49.6	8100	0.0061
9	Green Space of Tsinghua University	274.7	8000	0.0343
10	Green Space of Beijing Forestry University	31.22	2000	0.0156
11	Green Space of the Affiliated Middle School of Cap	4.13	153	0.0270
12	Dawning Disaster Prevention Education Park	21.74	3300	0.0066
13	Linglong Park	5.8	400	0.0145
14	Green Space of Tamura Yama Sports Center	11.9	700	0.0170
15	Green Space of Yongxing Garden Hotel	1.6	609	0.0026
16	Green Space of Wanshou Road a No. 15 courtyard	199.2	6800	0.0293
17	Green Space of New China Customs mall square	2.6	167	0.0156
18	Road traffic green land in the West Earth City	17.1	4100	0.0042
19	The belt greenbelt of the East Street of en Ji	2.3	1100	0.0021
20	Minzhuang road roadside green space	21.8	3000	0.0073

3.2 Calculation method

Figure 3.2.1 Average surface temperature difference extraction table in different buffer zones of each green space

Number of green space	Name of green space	Buffer distance(m)															
		30	60	90	120	150	180	210	240	270	300	330	360	390	420	450	480
1	Phoenix Valley natural scenic area	3.48	4.4	4.9	5.25	5.33	5.51	5.68	5.72	5.81	5.88	5.79	5.67	5.69	5.2	5.23	5.32
2	Yuanmingyuan Ruins Park	3.51	4.07	4.42	4.74	4.86	4.92	4.96	4.92	5.06	5.01	5.16	5.2	5.03	5.06	4.8	4.71
3	the Summer Palace	4.15	4.75	5.2	5.42	5.48	5.52	5.58	5.74	5.79	5.45	5.54	5.21	4.93	4.63	4.21	4.15
4	Beijing Botanical Garden	1.29	2	2.91	3.05	3.11	3	2.64	2.34	1.99	1.86	1.62	1.84	1.79	2.09	2.5	2.86
5	Yuyuantan Park	2.57	3.28	3.77	4.12	4.44	4.77	5.14	5.15	5.02	4.91	4.79	4.69	4.77	4.57	4.34	4.1
6	Haidian Park	1.72	2.45	3.04	3.62	3.96	4.1	4.32	4.3	4.2	4.17	3.87	3.62	3.38	3.45	3.67	3.8
7	Zizhu Park	0.2	0.43	0.76	1.01	1.11	1.29	1.52	1.57	1.62	1.51	1.36	1.15	0.92	0.69	0.48	0.37
8	Green Space of Beijing Institute of Technology	1.46	1.49	1.6	1.59	1.43	1.18	0.95	0.67	0.56	0.4	0.28	0.16	0.08	0.06	0.03	0.02
9	Green Space of Tsinghua University	1.2	1.23	1.76	1.01	1.21	1.29	0.52	0.57	0.62	0.59	1.36	1.51	0.92	0.6	0.78	0.7
10	Green Space of Beijing Forestry University	3.39	4.44	5.19	4.45	5.62	5.67	5.56	5.57	5.57	5.82	5.98	5.95	5.85	5.74	5.63	5.58
11	Green Space of the Affiliated Middle School of Capital Normal University	1.77	2.63	3.91	4.36	4.38	4.24	4.2	4.07	3.95	3.66	3.52	3.5	3.59	3.9	3.81	4.12
12	Dawning Disaster Prevention Education Park	2.13	3.35	3.57	3.72	4.13	4.35	4.82	5.2	4.67	4.53	4.39	4.41	4.04	3.92	4.15	4.12
13	Linglong Park	0.3	0.95	1.05	1.23	1.17	1.39	1.55	2.03	2.29	2.54	2.7	2.84	2.86	2.77	2.78	2.5
14	Green Space of Tamura Yama Sports Center	1.95	2.85	3.1	3.54	4.29	4.99	4.99	5.17	5.12	5.22	5.6	5.4	5.4	5.41	5.06	5.29
15	Green Space of Yongxing Garden Hotel	2.86	3.43	3.56	3.49	3.39	3.09	2.88	2.56	2.37	1.76	1.7	1.22	1	1.05	0.69	0.61
16	Green Space of Wanshou Road a No. 15 courtyard	4.15	4.55	5.12	5.34	5.44	5.52	5.58	5.59	5.79	5.45	5.54	5.01	4.24	4.63	4.21	4.15
17	Green Space of New China Customs mall square	0.48	0.78	0.93	1.02	0.84	0.91	0.75	0.86	0.87	0.85	0.62	0.64	0.42	0.4	0.29	0.45
18	Road traffic green land in the West Earth City	1.98	2.85	3.21	3.55	3.56	3.65	3.53	3.39	3.23	3.11	2.92	2.62	2.12	1.85	1.65	1.65
19	The belt greenbelt of the East Street of en Ji	0.2	0.85	1.97	2.45	2.37	2.37	2.23	2.25	2.04	2.03	2.07	1.9	1.96	1.56	1.56	1.37
20	Minzhuang road roadside green space	2.33	3.35	3.87	3.96	4.33	4.35	4.92	4.9	4.87	4.83	4.49	4.51	4.24	4.07	4.15	4.12

The difference in surface temperature will increase to some extent as the distance from the green space boundary increases. When a certain distance is reached, the surface temperature difference tends to be gentle or gradually decreasing as the distance from the green space boundary increases. That is to say, within a certain range, the surface temperature increases with the distance from the green space. After reaching a certain distance, the surface temperature tends to be gentle or decreasing with increasing distance from the green space. The surface temperature difference curve is plotted with the distance variation law. The summer urban green space cooling curve is shown in Figure 3.2.2.

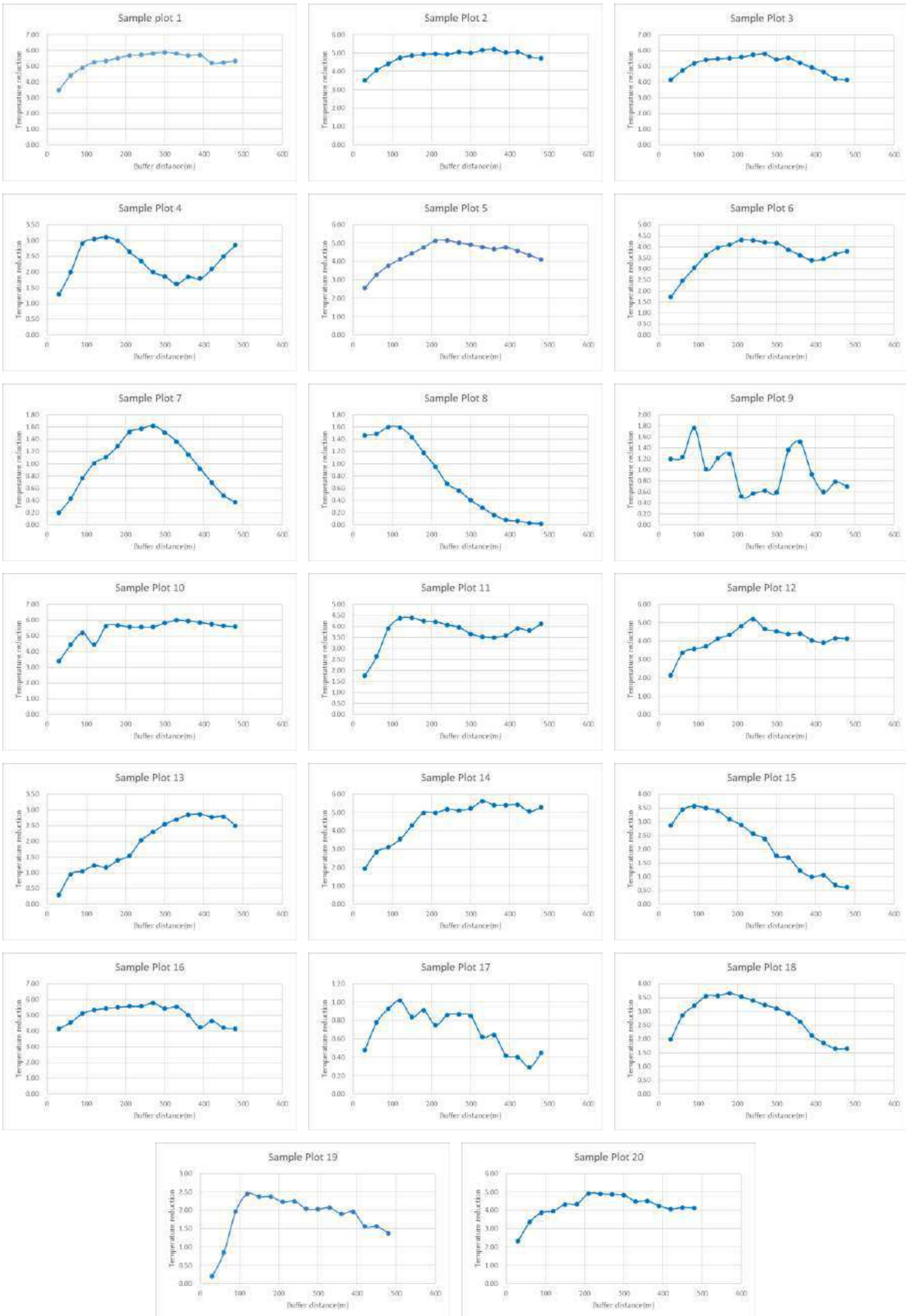


Figure 3.2.2 Urban Greenland Cooling Curve

The green ground cooling curve more intuitively reflects the change trend of the surface temperature change in each green space buffer. Basically, the cooling curve of green space in each city shows a trend of decreasing after rising first.

In order to facilitate the study of green form parameters and cooling effects, three indicators were extracted according to the urban green space cooling curve to carry out quantitative calculation: cooling range, cooling range and maximum temperature difference statistics table, as shown in Figure 3.2.3.

Explain the three indicators. Cooling range: The buffer boundary distance indicated by the inflection point of the urban green space cooling curve can be regarded as the cooling range of summer urban green space. Cooling range: the difference between the average surface temperature inside the green space and the average surface temperature in the buffer zone within 30m outside the boundary. The maximum temperature difference between the inside and outside of the green space: that is, the maximum temperature change inside and outside the green space is the maximum temperature difference obtained by subtracting the lowest surface temperature value inside the green space from the highest surface temperature in the 30m buffer zone outside the green space.

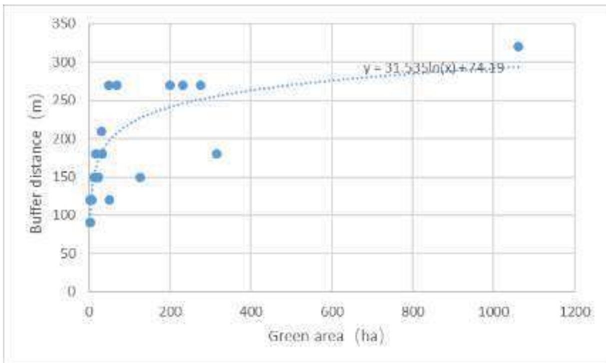
Figure 3.2.3 Statistical Table of Cooling Range, Cooling Range and Maximum Temperature Difference of Urban Green Space

Number of green space	Name of green space	Green area (ha)	Green space perimeter (m)	Green space shape coefficient	Buffer distance (m)	Temperature drop range (℃)	Maximum cooling difference (℃)
1	Phoenix Valley natural scenic area	1062	8700	0.1221	320	4.254	12.287
2	Yuanmingyuan Ruins Park	315	9100	0.0346	180	3.593	13.385
3	the Summer Palace	232	7300	0.0318	270	4.201	12.080
4	Beijing Botanical Garden	124.9	5700	0.0219	150	1.574	12.830
5	Yuyuantan Park	67	9600	0.0070	270	2.574	8.940
6	Haidian Park	30.6	3800	0.0081	210	1.604	9.780
7	Zizhu Park	47.35	9300	0.0051	270	2.192	8.070
8	Green Space of Beijing Institute of Technology	49.6	8100	0.0061	120	1.767	7.589
9	Green Space of Tsinghua University	274.7	8000	0.0343	270	1.540	5.010
10	Green Space of Beijing Forestry University	31.22	2000	0.0156	180	3.388	12.190
11	Green Space of the Affiliated Middle School of Ca	4.13	153	0.0270	120	1.770	5.880
12	Dawning Disaster Prevention Education Park	21.74	3300	0.0066	150	2.450	6.940
13	Linglong Park	5.8	400	0.0145	120	0.301	3.510
14	Green Space of Tamura Yama Sports Center	11.9	700	0.0170	150	1.952	9.850
15	Green Space of Yongxing Garden Hotel	1.6	609	0.0026	90	0.543	2.243
16	Green Space of Wanshou Road a No. 15 courtyai	199.2	6800	0.0293	270	2.201	6.080
17	Green Space of New China Customs mall square	2.6	167	0.0156	90	0.482	4.830
18	Road traffic green land in the West Earth City	17.1	4100	0.0042	180	1.975	6.682
19	The belt greenbelt of the East Street of en Ji	2.3	1100	0.0021	120	0.204	5.470
20	Minzhuang road roadside green space	21.8	3000	0.0073	150	2.335	7.560

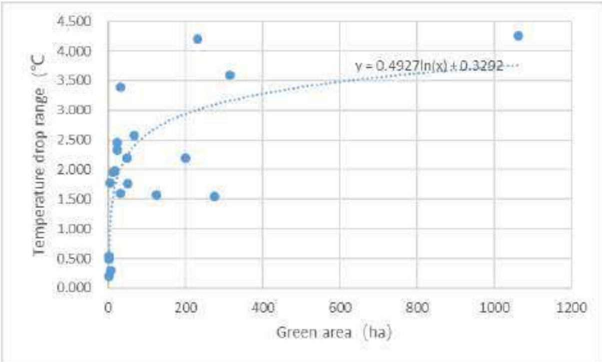
3.3 Results and analysis

3.3.1 Correlation analysis of green area on cooling effect

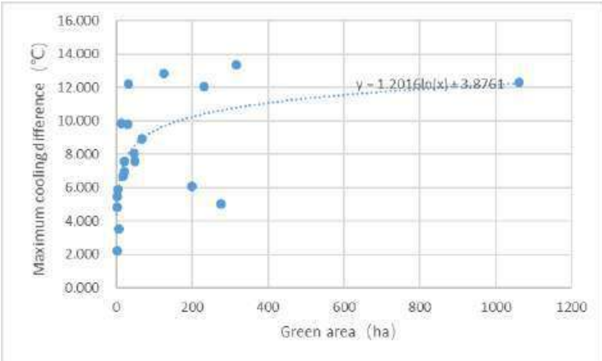
Based on the statistics of the urban green space area and the cooling range of the green space and the cooling range of the green space, the regression analysis is carried out on the green area and its cooling range, cooling range and maximum temperature difference respectively. The results are shown in Figure 3.3.1.



(1) Correlation analysis of green area and its cooling range



(2) Analysis of the correlation between green area and its cooling range



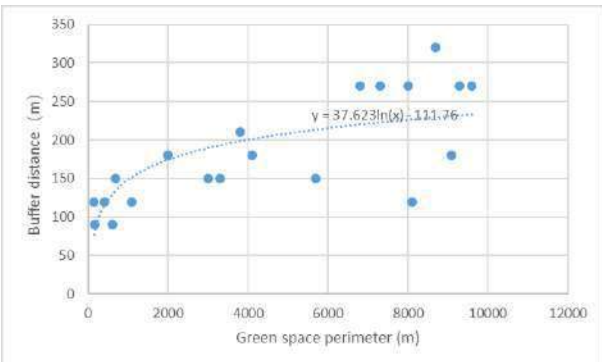
(3) Correlation analysis of the maximum difference between green area and its cooling

Figure 3.3.1 Correlation analysis of green area on cooling effect

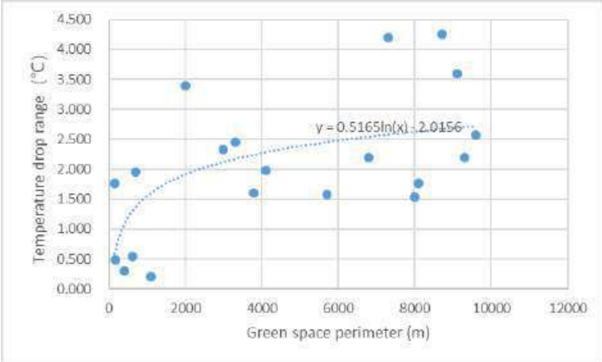
Regression analysis was performed on the above area correlation analysis and the equations were fitted. The relevant equations are y=31.535ln(x)+74.19, y=0.4927ln(x)+0.3292, y=1.2016ln(x)+3.8761. The area of green space and its cooling range, cooling range and maximum temperature change inside and outside the green space are logarithmically related. Within a certain range, these three indicators increase with the increase of the area, but the rising ratio gradually decreases with the increase of the area. According to the analysis of the research data, it can be found that when the green area is increased to about 23 hectares, it is most economical to increase the cooling effect.

3.3.2 Correlation analysis of the effect of green space perimeter on cooling effect

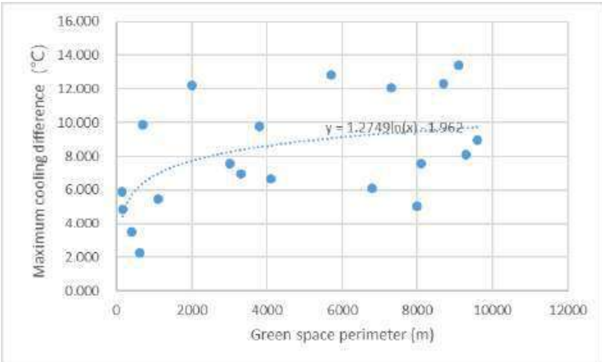
Based on the statistics of the urban green space perimeter and the green space cooling range and the green space cooling range, the regression analysis of the green space perimeter and its summer cooling range, cooling amplitude and maximum temperature difference are performed respectively. The results are shown in Figure 3.3.2. Show.



(1) Correlation analysis between the perimeter of green space and its cooling range



(2) Correlation analysis between the perimeter of green space and its cooling range



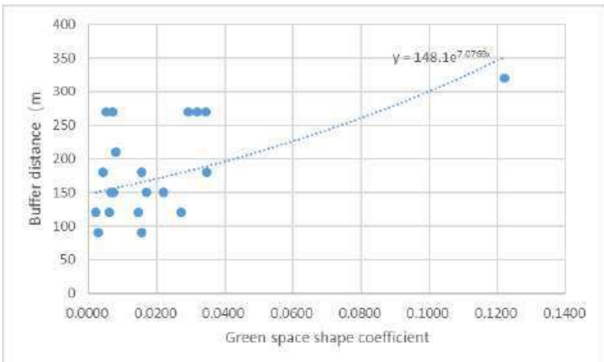
(3) Correlation analysis of the maximum difference between the perimeter of green space and its cooling

Figure 3.3.2 Correlation analysis of the effect of green space perimeter on cooling effect

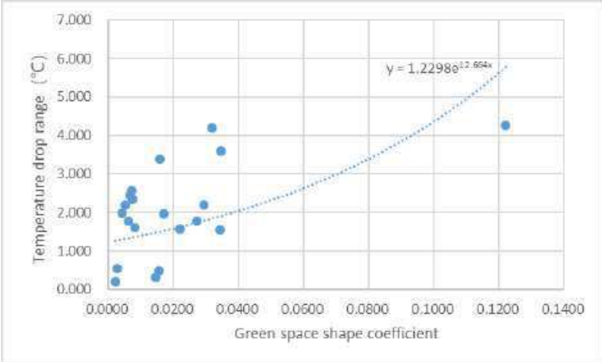
Regression analysis was performed on the above correlation analysis of the circumference and the equation was fitted. The relevant equations are y=37.623ln(x)-111.76, y=0.5165ln(x)-2.0156, y=1.2749ln(x)-1.962. The perimeter of the green space is logarithmically related to the range of cooling, the magnitude of cooling, and the maximum temperature change inside and outside the green space. Within a certain range, these three indicators increase with the increase of the area, but the rising ratio gradually decreases with the increase of the area. The analysis found that it is most economical to increase the perimeter of the greenbelt within 4800m.

3.3.3 Correlation analysis of green space shape index on cooling effect

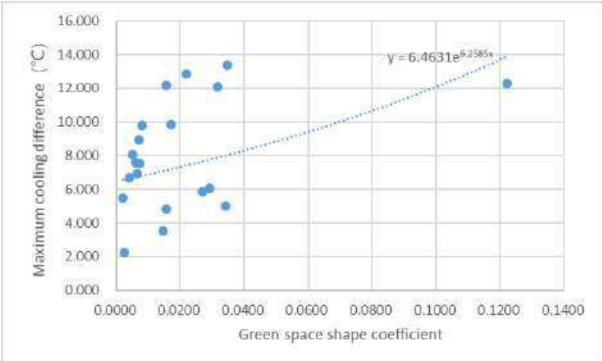
Based on the statistics of the urban green space shape index and the cooling range of green space and the cooling range of green space, the regression analysis of the green space shape index and its summer cooling range, cooling temperature and maximum temperature difference are carried out. The results are shown in Figure 3.3.3. Show.



(1) Correlation analysis of green space shape index and its cooling range



(2) Correlation analysis between green space shape index and its cooling range



(3) Correlation analysis between the shape index of green space and the maximum difference of temperature drop

Figure 3.3.3 Correlation analysis of green space shape index on cooling effect

Regression analysis was performed on the above correlation analysis of the circumference and the equation was fitted. The shape factor is the green area divided by the green perimeter. Therefore, the larger the shape factor, the more regular the green shape is. It can be seen from the curve in the figure that as the shape factor increases, the range of green space cooling, the temperature drop range and the maximum temperature difference are also gradually increasing. That is, the more regular the green field is, the better the cooling effect of the green space is.

6 Conclusion

6.1 Research conclusions

This paper uses the data contained in Landsat ETM remote sensing images from 2003 to 2017 to extract and map the temporal and spatial evolution of surface temperature and vegetation coverage in Haidian District, Beijing, and study the correlation between the two variables of surface temperature and vegetation coverage. It was found that the rapid development of the city and the substantial increase in the land used for construction in the past 15 years led to an overall decline in vegetation coverage and an overall enhancement of the heat island effect. In addition, studies have shown a significant negative correlation between surface temperature and vegetation coverage. Vegetation coverage increased by 10%, the average surface temperature can be reduced by 0.84℃ ~ 1.67 ℃, the average urban temperature is reduced by more than 1℃ in summer, and the local area can be reduced by more than 5 ℃, significantly improving the outdoor experience of urban residents.

At the same time, through the study of 20 plots selected in the study area, the green area and perimeter are significantly logarithmically related to the summer cooling range, cooling range, and the maximum temperature difference of the green space. It is most economical to increase the green space by appropriately increasing the green area within 23ha or increasing the green space perimeter within 4800m. The more regular the urban green space is, the better the cooling effect will be.

6.2 Recommendations and measures

The following suggestions are proposed for the green space planning of Haidian District:

(1) Through the optimization of industrial functions, intensive use of land, ecological restoration of wasteland and bare land, rational planning of park green space layout, and increase urban green space.

(2) To make full use of urban space to develop greening, use the techniques of roof greening and vertical greening to improve the coverage of green space. For the area where heat emission is concentrated, the city's “cold island” can be constructed through the combination of green space, water body and ventilation corridor to alleviate the heat island effect.

(3) When adding or renovating green space, combined with the actual situation to control the green area, shape and other factors, appropriately increase the urban green area or perimeter, control the green space form more regular, and improve its efficiency in reducing ground temperature.

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Symbiosis with Rivers: The Management of Flood Respond to Climate Changes from the Perspective of Landscape Planning

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Extreme weather caused by climate changes, especially heavy rains and flooding, have repeatedly plagued urban areas. Thus, we should find a solution to disasters based on the idea of resilience by establishing a place that can adapt to the temporal dynamics. In order to ingeniously handle the management of flood as well as symbiosis with rivers, detailed strategies from the perspective of landscape planning are provided through our projects or studies.

1. Background: The Changes of River System and Waterfront Environment in Guangzhou

Owing to historic reasons and special circumstance of modern China, the evolution of river management in Guangzhou is unique compared to most cities. As a well-known oriental sea port and the starting point of the “Marine Silk Road”, Guangzhou was born because of its location on Pearl River System. The tributaries of Pearl River named "Chong", which were densely distributed throughout the city, represent the most characteristic kind of rivers in Guangzhou, forming the backbone of the city's water system.[1] With a small amount of water, they were natural waterways directly connected to major rivers. In the urban area, there are 238 rivers with a total length of 913 km, which merge into Liuxi River, Baihe River and Pearl River.[2] And they employed an important influence on regulating water levels because of being affected by tides.[3]

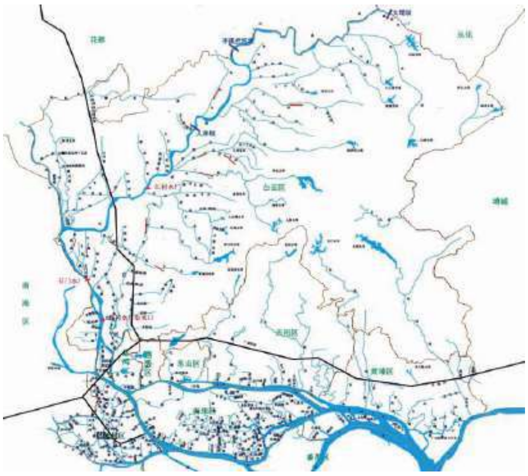

Figure 1: "Chong" and other water system (quoted from Planning of water system in Guangzhou)

1.1 The Period of Rivers' Cultural Development

Throughout the its long history, these rivers, as well as their environment, have been closely connected with people's daily lives, because they shoulder not only the city's task of flood management, irrigation and shipping transportation, but also the back lanes of residents' lives, such as taking water, washing, daily traveling and even recreational activities. Thus, instead of a merely beautiful natural landscape, the urban riverfront is a unique cultural landscape, which has shaped the urban spatial pattern of style for more than 2,000 years. For example, East Hao Chong, once a moat in the Ming and Qing Dynasties, has gradually formed a commercial center along the river at the end of the feudal society, supporting the development of business. [4]

1.2 The Period of Rivers' Traffic Decadence

However, in the 1910s, with the modern urban city-building movement, Guangzhou began to demolish the ancient city walls, constructed a great variety of municipal roads, which eventually became the main transportation system.[2] As a result, the traffic function of the rivers began to degenerate even gradually disappeared, signing an evident trend of transport declining, nevertheless, they did not lose their main function as the drainage channels. The development of the city was slow and orderly, [3] and the rivers, with high quality of purity, at that time still played an important role in the urban ecosystem and residents' lives.

1.3 The Period of 'Over-engineering' Rivers

After the 1950s, with the rapid development of the city's economy and the population growth, because of the disordered construction and management of the surrounding areas along rivers, the intensive buildings altered the original natural bank form of the river, weakening their capacity of flood discharge. Consequently, the riverfront repeatedly experienced guilt during rainy season. In order to solve the problems, Guangzhou reformed the urban drainage system from natural embankments to upright rigid embankments under the guidance of the idea of flood control at that time. There is no doubt that destruction of river system seems to be inevitable in the process of rapid urbanization. Moreover, Massive rivers were 'over-engineering', especially when Guangzhou in an all-round way started to unify the open channels into underground channels with city roads on its cover. Those open channels with slate were changed to underground channels with reinforced concrete box culverts, as we can see in Xiguan Chong and Yudai Hao. [2] What caused more serious problem is that the pollution of industrial and domestic sewage discharged into rivers was increasing, so the rivers in the central city become black and odorous as sewage pipes for the city.

1.4 The Period of 'Disappearing Rivers'

After the 1970s, especially the beginning of the Reform and Opening-up in 1979, Guangzhou entered a new period of booming development and its urban area has expanded dramatically. Thus the urban landscape has undergone major changes in the rapid increase in population, traffic jams, and the emergence of viaducts. However, the deterioration of the riverfront water environment was still intensifying. The environmental problems and traffic pressure brought about by the abnormal development of the urban construction have caused more rivers to lose their original ecological functions and landscape environment. As a result, many rivers in the city have gradually disappeared such as West Hao Chong, Yudai Hao, Lizhi Wan and many other rivers have been replaced by underground culverts. Only the effluvial East Hao Chong flows on the ground with the high-rise buildings around, with scarce slate road left over from history. The original bustling life scene disappeared and the river have almost been forgotten by the world. [3] There is no longer the scene of 'clear creek and green space' everywhere and Guangzhou lost its 'Water City' feature. What's more, the quality of rivers are becoming increasingly polluted and blocked. In 2016, the rivers that did not reach the standard of water quality accounted for 88.79% of the total. Consequently, urban water systems can hardly cope with environmental problems such as floods, intensified by the climate change.

Since the 21st century, more and more people have improved the awareness of the rivers' importance to the urban ecology and living environment.[5] However, the contradictions between gray infrastructure and green infrastructure are particularly prominent. There are two core problems of the rivers' status: the decline of the urban water system and the decline of urban space. The former, caused by being covered, has resulted in serious water pollution and weak capacity of flood management. The latter, plenty of negative activities such as illegal possession and garbage dumping, has led to the monotonous urban space without regional features and vitality. Thus it is against this background that we have started this large-scale project of comprehensive renovation of rivers.

Figure 2 "Chong": From the unique cultural landscape to the underground 'over-engineering' channel

2. Objectives: The Concept Based on the Idea of Resilience

Taking Guangzhou's intrinsic and unique features of urban river network conditions into consideration, this project seeks to find a solution based on the idea of resilience by establishing ever-changing urban renewal places that is symbiotic with rivers. The city's adaptation to disasters should reflect the temporal dynamics. The traditional engineering measures dealing with flood only with a single function of defense, or simplex ecological remediation, resulting in waste of urban space and resources.
Our plan is proposed to improve the construction and development of the cities built downstream along the river by solving the problems both under covers and on urban surface. The water flow plays a role of transporting sludge to the confluence or estuary considering time effect. A system aiming to transform sludge into humus is constructed underground, which will also provide opportunities for the renaissance of urban green space. After uncovering, various possibilities were re-introduced into the city and the waterfront areas became the basis for activating the urban space once decayed. Except for protecting cities from flooding it also has the function of revitalizing the public space and improving the eco-environment. Moreover, it is also an optimal strategy of balance between the tense land use and the protection of natural ecology.

3. Methods: Three Main Stages and Ecological Technology

Through on-site investigation and cases study, an exploration aiming to bring the covered river to light again through landscape strategies is proposed through in three main phases:

Figure 3 The Mode of Three Main Stages

3.1 Stage Ⅰ: Restoration Plan Both on the Urban Surface and Underground

In the first stage, in order to form the foundation of ecological and cultural river restoration, reconstruction is divided into two parts: the treatment plan on the urban surface and underground. On the one hand, underground excavation is conducted locally to form a stagnation space, where sludge is transported to by the process of river's automatic force. Then biogas power generation is used to convert concentrated sludge into humus. On the other hand, at the beginning of the restoration of the river, we ought to find waste space and potential areas on the ground to build some pocket parks. And electricity generated by that process of biogas could partly supply public infrastructure. The sludge transformation system is constructed underground since oxygen is exposed through openings of equipment on the ground, which will also provide opportunities for the construction of green space and the renaissance of urban public space. After uncovering, the purified sediment can be used directly for the construction of the revetment, as the foundation of the new waterfront space composition. So there is no doubt that it is an efficient way to restoring ecosystem of the rivers.

3.2 Stage Ⅱ: Uncovering and Diverse Treatment of Revetments

In the second stage when the regional sludge water system has basically been constructed, the large amount of sludge under the cover plate would gradually transform into soil containing humus, which will become the foundation of the new waterfront space composition after opening the cover plate. Obviously, the river will become visible, evoking the public environmental awareness. In particular, it is necessary to consider the status and adopt targeted methods to reconstruct revetments for different levels of urban density.
While uncovering sufficient space for the urban ecosystem, the comprehensive rectification of riverfront must first adopt diverse treatment of revetments according to the specific conditions of different rivers, making the river line richer in both morphology and function.[6] Because the revetment of river is not only a defensive line to ensure the safety of watershed, but also an important component of the waterfront landscape and spatial utilization. Modern ecological technologies are used to design different riverbeds and revetments including semi-permeable fabric-formed concrete channels, tubular mesh fabric growing containers and gabions in limited estuary water level change areas, different ways to form a high ecological potential green infrastructure that has flexible functions of flood control, as well as meets the needs of various animals and plants. For example, in the downtown area, where the space is relatively confined with over-engineering revetment, semi-permeable fabric-formed concrete channels and multi-level platforms with tubular mesh fabric growing containers are set up in order to meet the flood control requirements.[8] Only by this way could we weaken the rigid coastline to form an interesting waterfront with various needs such as hydrophilicity and recreation. In different circumstance, there is wide range for ecological restoration of the river, especially on the outer edge of city. For the treatment of such river banks, the design mostly uses natural grading treatment with natural materials such as rubble, wooden piles and gabions to stabilize slopes, and sometimes it also includes tubular mesh fabric growing containers to form a flexible ecosystem with functions of flood control.

3.3 Stage Ⅲ: Reactivating urban space with Diverse Possibilities and Technology of Water Purification

In the third stage, in the case that single landscape could be easily eroded by the construction of other lands, aggregation and transformation is necessary in the contemporary context rather than tearing apart river and city. The new functions replaced the original monotonous blocks, giving the blocks diverse possibilities, consequently the old city's space being reactivated. Meanwhile, humanistic landscape on river bank of architectural culture heritage protection and leisure space construction are involved in integration method.
There are three representative types of revival spaces. Cultural rivers, as the first type, are mostly located in the old urban area of the city with an attractive style of historic neighborhood, surrounded by a great variety of historical and cultural resources. There are massive scenic spots such as Morning Tea Market, River Museum, Outdoor Café, Street Corner Garden and so on. The second type called rejuvenated rivers, located in the developing part of urban area, have a lot of opportunities for the development of commerce and entertainment industries. The industrial transformation and activation of public space will make it the central area of future urban vitality, as we can see in City Terrace, Waterside Theatre, Water Steps and Bridge Park. Because of being located in urban fringe areas and important ecological nodes, the third type named ecological rivers have plenty of room and flexible space. Through Silt Garden, Rainwater Pond, Suburban Wetlands and Popular Science Park, in the future, they will become important regional eco-corridors or ecological parks.

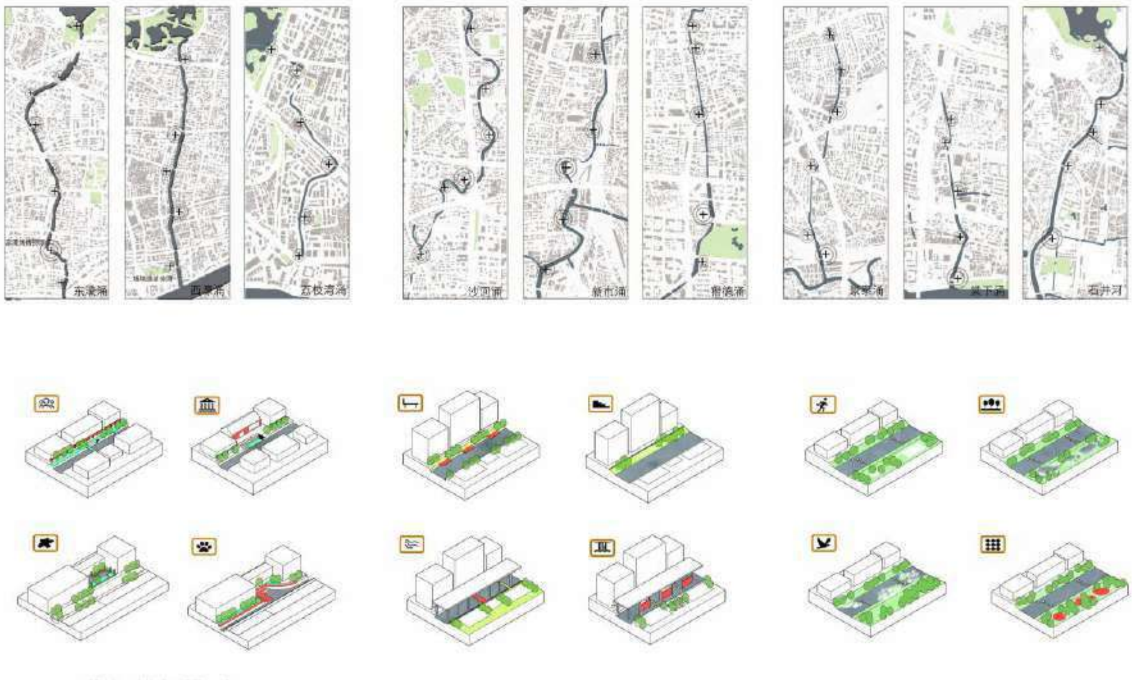

Figure 4 Three Representative Types of Revival Space

Water purification in the river is another important, long-term ecological mechanism for the comprehensive renovation. Plant purification is a common method: combining the requirements of the landscape, a combination of aquatic plants with highly effective purification is planted in the river fluvial to achieve the effect of adsorbing and degrading river water pollutants and purifying sewage. Since many rivers in the city are tidal rivers, the water level varies greatly with the tide of the Pearl River. In order to solve the impact of water level changes on wetland plants, ecological floating beds have been widely used for planting aquatic plants. The ecological floating bed is free to rise and fall as the water level changes, and it can respond well to tidal changes.[7] Moreover, aquatic plants, semi wet plants and damp-tolerant terrestrial plants preserve the natural environment and waterfront habitat as much as possible.[2] Through the purification of water quality, the rivers in the central urban area have changed from stagnant water to live water, and the river water environment has been improved.

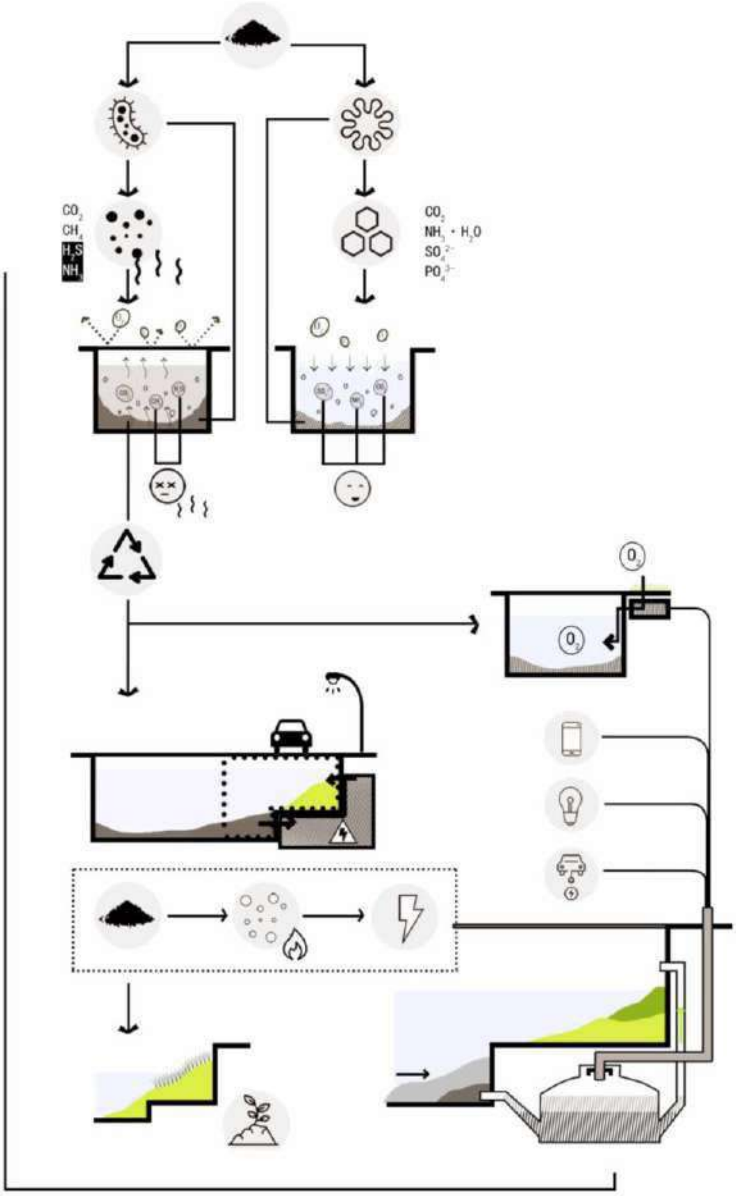

Figure 5 The Technic Mechanism of Ecological Restoration

4. Methods: Regional Renewal Strategy in a Large Scale

In a large-scale planning, the regional update strategy is also conducted through three main phases: taking Guangzhou's unique terrain and surrounding mountains into consideration, in the first phase, while starting ecological restoration of mountains, the sewer network is constructed as the foundation of all other process of ecological restoration.

Most of the rivers in central Guangzhou have lost their navigational functions, however, they are still the city's 'blue line' in the psychological of the public.[2] So in the second phase, we clearly defined the control area of rivers and the band-shaped green space reserved for the rivers. The control area of rivers could not only act as the natural site for the construction of the urban ped-bike system, but also guide the public to intimate contact with the waters, establishing dialogues and exchanges between the 'blue line' space and the greenway system.

In the third phase, various possibilities were re-introduced into the city and the waterfront areas became the basis for activating the urban space once decayed. Ultimately, the riverfront environment can serve city life in a more extensive scope. In return, river network regeneration can benefit from the urban space revival.

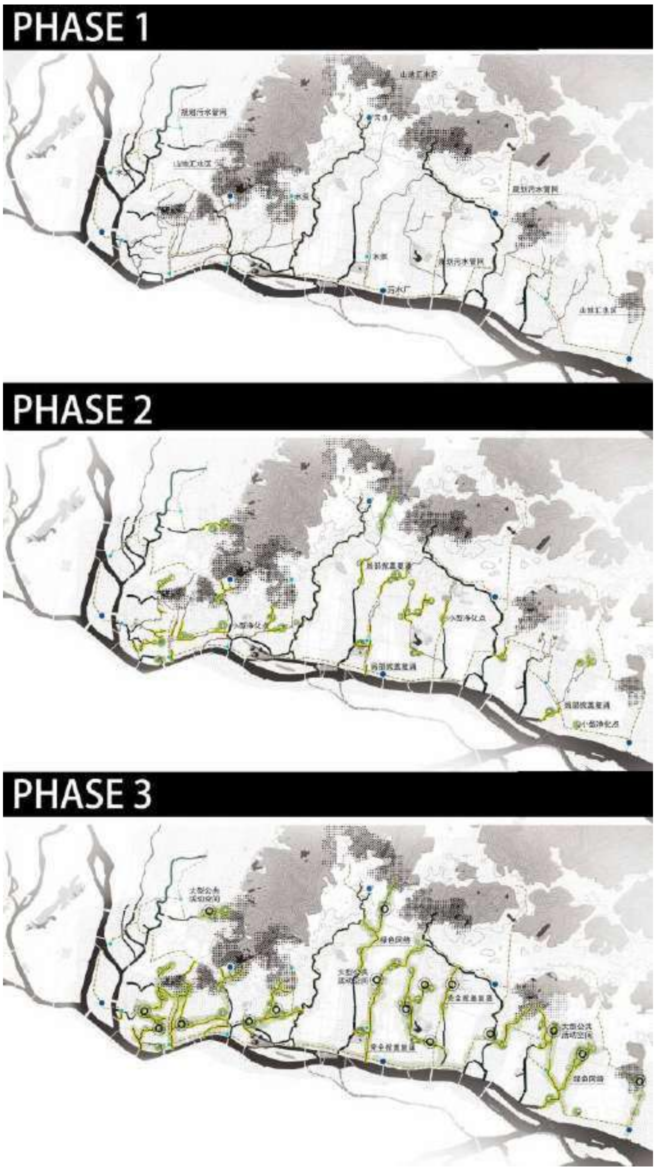

Figure 6 Regional Renewal Strategy

5. Results: Unique Space to Rebuild Close Relationship Between Waterfront Environment and Urban Life

Once as a real 'water city' being born in water and living in water, the river network in Guangzhou is widely distributed everywhere just like lanes, so the rivers are original place where the residents have live for thousand years, which employ an indispensable influence on their life-styles, however, after decades of urban development, the rivers have become no longer relevant to everyday life in urban city. The rivers are not only an important component of the urban ecological environment, but also a stage for the urban life. So the improvement of the riverfront environment is not only a simple ecological restoration or scenic construction of rivers, but also a repairing process of the relationship between city and river.

Taking social concern of riverfront improvement into consideration, urban riverfront remediation should fully measure the functional orientation, cultural inheritance, and life style of the surrounding urban area, so that it will become a space truly correspond to Guangzhou's flavor, carrying local life-styles. For example, if the houses along the riverbanks of East Hao Chong, once a moat in Guangzhou with a long history, were almost demolished during the renovation, the living space pattern of this area, which was rich in old Guangzhou, will disappear. In terms of the protection of urban life forms, the complete construction is often irreversibly destructive. While preserving selective part of the residential area and it will be transformed into an integral part of the riverfront green space. The existing neighborhood and unique urban life will continue, which should be a better choice to create more vitality with the temperament of Guangzhou.[3] Eventually, far from reverse to river as it used to be, the vitality of the waterfront environment will redirect the urban life facing the river, rebuilding the close relationship between waterfront environment and urban life. It is bright future prospect to contrive a beautiful vision of harmonious co-existence between people and river through the phased rejuvenation strategy of ecological restoration, exhumation and spatial integration.

Figure 7 Diverse Space to Rebuild Close Relationship Between Waterfront and Urban Life

6. Enlightenment of Constructing Green Infrastructure Based on Ecological Restoration of Rivers in Guangzhou

As we can see in restoration of rivers in Guangzhou, there is no doubt that the implementation of green infrastructure in the process of rapid urbanization is bound to encounter unimaginable difficulties, but it also contains unprecedented opportunities. I would like to conclude the enlightenment of constructing green infrastructure.

In urban construction, we must strictly protect existing key natural ecological areas that have not been destroyed through forward-looking planning. Next, we must seize the opportunity of urban development to explore a series of potential urban space construction and restoration of natural functions through creative means.[9] In particular, it is necessary to consider the combination with the urban status and adopt more targeted strategies and methods to reconstruct green infrastructure for natural, semi-natural, productive areas, suburban expansion areas, low-density and high-density urban core areas.

Moreover, the updated space with renewal of urban area could constitute green infrastructure with internal connectivity and systematic natural ecological functions, which would be compatible with the spatial and functional characteristics of modern cities. It is not merely a natural space, but also an efficient ecological framework for ensuring sustainable social and economic development, and an optimal strategy of balance between the tense land use and the protection of natural ecology. Some single landscape strategies can easily make the land eroded by the construction of other land. Instead, a compound urban strategy should be adopted to focus on the vitality and development potential of the multi-functional space, clearly defining a mixed proportion of land uses.

In addition, the green infrastructure in the urban environment must be protected by artificial means to make it more efficient,[9] reduce its existing vulnerability, and rely on the continuous development of advanced technologies and engineering facilities to enhance the functional efficiency of the green infrastructure.

The last but not the least, the construction of green infrastructure needs to solve the problem of short-sightedness, which only exists in the immediate future, which prevails in the process of rapid urbanization. It fully recognizes that its ecological role is played gradually, but its functional effect is long-lasting and low-cost. It will be a long-term development strategy and long-term ecological mechanism for the “green modern city” in the future.

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Track 5

SOCIAL NETWORKS:
Citizen Participation, Urban Governance and Cultural Transformation

Evaluation of public space vitality of based-scenic villages in subtropical climate region：*A case study of Guanhu Village in Shenzhen*

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Abstract：

With the rise of short-term tourism, more and more urban residents go to scenic spots around the city for short-term holidays. It brings new vitality and opportunities to villages around the city, and also brings some issues. Tourists instead of villagers became the main user of space. It leads to the function of the original public space could not meet the new demand anymore. And a large number of new illegal building disrupted tourists' activities in the village public space. These two phenomena lead to the serious problem of public space vitality. At present, there are many studies on the optimization strategy of village space, but there is no quantitative research on the public space vitality of villages. Establishing a method to evaluate the public space vitality (PSV) of based-scenic villages in subtropical region based on tourists' preferences is the purpose of this study is to. First of all, Analytic hierarchy process (AHP) was used to determine the influence factors and factors weight of public space vitality (PSV), basing on which the evaluation system of PSV is established. Secondly, analytic hierarchy process was applied to Guanhu Village, a typical subtropical village with sea view in Shenzhen.Then, important-performance analysis was conducted to diagnose the strengths and weaknesses of PSV of Guanhu Village. Findings suggest those high score for both important and performance , such as Number & layout of entrance, Function type of building and Density of leisure facility are tourists' key evaluation factors of PSV. This paper extends previous research on based-scenic village, and offers insights into the theoretical investigation and practical development of PSV of based-scenic village in subtropical climate region.

Keywords: *Subtropical Climate Region; Based-scenic village; Public space vitality; Analytic hierarchy process (AHP); Importance-performance analysis (IPA); China*

1. Introduction

With the rapid development of urban economy and social change, urbanization in China has grown year-by-year and reached an urbanization rate of more than 50% in 2010. Nowadays in China, many rapid-growth cities suffer from various urban problems, such as environmental pollution, space exhaustion and traffic jams. According to the research of two psychotherapists, Buzzell and Chalquist (2010), urban residents need to find a place, where they can reconnect themselves with nature and natural cycles of human life, to slow down their lives and experience different culture. Based on the Chinese residents' improvement of the living standard and changes of consumption ideas, more and more people are willing to travel to the scenic spots near the city on short-term holidays to relieve pressure and relax themselves. Because of its rich tourism resources and the position advantage, the scenic spots and villages near cities have become the first choice for urban residents to travel in the short term.

The concept of based-scenic villages was first proposed in "the administrative measures of famous west lake scenic villages in Hangzhou". It defined the based-scenic village as a tourist village located within or around the scenic area. Such villages have a strong dependence on scenic spots and share tourist sources with them. Based-scenic village and scenic spots complement each other in terms of tourism resources and tourism products. The based-scenic villages play an important role in the improvement of tourism service function and environmental quality of nearby scenic spots. In terms of industry, these villages have expanded the traditional agricultural industrial chain, developed their own tourism resources. Affected by the radiation spillover effect of the scenic area, the village has completed the transformation of tourism. In terms of social structure, and the lifestyle of traditional agricultural activities has been disintegrated. The population composition of villages is becoming more and more complex, and it is in the state of mixed local villagers, other investors and tourists. From the perspective of management model, most villages still retain the economic model of collective ownership. Land ownership and administrative management mainly rely on the village collective and it also restricted by the management mechanism of scenic spots. From the perspective of spatial characteristics, these villages often retain the original village texture and local traditional landscape characteristics. The agricultural function of the original space has transform into function of tourism service. The original public space in the village died out, while the new public space appeared.

With the continuous development of the based-scenic village, more and more studies have been put forward. Most researches tend to put forward specific development strategies, and ignore the space problems which arises in the process of traditional village turns into based-scenic village. It also ignores the special characteristics of based-scenic village in different regions and climate conditions. The optimization strategy of based-scenic village lacks strong theoretical support. Therefore, it is necessary to establish a feasible quantification method which can be used as a measurement standard for the public space vitality of based-scenic village. This study selected a based-scenic village in subtropical climate region as the research object, fully taking into account the demand and the comfortable experience of tourists in the region. The activities of the tourists is the source of public space vitality.

According to the previous relevant studies, this study establish the evaluation system of the PSV of based-scenic village. This evaluation system is based on the integration of Analytic Hierarchy Process (AHP) and Importance-Performance Analysis (IPA).AHP identifies layers of evaluation criteria related to attributes of PSV, whereas IPA further measures the gap between importance consideration and performance aspect that in turn affects the vitality level of public space. Precisely, this study has two-fold objectives: (1) to investigate and quantify PSV of based-scenic village, and (2) to advance the theoretical framework of PSV research in the context of the development of suburban tourism in subtropical areas. Through the inclusion of an empirical study in the case of Guanhu Village in Shenzhen, the findings will give useful implications for the improvement and reconstruction of PSV when the tourism authorities plan to transform the traditional villages into tourism destinations.

This research can shed lights on the theoretical investigation of PSV on the whole by introducing a quantitative evaluation system of public space attributes. This study can analyze and utilize the advantages and disadvantages of the development of the based-scenic villages. Guanhu Village is a fully-established based-scenic village where tourists have become its primary place consumers. The original villagers have moved away from the village, and tourists have become the main activity groups here. Therefore, this study focuses on tourists and does not discuss the original villagers.

2. Literature Review

2.1 Study on adaptation in subtropical Region

Most studies on public space planning in subtropical areas focus on people's comfortable sensation. The space users in subtropical areas mainly feel thermal comfort in public space. The temperature of public space will affect the behavior and psychological feelings of space users. In hot seasons, people usually have a strong preference for cool temperature and weak sunshine. Seeking shade of trees is the first choice for users to adjust their behavior（Lin T P，2009）. Studies have shown that in hot environments, the shadow provided by trees can effectively reduce the surface temperature of the shaded area. Therefore, the effective application of green plants can improve people's space experience in subtropical areas（Shashua-Bar et al.，2009；Drake M & Guaralda M,2013）. While trees can provide shade and reduce short-wave radiation. However, too many trees can reduce wind speeds, which is another important factor for people's comfort in subtropical public space（Yoshida et al., 2006; Gromke et al., 2008）. Tree shade and wind speed are two important indexes for preliminary evaluation of space thermal comfort. It is best to have shade and good ventilation. Therefore, there is a trade-off between planning measures to reduce solar radiation and improve wind speed（Hsieh C M et al. 2016）. In addition to environmental factors, the feelings of space users are related to the natural nature of the environment, the psychological expectation of users and the purpose of behavior. People are usually more tolerant of more natural environments. In different seasons and space, people's expect and comfortable sensation are different. Studies have shown that people with specific travel goals are more tolerant of public space and better adapted to the environment（Nikolopoulou M, Steemers K, 2003）.

2.2 Based-scenic village

The based-scenic village is a tourist village which is developed by the tourist source of the scenic spot and the unique tourist resources in the countryside. This kind of villages have strong dependence on scenic spots, and share with tourists in scenic spots, complementary resources and products, which has an important impact on the improvement of scenic function and environmental quality(Hu, 2013). From the perspective of social characteristics, village style characteristics and industrial mode, the dual attributes of landscape in the village with the "scenic spot" and "village", is located in the scenic area within the tourism is the main industry in the village, while retaining the rural style, collective ownership economy and land ownership, but the villagers to farming the way of life has collapsed (Zhou, 2016; Hou, 2007). Compared with the general rural settlements, the characteristics of scenic village are not only located inside the scenic area, but also have the characteristics: the use of their own natural cultural resources to develop tourism industry, the village land resources are generally scarce, the rapid population flow of villages (Zhang, 2013). Using the method of multiple regression analysis, starting from the characteristics of the development of scenic areas and villages, it proposed an internal force scenic-based tourism village and the center view of coupling development in difference potential, catalytic potential, management potential and more stable potential, and on this basis, in-depth to explore ways to view the development of coupled Village (Yang, etc. 2011).

2.3 PSV of based-scenic village

Urban vitality is composed of economic, social and cultural vitality (Jiang, 2007). The vitality of urban public space is the ability of all kinds of landscapes to attract, diversiform and continue to carry on activities for a long time (Zhang & Xiao, 2016). There are many aspects of evaluation of vitality, which are reflected in urban open space (Yao, 2012; Wang, 2012), campus public space (Zheng, etc. 2016), neighborhood vitality (Dong, 2015; Zhu, 2016), street vitality (Jiang, 2012; Gou, 2011), and less evaluation of village public space vitality. Some scholars appraise the village public space based on the satisfaction of farmers (Li, 2014; Wang & Zhang, 2016). Some scholars evaluate public space from the perspective of tourist satisfaction (Zhao, 2013; Chi, 2016). However, the evaluation of the vitality of based-scenic villages is less.

Considering the above previous methodological ideas of PSV assessment in different parts of China, this paper firstly uses AHP as the fundamental and multi-attributed approach to frame and measure the in Guanhu Village’s PSV from a touristic perspective, and then applies IPA to diagnose the strengths and weaknesses of the PSV based on the ratings and weightings of each attribute on site. AHP was introduced by Saaty (1980) as an approach to allocate the relative importance of evaluation items based on weights of criteria (Hsu & Tsai, 2009). IPA was introduced by Martilla and James (1977), who initiated this method in marketing analysis and planning. They suggested two dimensions, importance and performance, to prioritize the actions or improvements to be considered by decision makers in various fields of service quality and customer management (Duke & Persia, 1996; Arbore & Busacca, 2013). This method has been widely adopted in research areas such as airport and airline services (Mikulić & Prebežac, 2011), tourism policy and development (Evans & Chon, 1989; Coghlan, 2012; Li, 2012; Lai & Hitchcock, 2015; Sever, 2015), hotel operation (Chu & Tat, 2000; Pan, 2015), and so forth. One research methodological gap in the previous studies was the dearth of tourist perspective in the tourist resource assessment. Most of the assessment exercises were conducted by panels of experts and this study therefore makes an attempt to consider tourists' satisfaction with the PSV resources as the key component of the evaluation system.

Following the idea of combining IPA with other useful analytical tools (Lai & Hitchcock, 2015; Sever, 2015), this research investigates tourists' perceptions of the levels of "importance" and "performance" of the AHP-framed PSV attributes, and further diagnoses the strengths and problems of PSV in Guanhu Village.

3. Methodology

3.1 Identifying evaluation items of PSV

Based on the existing evaluation system of public space vitality, this paper finds that many scholars discussing the PSV from two aspects, representational elements and constitutive elements. They believe that the behavior and activities of space users, as the Visual representation playing a similar important role on the evaluation of PSV like the factors of material environment. The environmental factors of public space are usually divided into macroscopic, mesoscopic and microscopic aspects, corresponding to the traffic accessibility, the interface features, and the internal environment of the public space. Besides, service facilities and maintenance management factors in public space are also important primary indicators of PSV. Summary, this paper divides the evaluation index of PSV into 7 primary indicators: users, activities, traffic accessibility, surface, internal environment, service facilities and maintenance management. According to the existing 17 paper researching on evaluation of PSV, we found 40 frequency secondary index. The User has 4 secondary index, Activity has 3, Traffic accessibility has 6 index, surface has 6, internal environment has 12, service facilities has 6, and management maintenance has 3 index. These index have the particularity of their research, and the different quantitative and qualitative methods of PSV lead to the same indicators has the different definition. Besides, this research have to consider the particularity of the PSV of based-scenic villages in subtropical climate region. So it is necessary to screening the index.

The PSV of based-scenic village is different from the general urban public space. It has the typical characteristic of public space village, and different from traditional villages. Affected by tourism development, the form, function, activities and users of village public space have all changed. From the perspective of tourism development, the based-scenic village affected by the around scenic areas, and the life style of agriculture has changed. Original villagers had moved away, and tourists living in nearby cities crowed into the village through external transportation. Therefore, the accessibility of space and external traffic, the degree of close connection with scenic spots and the variety of tourism activities available become the key to attract tourists. These will affect the number and last time of tourists in the public space, which is an important indicator of the vitality of the public space. In addition, the needs of tourists in the village public space are different from those of villagers, who have three needs: food, shelter and travel. Then, the corresponding indicators such as tourism service facilities and functional types also need to be included in the set of indicators. From the perspective of tourists' short-term residence, in order to better meet tourists' demand in public space for living in, it is necessary to take into account the evaluation indicators such as tourists' night activities and leisure activities, such as public infrastructure, night lighting and transportation facilities within villages. Besides, the night activity facilities also can improve the PSV at night. From the perspective of the location and regional characteristics of the climate zone, the based-scenic village affected by the nearby scenic spots and the climate region, formed special regional characteristic. This paper choose the based-scenic village around seaside as the example. The coastal resources, the home stay facility culture and coastal activities are also the key points to be evaluated. Besides, in the subtropical climate region, it is usually hot and rainy in summer and mild and rainy in winter. Tourists usually have higher requirements on shading facilities and ventilation in public space

In conclusion, 34 indicators were selected to form the final set of evaluation indicators (Table 1).

Criterion layer(6)	**Sub-criterion layer(34)**
User (B_1)	Number of user (C_1)
	Type of user (C_2)
	Density of user (C_3)
	Duration on site (C_4)
Activity (B_2)	Type of activity (C_5)
	Frequency of activity (C_6)
Traffic accessibility (B_3)	Distance between public space and beach(C_7)
	Distance between public space and parking(C_8)
	Number & layout of entrance(C_9)
	Number of public transport station (C_{10})
Surface (B_4)	Function type of building (C_{11})
	Density of shopping (C_{12})
	Proportion of assessable building(C_{13})
	Degree of space enclosure(C_{14})
	Characteristic of building surface(C_{15})
	Elevation of boundary(C_{16})

	Size of space(C_{17})
	Depth-width ratio of space section(C_{18})
	Safe of traffic(C_{19})
Internal environment (B_5)	Surface roughness (C_{20})
	Occupation rate of pavement by vehicle (C_{21})
Internal environment (B_5)	Sunshade ratio (C_{22})
	Green ratio (C_{23})
	Wind speed (C_{24})
	Character of landscape element (C_{25})
	Density of leisure facility(C_{26})
	Sign of road(C_{27})
	Density of light facility(C_{28})
Service facility (B_6)	Density of dustbin (C_{29})
	Number of public toilet (C_{30})
	Density of obstacle-free facility (C_{31})
	Density of activity facility (C_{32})
Management & maintenance (B_7)	Frequency of cleaning (C_{33})
	Maintenance of facility (C_{34})

Table 1: Framework of the system for evaluating tourist satisfaction with PSV

3.2 Study site

The second stage is the analysis of the study site, Guanhu Village, by observation. Guanhu Village is a tiny coastal village covering a land area of 22 hectares located on Dapeng peninsula in Shenzhen (Figure 1). Guanhu Village is located in Dapeng peninsula of shenzhen city, belonging to Kuichong street of Dapeng new district. Guanhu Village is located on the north side of Guanhuchong beach, west side of Wangyuling park, east side of Dongjiang Column Memorial park. Along the main roads in the village about 1000 m west of Guanhu Village we can go to Shayuchong Village. Guanhu Village has good tourism resources. Due to its location in the urban fringe (approximately 58 km away from the city center) and its characteristics (different from most urbanized villages in China), Guanhu is considered a tourist village rather than rural village in this study. Most of villagers have moved from the village, and only 50 registered resident population and merchant managers of nearly 110 are living in the village now. During the last decade, the main income source of the villagers came from an industrial building lease to the Dapeng Cooperation Company.

In 2011, the Shenzhen Municipal Government designated Dapeng as a new district of Shenzhen. After that, some sorts of investment on the coastal tourism development of in Dapeng district emerged, while the idea of creating touristic homestay accommodation inspired the change of this coastal fishing village to a tourism destination. Since 2014, some farmer houses were converted into homestay accommodation for tourists by the villagers spontaneously. In 2016, the annual tourist arrival has gradually reached 80,000. Although they face up with the problems lacking of funds, without the financial support from the government, every villagers fully take part in public participation. The "bottom-up" renewal mode could be valuable reference for the surrounding undeveloped villages.

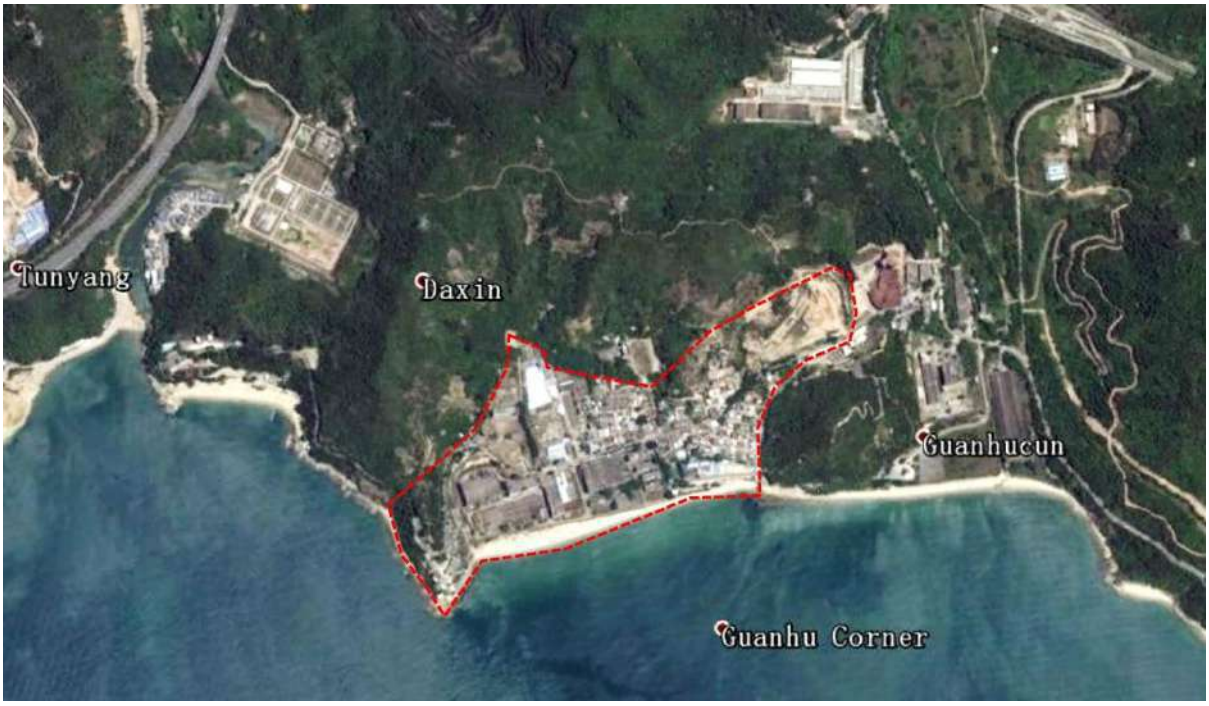

Figure 1: Aerial photo showing the location of Guanhu Village

Guanhu Village was chosen as the study site mainly because of three reasons. Firstly, Guanhu Village is a typical self-organized tourism village in Dapeng district. According to the Industrial Space Layout Planning in Shenzhen (2011-2010), Dapeng district was positioned as the characteristic tourism area based on its unique coastal landscape, valuable history and rich ecological environment. Official statistics indicated that tourist arrival in 2013 reached 3 million, and was expected to surpass 8 million in 2020 (Shenzhen statistics Bureau, 2014). Due to the limited government resources, the self-organizing development model of villages is the main development pattern and also advocated by the academic community. Secondly, compared to other tourism villages in Dapeng, Guanhu Village has a larger village scale and made an outstanding progress in terms of tourism industry development. Guanhu Village has a variety of public space and the space problem is also obvious. Thirdly, the village has a good basement for tourists. Most tourists for Guanhu come from Shenzhen city, Guangzhou Province or other parts of Pearl River Delta region. As these tourists have had a high revisit rate, they have a good understanding of the Guanhu Village and its PSV, and may thus provide a reliable source of perception and information about the satisfaction with the site.

3.3 Data collection

The last stage of the research method is related to the process of data collection. An administrated questionnaire-based survey was designed for this study. This questionnaire in

Chinese consisted of three parts. Parts 1 is the user background survey. Through basic information to the user, the user's gender, age, income, the identity, source, tourism purpose, such as dynamic evaluation results analysis for subsequent village public space and space optimization strategy provides the basis. The second part of the questionnaire asks users to rate public Spaces based on questions. Translating qualitative indicators requiring subjective evaluation into easy-to-understand questions, and collecting the results of public space based on tourists' experience. The third part of the questionnaire is the measurement results list of each quantitative index. Through field investigation, quantitative indicators such as the number of users, residence time, size, height and width ratio of sections, and the number of facilities of each public space are calculated to prepare for the next step of evaluation. All the quantitative and qualitative indicators involved in the questionnaire based on 34 evaluation indicators in the evaluation system.

A total of 350 questionnaires were distributed in Guanhu Village among a convenience sample of tourists during March (100 questionnaires in low season) and May 2016 (250 questionnaires in peak season). The entire survey was conducted by ten trained interviewers at different public spaces of the village. After an introduction of the study purpose, the voluntary nature and the confidentiality, an agreed participant would complete a self-administered questionnaire and each session took about 10 to 15 minutes. The interviewers would provide clarifications to the questions upon request. The quality of collected responses was checked by the interviewers separately. A returned questionnaire was deemed invalid when any respondent provided multiple answers to single-choice questions, or when a substantial portion of questions was left unanswered.

The resultant judgment matrices had to be combined with the ratings provided by tourists in the main survey, in attempt to attain the final satisfaction scores for evaluation of PSV. Finally, in the tourist main survey, a total 100 questionnaires were collected in low season with 96 valid responses included. Another 250 questionnaires for peak season were collected, including 243 valid responses. The effective response rates of the two parts of the survey are thus 96% and 97.2% respectively.

Table 2 shows the socio-demographic profile and the visitation characteristics of the two respondents groups respectively. Both low and peak season samples have a balanced gender distribution (the percentages of either male or female respondents do not exceed 60% in each). However, the proportion of male tourists is higher (59%) during low season when they often prefer participating in one-day leisure travel. Female tourists have a higher proportion (52%) during peak season as observed popular water sport activities like surfing and swimming among them. The majority of the sample has an age range of between 18 and 45 years (about 63% in low season to 64% in high season). During peak season, the proportion of elderly and children increased due to the pleasant weather, while many tourists age from 31 to 45 like travelling during the off-season, because their highly income level and relatively freely work time. Both groups have an even distribution of annual personal income though almost 50% earned more than RMB150000 per year. Regarding visitation, tourists from Shenzhen dominate the place of origin (about 67%). They mainly reach the village either by public transport or driving, both about 85.8% of the total.

Variable		**Low season**		**Peak season**	
		Frequency	**Percentage (%)**	**Frequency**	**Percentage (%)**
Gender	Male	56	58.3	115	47.3
	Female	40	41.7	128	52.7
	Total	96	100.0	243	100.0
Age	Below 18	0	0.0	9	3.7
	18-30	22	22.9	84	34.6
	31-45	40	41.7	72	29.6
	46-60	9	9.4	63	25.9
	Over 60	25	26	15	6.2
	Total	96	100.0	243	100.0
Personal annual income (RMB)	Below 80000	0	0.0	62	25.5
	80001-150000	29	30.2	86	35.4
	150001-300000	58	60.4	84	34.6
	300001-1000000	7	7.3	6	2.5
	Over 1000000	2	2.1	5	2.0
	Total	96	100.0	243	100.0
Place of origin	From Shenzhen	77	80.2	150	61.7
	Guangdong Province except Shenzhen	19	19.8	86	35.4
	From other province	0	0.0	7	2.9
	Total	96	100.0	243	100.0
Mode of transportation	Public transport (except taxi)	7	7.3	11	4.5
	Taxi	0	0.0	14	5.8
	Driving	87	90.6	186	76.5
	Tour bus	0	0.0	28	11.5
	Bicycle	2	2.1	4	1.7
	Total	96	100.0	243	100.0

Table 1: Socio-demographics of the respondents (n=339)

4. Results

4.1 Results of AHP

Before the main tourist survey, the weighting set of PSV attributes was determined by fifty experts in tourism and local rural development who included 42 professors of tourism planning and 8 officers of urban planning and rural renewal. These experts rated the level of importance of the PSV items using a 1-to-9 scaled pair-wise comparison method. After eliminating one invalid case, the remaining 47 valid responses were used for the analysis.

A consistency test was further conducted to check the rationality of the weights, and the result shows that CR=0.073, which is below the critical value of 0.1 (Satty, 1980). Thus the judgment matrix has satisfactory consistency, indicating that the final weight set obtained by AHP in Appendix 2 is reasonable. Following the same procedure, the weight sets of the secondary evaluation items were also calculated, as shown in Appendix 3. The consistency test of these second-level weights are also below the value of 0.1. Based on the weighting judgement matrices, the resultant weights of the evaluation criteria of the Jiaochangwei's PSTV are shown in Table 3.

First-level factor	Weight	Second-level factor	Weight
B_1 User	0.153	C_1 Number of user	0.467
		C_2 Type of user	0.095
		C_3 Density of user	0.277
		C_4 Duration on site	0.161
B_2 Activity	0.247	C_5 Type of activity	0.333
		C_6 Frequency of activity	0.667
B_3 Traffic accessibility	0.393	C_7 Distance between public space and beach	0.586
		C_8 Distance between public space and parking	0.115
		C_9 Number & layout of entrance	0.242
		C_{10} Number of public transport station	0.057
B_4 Surface	0.083	C_{11} Function type of building	0.445
		C_{12} Density of shopping	0.158
		C_{13} Proportion of assessable building	0.234
		C_{14} Degree of space enclosure	0.034
		C_{15} Characteristic of building surface	0.084
		C_{16} Elevation of boundary	0.045

B_5 Internal environment	0.037	C_{17} Size of space	0.046
		C_{18} Depth-width ratio of space section	0.065
		C_{19} Safe of traffic	0.323
		C_{20} Surface roughness	0.031
		C_{21} Occupation rate of pavement by vehicle	0.220
		C_{22} Sunshade ratio	0.153
		C_{23} Green ratio	0.027
		C_{24} wind speed	0.117
		C_{25}Character of landscape element	0.018
B_6 Service facility	0.064	C_{26} Density of leisure facility	0.400
		C_{27} Sign of road	0.029
		C_{28} Density of light facility	0.248
		C_{29} Density of dustbin	0.054
		C_{30} Number of public toilet	0.130
		C_{31} Density of obstacle-free facility	0.054
		C_{32} Density of activity facility	0.085
B_7 Management & maintenance	0.023	C_{33} Frequency of cleaning	0.667
		C_{34} Maintenance of facility	0.333

Table 3: Weights of the evaluation criteria

The weighting criteria and scores in Table 3 form the basis of the satisfaction evaluation. Because of the different standards of different index, it is necessary to order a new unified evaluation standard. In order to analyze more accurately the evaluation criteria, the Likert scale method used in the questionnaire was further re-scaled and converted to an evaluation standard shown in Table 4 so that the ratings can be used for AHP evaluation.

Tourist satisfaction evaluation	Average score
E1 (excellent)	$X_j > 4.5$
E2 (good)	$3.5 < X_j \leq 4.5$

E3 (moderate)	2.5<Xn≤ 3.5
E4 (fair)	$1.5 < X_j \leq 2.5$
E5 (poor)	$X_j \leq 1.5$

Table 4: Tourists' satisfaction evaluation standard

4.2 Results of PSV

12 public spaces in Guanhu Village were selected to investigate each sample on the basis of the index set of the evaluation system. The evaluation indexes of this evaluation system are divided into two categories: quantitative and qualitative. Quantitative indicators can be obtained by measuring and counting the results. Such as the quantitative indicators of traffic accessibility, interface, internal environment, service facilities and maintenance management in the index, such as size, width, height and density of the facility scale measurement tools to get 12 samples of exact data space. There may be small errors in the measurement process, which does not affect the evaluation. In addition, the indexes as the user and the activity are affected by different measurement times which can easily produce large errors. So randomly selected 15 minutes including 8:00-10:00, 10:00-12:00, 12:00-14:00, 14:00-16:00, 16:00-18:00, 18:00-20:00, total of 6 periods of working day and weekend to statistics the all two level indicators of users and activity levels in twelve spatial samples. The average data measured in each time period is selected as the final data to eliminate the error caused by the difference of population activity in different time periods. The results of the three qualitative indicators of the target concentration need to be evaluated with the help of the tourist questionnaire. The questionnaire can be distributed randomly in the 6 research period. When the questionnaire is issued, the collection of spatial data should be considered in a balanced way, and to ensure that there are a certain number of effective questionnaires in each space.

Through field survey and questionnaire collection, obtain the each index data of the space vitality evaluation sample of Guanhu Village. Because of the large difference in the unit of each index, five points should be used to unify each index. Through horizontal comparison, choose the best spatial evaluation data of the 12 spatial samples under the same index as 5 points, and the other samples are scored according to the corresponding ratios. Finally, the index scores of 12 spatial samples were obtained according to formula (1) and got the final result.

$$U_i = \sum_{i=1}^{n} R_i * W_i \qquad (1)$$

where Ui is the evaluation result of vitality; Ri is the result of second-level factors; Wi is the weight of second-level factors in the target layer.

According to the above formula, the final result of the evaluation of the vitality of 12 public space samples in Guanhu Village is obtained. According to the evaluation semantics, all the samples are divided into four categories.

Evaluation of PSV	Public space	Result
excellent > 4.5	-	-
3.5 <good vitality≤ 4.5	X_4 (shopping street)	3.70
2.5 <moderate vitality≤ 3.5	X_5 (Hulong Yixiang)	3.45
	M_1 (beach)	3.38
	M_2 (center square)	3.08
	M_4 (seaside square)	3.02
	X_2 (the western street close to ancient tree square)	2.82
1.5 <fair vitality≤ 2.5	M_3 (ancient tree square)	2.32
	M_5 (Basketball Court)	2.05
	X_6 (Hulong Jiuxiang)	1.84
	X_1 (inward streets)	1.84
	X_3 (streets in old village)	1.68
Poor vitality≤1.5	D_1(Torri and the surrounding)	1.42

Table 5:Results of PSV

4.3 Results of IPA

According to the vitality evaluation scores of 12 public space samples, there is no space got Score above 4.5, belonging to the excellent public space. In the 3.5-4.5 score range, only has one spatial sample,X4 (shopping street),X5 (Hulong Yixiang), M1 (beach) and 5 samples belong to the moderate vitality space of 2.5-3.5, while the rest belong to the poor vitality space. The activities of tourists in the public space of Guanhu Village tend to be in the scenic area, so it is reasonable that their activity distribution leads to the difference public spaces vitality in the village. The public spaces close to the beach should have good space vitality, while the spaces deep into the village are generally reasonable compared with the former. However, it is found that the evaluation of the public spaces vitality near the sea are general and different from the expected results through analysis. In order to find out the problems in these public spaces, IPA analysis method is introduced in this study

The four quadrants in an IPA correspond to specific conditions of the subject (Duke & Persia, 1996). Connecting to this PSV study, the "keep up the work" quadrant (I) indicates a desirable condition with great importance and satisfactory performance, while the "concentrate here" quadrant (II) refers to the zone where tourists attach great importance to a space but are dissatisfied with its performance. These are the two areas deserving enhancement and improvement. The quadrant with “low priority” (III) is accorded as tourists consider less important in the space and are also dissatisfied with the space’s performance. Lastly, the “possible overkill” quadrant (IV) defines a public space with high performance (and perhaps resource allocation or management) but is of less important according to the tourists.

For example, for seaside square, the items in the upper-left quadrant of the matrix are the most significant evaluation items of PSV with poor performance: Density of user (C_3), Duration on site (C_4), Type of activity (C_5), Frequency of activity (C_6), Distance between public space and beach (C_8), Number of public transport station (C_{10}), Function type of building (C_{11}), Density of leisure facility (C_{27}), Frequency of cleaning (C_{33}). These items represent the weaknesses of seaside square’s PSV and deserve further attention (Fig.2).

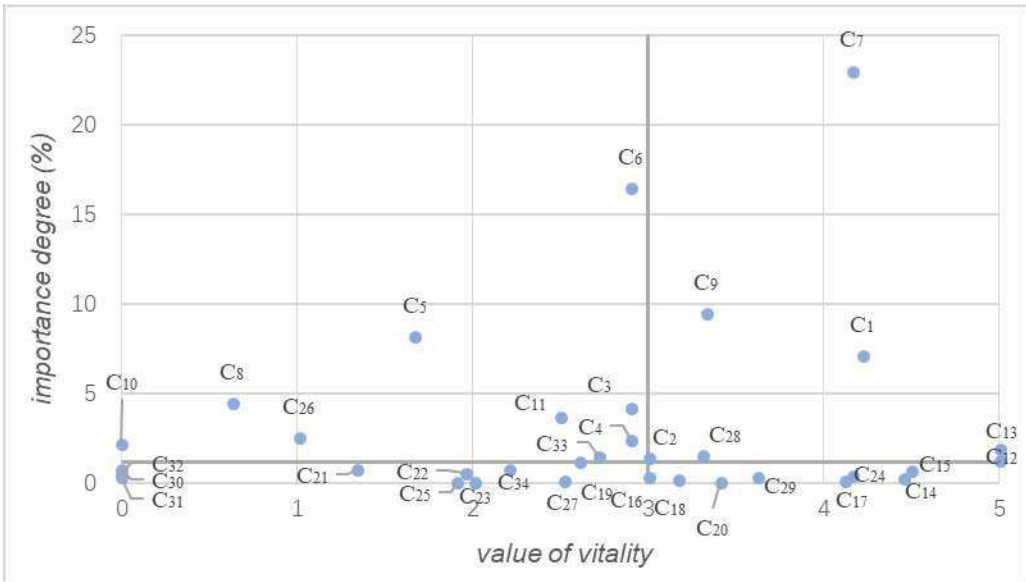

Figure 2:Result of IPA of seaside square

For beach, he items in the upper-left quadrant of the matrix are the most significant evaluation items of PSV with poor performance: Distance between public space and parking(C_8)、Number & layout of entrance(C_9)、Number of public transport station (C_{10})、Function type of building (C_{11})、Density of shopping (C_{12})、Proportion of assessable building(C_{13})、Density of leisure facility(C_{26})、Density of light facility(C_{28}), and Frequency of cleaning (C_{33}). These items represent the weaknesses of beach’s PSV and deserve further attention (Fig.3). As the beach is a special forbidden area, many service facilities will become a safety hazard in bad weather, so the optimization strategy should be put forward according to the actual requirements.

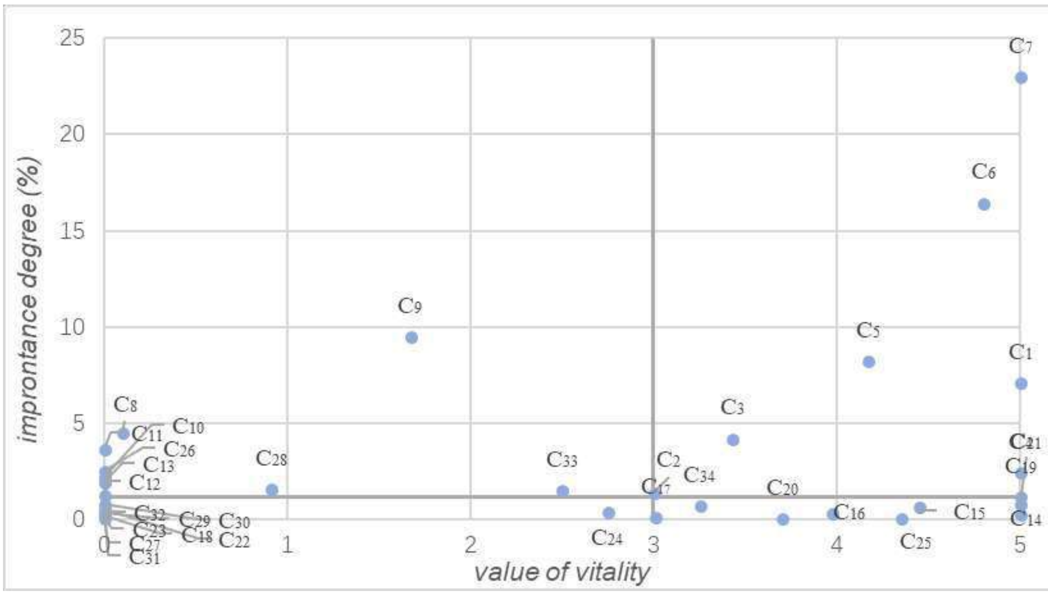

Figure 3:Result of IPA of beach

5. Conclusions and Implications

5.1 Key findings

The primary objectives of this study are to identify PSV of based-scenic villages, and to measure strengths and weakness of PSV of Guanhu Village via AHP and IPA. Although exploratory in nature, this study offers useful insights into the theoretical investigation and practical development of PSV.

First, this study contributes to the understanding of PSV of based-scenic villages on the theoretical grounds. While the development of based-scenic villages is gaining popularity, there has been insufficient research on PSV of based-scenic villages. Based on a literature review and factor analysis, this research identified 33 key evaluation items of PSV and grouped them into seven categories: “user”, “activity”, “traffic accessibility”, “surface”, “internal environment”, “service facility” and “management & maintenance”.

Second, this study provides insights into the approach for measuring and identifying the strengths and weaknesses of PSV. Given the limited literature on quantitative evaluation of PSV, it is deemed necessary to investigate the evaluation approach of PSV. Employing the AHP, this paper conducted the PSV assessment of Guanhu Village in Shenzhen, China. Further investigation using IPA shed light on diagnosing the strengths and weaknesses of PSV in Guanhu Village. Collectively, the methods used in this study are instrumental for quantitative assessments of PSVs.

5.2 Managerial implications

The findings of this paper will not only contributes to the academic research of PSV, but also chart new directions for the planning and construction of public space of based-scenic villages in practice.

First, the items of PSV identified in the present research are useful for the management of based-scenic villages. This research could help practitioners understand how to improve PSV of based-scenic villages according to tourist needs, wants, and preferences and, in turn, enhance tourist experience and improve PSV of based-scenic villages.

Second, the weights of PSV evaluation items in this study can shed light on the construction sequences of PSV. The weights of PSV evaluation items can inform the managers of the roles these key items play in PSV. As shown in Fig.2 and Fig.3. Those items should be given priority when improve an effective PSV.

5.3 Research limitations

This study used convenience sampling to survey the tourists in Guanhu Village, which may limit the ability to generalize its research findings to the entire tourist population there. It is necessary to extend the research approach to other PSVs will respond to the survey in a different way. In other words, further research could use other based-scenic villages as the study sites to examine whether the findings from this study are replicable.

(Number of words: including tables, figures and references)

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Women and sustainability

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ABSTRACT:

The environmental and health consequences of climate change, which disproportionately affect low-income countries such as Sudan, profoundly affect human rights and social justice. Environmental consequences include increased temperature, excess precipitation in some areas and droughts in others, extreme weather events, and increased sea level. These consequences adversely affect agricultural production, access to safe water, and worker productivity, and, by inundating land or making land uninhabitable and uncultivable, will force many people to become environmental refugees. Yet the very groups who are most affected by climate change impacts are least likely to be involved in climate adaptation discussions. Climate change, which reduces crop yields and food production particularly in developing countries, affects women's livelihood strategies and food security, and therefore their right to food. Women are responsible for 70-80 percent of household food production at West Sudan. Traditional food sources may become more unpredictable and scarce as the climate changes.

Women's role in communities is not formally recognized or accounted for in mitigation, adaptation and relief efforts. Women's knowledge about ecosystems and their strategies, experiences and skills for coping with natural disasters and water shortages, are often ignored. Strategies and policies to cope with climate change are neglecting the gender dimensions of climate change and the current gender-climate change agenda. Women are poorly represented in planning and decision-making processes in climate change policies, limiting their capacity to engage in political decisions that can impact their specific needs and vulnerabilities. The integration of gender appears most likely to succeed at the regional and local levels but even here it is the exception rather than the rule. Women's knowledge and experience of maintaining bio-diversity through the conservation and domestication of wild edible plant seeds and food crop breeding is key to adapting to climate change more effectively. This paper will illustrate the rights, strategies, and benefits from involving gender view in solving the sustainability issue taking west of Sudan as a perspective.

Opening Smart City ‘fairy tale’ to Critical Scrutiny: insights from dialogic accounting literature

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Abstract

Purpose – The paper intends to contribute to theoretical development of Smart City concept and discussions about its democratic governance through juxtaposing the existing critical literature on Smart Cities and dialogic accounting theory.

Design/methodology/approach – This is a conceptual paper which is based on synthesis of literature within and beyond democratic governance, accounting and Smart City. While not presenting a new empirical research, the paper outlines the reflections on existing Smart City rankings and models within European countries from the point of view of dialogic accounting theory.

Findings – Based on critical examination, it can be argued that existing governance mechanisms do not give ability to include local citizens in real decision-making related to Smart City initiatives rather being embedded in logic of monologism. With dialogic accounting framework, the paper highlights new proposals for critical examination of current organizational practices in relation to Smart City initiatives, i.e. how to develop Smart City management which somehow should balance between divergent interests (e.g. technology, business, political elites, bureaucrats, environmentalists and citizens).

Originality/value – The paper responds to the recent calls to critical examinations of the development of Smart City concept and ways how it contributes to the society. In this regard, we bring the new insights regarding the value of dialogic accounting theory in shaping contemporary understanding of Smart City management and its criticalities under democratic governance agenda.

Keywords – Smart City management, dialogic accounting, democratic governance

Paper type – Research paper

Introduction

The idea of "Smart City" enjoys growing endorsement and popularity worldwide (Manville et al., 2014; Neirotti et al., 2014). Despite there is no common definition of Smart City, the core idea lies in attempts to solve problems of densification and excessive urbanization mostly in large cities around the world with promises of increasing quality of life through the use of technologies (mostly IT-focused) which will foster sustainable future: economic, environment and society oriented (Meijer & Bolívar, 2016). With such promises, it becomes a tool to increase city investments, business development and activity of the region in general (Manville et al., 2014) and increasing efficiency and effectiveness of social value creation for citizens in particular (Anthopoulos, 2017). In this way, Smart City idea becomes a 'fairy tale' with smart IT-solutions, smart people and smart collaboration for sustainable future (Meijer & Bolívar, 2016).

However, in contradistinction to the attention that Smart City attracts with its utopian and optimistic rhetoric in practice, there is increasing call to the critical theorization of the topic (Grossi & Pianezzi, 2017; Marvin et al., 2015). Indeed, despite Smart City Concept can give a new impulse for city development through a promise of sustainable future (Manville et al., 2014; Meijer & Bolívar, 2016), it is still unclear how to manage these promises in practice, especially in financial and city governance terms. Technology by itself cannot make a city, leaving a room for 'smart' decisions to be taken by actors involved such as politicians, public sector officers, investors, research institutes and companies giving technology solutions as well as citizens who will live in sustainable future city smarter (Meijer & Bolívar, 2016). Some critical studies already revealed that Smart City concept could lead to the marginalization of environmental, social and economic aspects of sustainability in favor of interests of IT companies and business elites. Those construct the city without asking other stakeholders (e.g. citizens and local authorities) what would be smart for them (e.g. Hollands, 2008; Kitchin, 2014; Marvin et al., 2015), rather using "Smart City" utopia for distracting attention from 'real' urban problems and promoting neoliberal idea(l)s (Grossi & Pianezzi, 2017). Such actions, in its turn, can lead to financial pressure for future generations who will be forced to live in 'smart' but most probably the expensive city. At the same time, there could be a danger of overemphasizing the societal promise of Smart City concept where populistic 'democratic' decisions can lead to threatening long-term financial sustainability (Huston et al., 2015), which, in its turn, can also question the attractiveness of the city for future generations (e.g. "nobody wants to live in smart but expensive city"). This, in its turn, can lead to situations where non-financial and financial information related to Smart City initiatives should be demonstrated/disclosed to the citizens in a way that they could understand and consider long-term financial sustainability of decisions to be approved and jointly committed (e.g. current and future committed costs of Smart City initiatives and consequences for taxation).

Therefore, despite Smart City 'fairy tale' have generated a surge in its attractiveness, it is still unclear how to develop Smart City management which somehow should balance between interests of financial sustainability, citizens, environment and business or/and political elites.

The intention of this conceptual paper is to contribute to theoretical development of Smart City concept through juxtaposing the existing critical literature on Smart Cities and so-called dialogic accounting theory (Bebbington et al., 2007; Brown, 2009; Brown & Dillard, 2015a, 2015b). Being originated in sustainable development, social and environmental accounting studies, dialogic accounting theory argues that value creation and its related non-financial and financial measures should be based on dialogue of divergent voices (Bebbington et al., 2007). This dialogue, in its turn, should be viewed as a complex politically-natured process with acknowledgment of pluralism, difference, ideological conflicts and power dynamics (Brown, 2009). Despite its origination in critical accounting literature (Bebbington et al., 2007) and political ideas of agonistic democrats (Mouffe, 2000, 2005, 2013), during recent years dialogic accounting theory become increasingly employed in critical scrutiny of Participatory

Governance and New Public Governance agendas (Aleksandrov et al., 2018; Brown & Dillard, 2015a). In this way, applying to Smart City idea(l)s' development with the core role of citizens' involvement (Torfing & Triantafillou, 2016), dialogic accounting theory can be valuable to bring new insights into understanding of challenges in citizens' involvement into Smart City decision making and how it is possible to overcome these challenges.

The paper will proceed as follows. Firstly, we will review the existing literature on Smart City management and develop arguments in favor of dialogic accounting theory in Smart City discourse. The point of departure is the acknowledgment by previous studies (Grossi & Pianezzi, 2017; Huston et al., 2015) of accountability problem in Smart City management, i.e. "practice of demanding and giving the reasons to conduct" related to value creation in cities (Robert & Scapens, 1985). Based on critical examination, it can be argued that existing accountability mechanisms (e.g. financial and non-financial measures, performance and planning instruments) do not give ability to include local citizens in real decision-making related to Smart City initiatives rather being embedded in logic of monologism [1]. Secondly, we will review the key ideas of dialogic accounting theory (Brown & Dillard, 2015a, 2015b), followed by its linking with previous critical studies on Smart City and its application to existing accountability mechanisms in cities' governments. Thirdly, we will reflect on how dialogic theory principles [2] can be applied to current Smart City management and accountability practices available via existing Smart City ranking and assessment models within European counties and possible challenges on its way.

Smart City as a modern 'fairy tale'

Nowadays many things become 'smart'. "Smart City" in particular invokes the growing interest during recent decades with particular promise of technology to solve the problems of the future and sustainable development of the city which will become safer, cleaner, richer more accessible, and more innovative (e.g. Anthopoulos, 2017; Greenfield, 2013; Manville et al., 2014; Meijer & Bolívar, 2016). However, what evidence do we have so far in delivering such promises? Do Smart City's promises become modern reality or rather a fairy-tale? What is the plot and who are the main actors here?

As noted by Meijer (2017), two general plots of Smart City promises are evident in the literature: first, the technological/engineering perspective on Smart City and, second, critical social studies telling a story of marginalization of the city by the business idea(l)s and danger of 'technological blindness'.

The technological/engineering plot of Smart City becomes rather active contributor in developing current trends within citizens infrastructures and general sustainable development (Anthopoulos, 2017; Batty, 2013; Kitchin, 2014; Mora et al., 2017; Viktor & Kenneth, 2013; Wiig, 2015). Here, the technology provides novel solutions for cyber-physical integration in the urban space, a growing network of city alliances, forums and marketplaces that aim to bring together scientists, practitioners and city governments in an attempt to define a common urban future and a promising international network of scholars (Anthopoulos, 2017). In such an optimistic technical plot, the main actors represent various ICT solutions, technological systems (e.g. transport, energy, surveillance, security) with the key role of data which would result in effectiveness and efficiency (e.g. better and efficient waste systems and transport infrastructures) (e.g. Batty, 2013; Viktor & Kenneth, 2013). This makes the smart city as an intelligent, interconnected and instrumented set of developments which are scientific, objective, commonsensical and apolitical in nature (Kitchin, 2015; Wiig, 2015). Nevertheless, such fairy tale becomes increasingly challenged with the critical plot of Smart City examination.

The growing number of critical studies has been developed during recent decade (e.g. Greenfield, 2013; Grossi & Pianezzi, 2017; Hollands, 2008, 2015; Kitchin, 2014; Marvin et al., 2015; Vanolo, 2014, 2016). The content of Smart City optimistic plot was in this regard stretched and 'bittered' with issues of politics, bureaucracy, power relations and marginalization within multiplicity of actors and their roles in Smart City initiatives. For example, Smart City concept could lead to the marginalization of environmental, social and economic aspects of sustainability in favor of interests of IT companies and business elites (e.g. Hollands, 2008; Kitchin, 2014; Marvin et al., 2015). Another possible content is "Smart City" utopian vision which distracts attention from 'real' urban problems and promoting neoliberal idea(l)s (Greenfield, 2013; Grossi & Pianezzi, 2017; Hollands, 2015; Kitchin, 2015), therefore, becoming a relatively poor concept if intended as a model of the urban life of the future (Vanolo, 2016). In addition ICT produces the big data which paradoxically can give too much relevant but useless information due to information overload (Leszczynski, 2016; Taylor Buck & While, 2017) and danger of 'technological blindness' when new tools become a passion rather than rational instrument or technology meets bureaucratic procedures (Kornberger et al., 2017; Walravens, 2015).

Reflecting on both technical/engineering and critical discussions on Smart City, the problem appears that these two plots are rather fragmented and do not acknowledge the complexities of urban governance and politics where social-technical dynamics of smart cities should be captured (Meijer, 2017). This becomes critical to examine under increasing complexity of society (Klijn, 2012) and its demands to unfold how to develop Smart City governance which somehow should balance between divergent actors' role in the development of the combined Smart City plot, i.e. bridging a fairy tale to reality. As a solution, Meijer (2017) proposes to see the construction of smart cities in term of "actors" (who are there in Smart City initiatives: private, public and civil society actors) "rules" (what guides the behavior of actors and how it is changed) and "games" (actors play data processing and technology developments in such a way that it maximizes their preferences for smartness). Within these dimensions, we need to move urban governance to the democratic direction where various actors try to win, including citizens.

As suggested by Smart City idea(l)s', citizens become the key actor in the development of Smart City initiatives (Torfing & Triantafillou, 2016). Broadly speaking, such ideological orientation goes with general contemporary discourses of Participatory Governance and New Public Governance which stress more wide citizens participation and involvement into decision-making related to cities' government (see e.g. Almquist et al., 2013; Fung, 2015; Grossi & Steccolini, 2014; Klijn, 2012; Osborne, 2010). From these perspectives, divergent voices/needs of citizens should be translated into political choices including agenda in relation to Smart City initiatives (Meijer, 2017), i.e. the local authorities will be accountable for 'smart' value creation in cities. In his sense, from Participatory Governance perspective, Smart City initiatives should be seen as an element of co-production (Fung, 2015) where citizens can be active contributors to complex problem-solving in government though bringing local knowledge (Lovan et al., 2017) and their participation gives ability of divergent/plural voices to be heard without consideration of people's current social status and whealth through delibration process (Fung & Wright, 2003).

Nevertheless, there is accountability problem in Smart City management (Grossi & Pianezzi, 2017; Huston et al., 2015), i.e. "practice of demanding and giving the reasons to conduct" related to value creation in cities (Robert & Scapens, 1985). Based on the critical examination, it can be argued that existing accountability mechanisms (e.g. financial and non-financial measures, performance and planning instruments) do not give the ability to include local citizens in real decision-making related to Smart City initiatives (Brorström et al., 2018). Similar concerns go to Participatory Governance, where the formation of deliberative democracy can be highly problematic (Aleksandrov et al., 2018).

Being motivated by this practical and theoretical conundrum along with increasing calls for critical evaluations of Smart city (Bibri & Krogstie, 2017; Meijer, 2017), we juxtaposing the existing critical literature on Smart Cities and dialogic accounting theory which is presented below. Despite its origination in critical accounting literature (Bebbington et al., 2007) and political ideas of agonistic democrats (Mouffe, 2000, 2005, 2013), during recent years dialogic accounting theory become increasingly employed in critical scrutiny of Participatory

Governance and New Public Governance agendas (Aleksandrov et al., 2018; Brown & Dillard, 2015a). In this way, applying to Smart City idea(l)s' development with the core role of citizens' involvement (Torfing & Triantafillou, 2016), dialogic accounting theory can be valuable to bring new insights into understanding of challenges in citizens' involvement into Smart City decision making and how it is possible to overcome these challenges.

Bringing dialogic accounting theory to Smart City: from deliberative to agonistic democracy view and taking divergent actors more seriously

Dialogic accounting theory (Bebbington et al., 2007; Brown, 2009; Brown & Dillard, 2015a, 2015b), being originated in sustainable development, social and environmental accounting studies, argues that value creation and its related non-financial and financial measures should be based on dialogue of divergent voices (Bebbington et al., 2007). Applying to Smart City discourse, the dialogue should be constructed among various actors where all interests should be aligned, decisions are based on consensus and knowledge constructed by all actors who want to intervene (but not necessary allowed). In such conditions, the dialogic process of Smart City construction for example would argue for creation of relations where the borders between citizens, technology companies, local authorities and political elites become fluid.

Nevertheless, under the dimension of dialogic approach, the existing practices of sustainability and environmental accounting rather claim for representation of one dominant voice of business and political elites, therefore, forming a monologue (Brown et al., 2015). Some similar concerns evident in Smart City plot which while encouraging for citizens engagement rather shows disappointing results (Bibri & Krogstie, 2017; Meijer, 2017).

The problem appears that while the literature already acknowledges the complex agenda of Smart City governance and its political nature (Meijer, 2017), the existing mechanisms of democratic engagement and dialogue are still based on idea(l)s of representative and now even more on deliberative democracy (Brown, 2009). In other words, the existing mechanisms of citizens involvement into Smart City and Smart City initiatives pretend to be deliberative while in reality they are not (Aleksandrov et al., 2018).

In this regard, Brown (2009) proposed moving from a deliberative and representative model of democracy to the agonistic one (Mouffe, 2000, 2005, 2013), which can influence our understanding how we approach democratic governance, including accountability relations and modes of governance in Smart City case. According to Brown and Dillard (2015b, p. 964), "democratic participatory governance requires that affected stakeholders and publics be able to scrutinize and debate the values and interests at stake from diverse perspectives". The general claim of political ideas of agonistic democrats in this regard is that any dialogue and its consensus, while requre pluralist actors to be heard, is also irrational and full of antogonism and conflicts where even if consensus is achived conflicts can remain with issues of power and domination (Mouffe, 2000, 2005, 2013). Based on these ideas, Brown (2009, pp. 319-320) criticizes the depoliticization of politics and the "difficulty dealing with the conflictual side of pluralist relationships" in deliberative democracy. The central benefit of the agonistic approach to the democratization of accounting is the acknowledgement of pluralism, difference, conflict and power struggles (Brown, 2009; Brown and Dillard, 2015a,b). In this regard, Brown (2009, p. 317) argues "for the legitimacy (and inevitability) of the 'political' in accounting" and its receptivity to the needs, voices and interests of plural society. Therefore, dialogue, in its turn, should be viewed as a complex politically-natured process with acknowledgment of pluralism, difference, ideological conflicts and power dynamics (Brown, 2009).

Based on an agonistic view of democracy, Brown (2009, pp. 324-238) proposed eight principles underpinning dialogic theory that can also be applied to Smart City. We summarize these principles with reflection to Smart City initiative development and citizens role within (Table 1).

Principle of dialogic accounting	Application for Smart City
1. Recognition of multiple ideological orientations	During development of Smart City initiatives, we should recognize that actors are different and 'account' for different things in different ways. Therefore, Smart City should recognize divergent ideological perspectives and give a 'voice' to all of them, as this gives a basis for exploring people's commonalities and differences.
2. Avoiding monetary reductionism	Smart City initiatives should provide a range of quantitative and qualitative data for individuals and groups, who can see diverse effects for themselves and make their own judgements about monetization, incommensurability and the extent to which they are prepared to make trade-offs.
3. Openness about the subjectivity and contestable nature of calculations	Smart City initiatives should not gloss over conflictual aspects of pluralist relations. The 'accounts' introduced should be open to being contested and challenged by other participants.
4. Enabling access for non-experts	Smart City initiatives should enable information to be accessible in technically understandable forms which are available for testing by non-experts.
5. Ensuring effective participatory process	Smart City initiatives should be organized with procedural rules designed to establish a more even 'playing' field and with developing broader structural change.
6. Attention to power relationships and their dynamics	Smart City initiatives should be aware that it wields considerable power and authority, giving a space for powerful elites to sustain and filter the big data and initiatives. During smart technology introduction, even when relations are win-win, asymmetric power relations mean that some groups may win far more than others.
7. Recognizing transformative potential of dialogic accounting	Smart City initiatives and mechanisms of involvement should encourage social actors to become more critically reflective and facilitate better discourses across groups with different perspectives. This assists in bringing the limiting beliefs and assumptions of all actors into consciousness and allows them to contest each other's limit situations.
8. Resisting new forms of monologism	Smart City initiatives and mechanisms of involvement should not be only about dialogic rhetoric where the 'banking' concept of communication in which speakers 'deposit' their beliefs is introduced or through dialogic means still aims to guide people to a predetermined 'right answer'.

Table 1. Principles to underpin dialogic accounting theory and its application for Smart City (adopted and based on Brown, 2009; Brown and Dillard, 2015a,b)

Reflections on existing Smart City ranking and models within European countries from dialogic accounting theory (in progress)

It is argued in this paper that existing accountability mechanisms do not give ability to include local citizens in real decision-making related to Smart City initiatives with rather symbolic roles attached to the citizens and in monologic developments of governance. By considering the existing Smart City rankings and frameworks within European counties that contain financial and non-financial measures, performance and planning instruments we can reflect on how dialogic theory principles can be applied to it.

Smart City rankings and frameworks have been flourishing in the recent years due to the growing interest in the smart city initiatives. They are necessary to assist decision makers among other things to assess cities' progress (Ahvenniemi et al., 2017). It exists several smart city assessment frameworks and rankings that have been developed to assess city's performance measurement systems.

European Smart Cities Ranking (R. Giffinger et al., 2007; Rudolf Giffinger & Pichler-Milanović, 2007) is the result of research project finished in 2007 and conducted by Vienna University of Technology, University of Ljubljana and Delft University of Technology. This ranking deals with medium-sized cities and their perspectives for development. Among the recommendations of their ranking Giffinger et al. (2007) state that more differentiated approach of relevant factors will provide information for policymakers and interested stakeholders. European Smart City Ranking contains six characteristics: smart economy, smart people, smart governance, smart mobility, smart environment and smart living. Giffinger et al. (2007, p.11) come up with the following definition: “A Smart City is a city well performing in a forward-looking way in these six characteristics, built on the ‘smart’ combination of endowments and activities of self-decisive, independent and aware citizens.” To operationalize this ranking, the 31 factors and 74 indicators (Giffinger et al., 2007, p. 11) have been identified hierarchically. Data on indicators is drawn from public and freely available databases (e.g. political activities of inhabitants, satisfaction with fight against corruption, unemployment rate and voters turnout at city elections, etc.) used to impute six characteristics of the smart city. The indicator values are transformed into standardized values and furthermore aggregated to the factors based on coverage rate of each indicator (Giffinger et al., 2007). European Smart Cities Ranking claims that it includes a mixture of local settings and activities carried out by politics, business, and the inhabitants. It is stated that this ranking should consider among other things awareness as “it seems important for a smart city as certain potentials can only be mobilized if inhabitants, companies or administration are aware of the cities position – knowing the city from the inside but also being aware of the surroundings and the system of cities the city is located in” (Giffinger et al., 2007, p. 10). As benchmarking tool, it provides a way to draw lessons from better performing cities or perhaps resulting in policy transfer. The process of data collection and analysis as being transparent and being reproducible by others is as important as possibility to produce ranking depending of the user of the information and his/her needs (Giffinger et al., 2007).

CITYkeys performance measurement framework for monitoring and comparing the implementation of smart city solutions (Huovila et al., 2016) is the project deliverable of EU-funded project (under the Horizon 2020 program) authored by by TNO (Netherlands), AIT (Austria), and VTT (Finland). This framework assists in conducting project and city level assessments. CITY keys represents the selection of indicators that can function as Key Performance Indicators for tracking the progress towards city and project objectives (Bosch et al., 2016). This framework is organized around such categories relevant for smart cities: people, planet, prosperity, and governance (Huovila et al., 2016). In developing smart cities KPIs, Bosch et al. (2016) define smart city as “a city that efficiently mobilizes and uses available resources (including but not limited to social and cultural capital, financial capital, natural resources, information and technology) for efficiently improving quality of life of its inhabitants[…], significantly improving resource efficiency, decreasing its pressure on the environment and increasing resiliency, building an innovation-driven and green economy, and fostering a well-developed local democracy” (p. 6). CITYkeys performance measurement system has been developed based on mapping the identified needs against 43 existing sustainable and smart urban performance measurement systems and their indicators and filling the identified gaps (Huovila et al., 2016). Data on indicators is based on available information about smart city projects with IT component describing all kinds of inputs and outputs that it then generalized to be able to cover many different projects (Bosch et al., 2016, p. 15). The KPIs for smart cities under the defined categories include such indicators as data privacy, innovation hubs in the city, citizen participation, etc. Bosch et al (2007) claim that CITYkeys assessment method and indicators are supposed to assist to evaluate the success of smart cities and what are the possibilities to conduct these projects in other contexts. It also builds on specific policy goals that can be a part smart city strategy. This performance measurement framework as developed by Bosch et al. (2016) answers the wishes of cities and citizens for the coverage of their priorities and reflects city goals.

Endnotes:

[1] Monologic accounting and accountability are associated with the production of conventional mainstream which is overwhelmed by the pre-given values/ assumptions of neo-liberal and capitalism ideologies (Brown, 2009).

[2] Critical dialogic principles (Brown, 2009; Brown & Dillard, 2015a, 2015b): recognizing multiple ideological orientations; avoiding monetary reductionism; being open about the subjective and contestable nature of calculations; enabling accessibility for non-experts; ensuring effective participatory processes; being attentive to power relations; recognizing the transformative potential of dialogic accounting; resisting new forms of monologism.

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Research on Sustainable Design of Historical Blocks Based on Inhabitant Social Integration Measurement: A Case Study of Harbin

(Research on Sustainable Design of Historical Blocks Based on Inhabitant Social Integration Measurement: A Case Study of Harbin)

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Abstract: The inhabitant behavior is the important part of the sustainable vitality for the historical blocks. In order to solve the conflict between inhabitant life and commercial tourism in the renewal of Chinese historical blocks, this paper proposes the sustainable design strategy for the vitality of historical blocks from a perspective of inhabitant social integration. Base on the theory of social integration and taking the DaoWai Historical Blocks in Harbin as an empirical case, the paper constructs the evaluation model of inhabitant social integration, uses the confirmatory factor analysis method to quantify the influence factor and its weight of inhabitant social integration by structural equation model (SEM). Empirical research proves that behavior and culture has a significant impact on the social integration. In the end, the paper discusses the sustainable design strategy of historic blocks from the five dimensions of behavior, culture, industry, space and management, and the emphasis of sustainable design should be put on the improvement of behavior and culture.
Keywords: Sustainable Design, Social Integration Measurement, Inhabitant, Historical Blocks

1. Introduction

The sustainable design of urban historic blocks aims not only to improve a dilapidated physical environment but also to redistribute and integrate spatial resources under scarce and confined spatial conditions. Its essence is to restore the cultural vitality and historical characteristics of such street blocks while protecting the interests of various groups and social communities. Urban vitality originates in the economic, social, and cultural interaction between people and the urban public space (Jiang, 2007). The interweaving of people, their activities, and their places of residence helps create diversity in urban life, thus nurturing its vitality (Jacobs Jane, 2006). The sustainable design of historic blocks is a necessary means to maintain economic and cultural vitality as well as the vitality of the social community of such districts.

The Venice Charter advocates the protection of the authenticity of historic spatial environments (Xu, et al., 2010). The key to revitalizing historic blocks is to retain residential inhabitants while conserving their lifestyle (Ruan, 2011). The focus of protection should be the life of the people. Protecting the lifestyle of the inhabitants is a central factor in maintaining the vitality of historic blocks as they undergo renovation (Yuan, et al., 2010). Only small-scale, gradual reconstruction based on the needs of the inhabitants can achieve the sustainable development of historic blocks (Xia, 2008), which is the fundamental means to increase the vitality of such blocks. In the reconstruction and revitalization of historic blocks solely under the guidance of economic values, emphasis is only placed on spatial improvements brought about by the renewal plan and economic growth due to the marketing effect. A thorough understanding of the renewal and a proper distribution of political rights and economic interests among all stakeholders are ignored. This approach will result in a so-called “space bubble” and intensify social contradictions (Chi, 2010; He, 2012; Zhang, et al., 2013).

China has witnessed the emergence of “hollow blocks” in many historic districts. Except for activities that occur during public holidays and daytime business hours, the hollow historic blocks are devoid of popularity and deserted by residents. It is impossible to sustain the internal organic vitality in these blocks. It is also impossible to meet the increasing demand for a satisfying touristic experience. Because of the emphasis on reconstruction and profitability, historic blocks have not performed well in terms of the social inclusion of inhabitants. Conflicts between inhabitants and developers are often rooted in unjust choices among interests. In many aspects, such as lifestyle, survival style, or social status, it is difficult for inhabitants to integrate their lives with tourism development in historic blocks. To socially integrate the inhabitants of historic blocks and sustain the organic vitality of such blocks, this paper constructs a theoretical model for measuring inhabitant social integration. Using survey data collected from inhabitants of Harbin’s DaoWai historic and cultural blocks, the paper adopts confirmatory factor analysis of structural equation modeling (SEM) to analyze the statistical data. In addition, a quantitative study on the influencing factors and their weights with respect to inhabitant social integration is performed. Subsequently, we propose a design strategy to achieve the sustainable vitality of the historic blocks while ensuring the social integration of inhabitants.

1.1 Sustainable Design

Sustainable design includes not only the sustainability of the environment and its resources but also that of society and culture. It is a strategic design activity for the construction and development of sustainable solutions, which weighs economic, environmental, moral, and social issues in a balanced manner while considering design guidelines and the satisfaction of consumer demand (Crosbie M J, 1994). Sustainable design requires the harmonious development of individuals and their environment as well as products, services, and systems that meet the needs of the present generation while ensuring sustainable future development (Szokolay S , 2004).

Sustainable design has four attributes: natural attributes, social attributes, economic attributes, and scientific and technological attributes. As such, it requires that the human living environment be sustained while the quality of human life is improved. The net benefits of economic development are increased to the maximum under the premise that the quality of natural resources and their services are maintained while the consumption of energy and other natural resources is reduced as much as possible (Azhar S, et al., 2011). The sustainable design of historic blocks involves the integration of the socio-economic culture in spatial management. The vitality of historic blocks entails adopting sustainable development in planning and design and using spatial planning to the greatest extent possible to realize the sustainable vitality of such districts.

1.2 Social Integration Measurement

Social integration, which became the core concept of Western social policy research and social policy practice in the early 21st century, has been widely encouraged by government, social policy research, and decision-makers. The definition of social integration by the European Union (EU) in 2003 can be summarized as follows: Social integration is a process to ensure that socially vulnerable groups have access to development opportunities and resources; participate in economic, cultural and social activities; receive social benefits; and receive significant opportunities to participate decision-making (Regina, 2002). The measurement of social integration was pioneered by Park and Burgess, who proposed a view of social integration in which four aspects interact: economic competition, political conflict, social connection, and cultural integration (Park, 1928). Landecker divided social integration into cultural integration, communicative integration, functional integration, and normative integration (Landecker, 1951). Subsequently, many sociologists divided the classification system of social integration measurement into more specific levels. The EU has also played an important role in the design of a social integration indicator system. In

December 2001, the Indicators' Sub-Group (ISG) of the EU's Social Protection Committee proposed 18 indicators divided into two levels: primary indicators and secondary indicators. In June 2006, the Social Protection Committee divided the social integration and social protection indicators into four major composite systems: overall indicators, social integration indicators, pension indicators, and health- and long-term care indicators (Lu, 2014). Different from in other countries that face immigration issues, social integration measurement in China focuses on the social integration of migrant workers, other migrants, urban new immigrants, and other groups (Chen, et al., 2015; Huang, 2011; Yue, et al., 2012).The measurement dimensions include economic integration (Huang, 2011; Yang, 2010), psychological integration (Yang, 2016; Zhang, et al.,2008), cultural integration (Lu, 2014; Yue, et al., 2012), identity integration (Chen, et al., 2015; Yang, 2010; Zhou, 2012; Ren, et al.,2010; Wang, et al., 2008), and community integration (He, et al., 2009). In the literature on social integration, little scholarly attention has been devoted to the inhabitants of historic blocks.

1.3 Inhabitant Social Integration Measurement

Inhabitant social integration introduces the concept of social integration into the revitalization of historic blocks. Inhabitant integration is based on social justice and harmonious integration. It emphasizes fairness regarding cultural, economic, environmental, and behavioral integration in the protection and development of historic blocks and planning ideas that are not solely oriented toward economic development. Attention is paid to the inhabitants' life model and group interests. Drawing on the social integration measurement of new urban immigrants (Zhang, 2008) and the Sydney Urban Frontiers Program (UFP) for socially vulnerable groups (Li, et al., 2004), a system is constructed to measure inhabitant integration in terms of behavior (Yang, 2010), culture (Zhou, 2012), industry (Zhang, et al., 2008), space (Zhang, et al., 2016; Lu, et al., 2017; Cai, et al., 2018), and management (Lu, 2014). The specific integration dimensions include the integration of inhabitant behavior and tourist behavior, neighborhood culture and business culture, the employment economy and the business economy, living space and tourism space, and public management and public participation.

(1) Behavior integration dimension

Behavior integration includes a wide range of aspects, such as interpersonal communication, living habits, community participation, and social behavior. The integration of two groups requires that one group is universally accepted by the other in daily life and the private domain (Blau, 1977). To integrate inhabitant behavior and tourist behavior in historic blocks, inhabitants must accept tourist recreational activities in their living environment. Regular disturbance of inhabitants by tourism should be minimized. The goal is to ensure that the inhabitants' life rhythm remains unchanged and their behavior and habits are respected. It is also necessary to incorporate the customary activities of historic block inhabitants into tourism activities. The integration of inhabitant and tourist behavior should be accomplished while avoiding disruption, providing protection, and encouraging conservation.

(2) Cultural integration dimension

The cultural integration of historic blocks requires tourism development to recognize the culture, local customs, and social concepts that prevail in historic districts. The goal is to overcome the impasse between preserving the traditional neighborhood culture and tourism development. The integration of neighborhood culture and the tourism business culture is the key to realizing the social integration of inhabitant communities in historic blocks. The recognition of traditional culture is based on respect for the culture of a historic block. The business culture created by tourism development should respect existing traditional forms of business and seek to continue an area's original forms of commerce and trade. In this manner, the integration of a traditional neighborhood culture and a business culture can be achieved. Appropriate measures must to be adopted to reduce the commercialization of folk cultural activities and restore the authentic tradition of the historic block. In this way, the contradiction between street culture and tourism culture can be eased.

(3) Industrial integration dimension
The revitalization and development of historic blocks inevitably results in the pursuit of economic benefits by profit-making industries. The tourism industry can bring substantial economic benefits from tourists. However, the realization of industrial integration in historic blocks must address the gap between the inhabitant employment level and the requirements of commercial companies. Industrial integration means the interpenetration and intersection of products from different industries or within the same industry and the eventual formation of a new, unified industry (Li, 2003). Inhabitant employment by companies undertaking the renewal of historic blocks, the comprehensive consideration of business selection criteria, and classifying business types to satisfy multiple demands will help integrate inhabitants into the renewed local economy. In this way, inhabitants can be involved in the life model of "integrating industry with living".
(4) Spatial integration dimension
In terms of social space, a city is a community with an internal growth mechanism that integrates various components. "Organic unity" and "mechanical unity" are different forms of organizing people. People occupy different spatial positions as a result of their differing occupations, status and prestige. The greater that the social differentiation is, the more complicated its spatial structure (Yang, 2014). The spatial integration of historic blocks is the counterpart of the corresponding spatial differentiation. In the process of planning and revitalizing historic blocks, preserving the inhabitant's living conditions inevitably results in the heterogeneity of tourism space and living space. The realization of spatial integration refers to how the physical spatial layout organically divides or integrates the areas in which the inhabitants live and the public places of tourism. In moving toward commercial development, the planning of historical blocks should give priority to considering the disruption of the living environment caused by tourist activity and improving the sharing of resources from public facilities.
(5) Management integration dimension
The most obvious means of inhabitant social integration is to establish a sound public participation mechanism and increase the level of public participation. The management of inhabitant communities and the commercial management of revitalized historic blocks can be integrated in a "two-in-one" approach (Liu, et al., 2017). In this manner, the public interest is represented on the same platform as the commercial interest, forming an integrated management plan in which these interests are balanced. This approach should be implemented throughout the process of revitalizing historical blocks. At each point, the functions of decision-makers and management and the rights of inhabitants should be clarified. The goal is to construct a platform for dialogue regarding the implementation of measures and strategies, to arrange a process of public management, and to establishing a long-term feedback mechanism in an integrated public management system.

2. Methodology

2.1 Data
The data used in this paper were collected by the Research Group of the Humanities and Social Sciences Project Fund of the Ministry of Education in the Study of Inhabitant Social Integration in the Revitalization of Historic Districts. The research team visited Harbin's DaoWai historic and cultural block in the traditional commercial city from June to July 2017 and conducted social surveys there. Harbin's historic and cultural traditional commercial city conservation block exemplifies the Chinese Baroque style. It is the largest such preserved area in China. Constructed in the 1920s and 1930s by Chinese artisans in DaoWai, the buildings imitate Western Baroque architectural styles with additional traditional Chinese decorative patterns. These structures are of important historic and humanistic value and are internationally influential.
To obtain relatively high-quality, first-hand data, the investigators established a team of trained master's degree and doctoral students. A total of 305 questionnaires were distributed, and 282 valid questionnaires were recovered. The recovery rate was 92.46%.

Of the 282 samples (see Table 1), 146 were completed by men and 136 by women. Of the respondents, 27% were 40-50 years of age. Inhabitants identified as business owners represented 92.2% of the total sample. A total of 22.7% of the inhabitants had resided in the district for 20-30 years. The monthly income of resident inhabitants was not high, with 41.5% of the total sample earning between 1,000-3,000 RMB/month. The data sample used in this paper was primarily based on a survey of the inhabitants of the protected area of the DaoWai historic block (purple line) and did not include the inhabitants who had moved out.

Table 1. Demographic and Social Characteristics of the Samples

Variable	Category	Freq	PCT	Variable	Category	Freq	PCT	Variable	Category	Freq	PCT
Gender	male	146	51.8	Identity	owner	260	92.2	Family	Couple	52	18.4
	female	136	48.2		Tenant	22	7.8	Structure	Nuclear	140	49.6
Age	10-20	7	2.5	Residence	0-10	57	20.2		Trunk	68	24.1
	20-30	25	8.9	Time	10-20	50	17.7		United	2	0.7
	30-40	52	18.4		20-30	64	22.7		Single-parent	7	2.5
	40-50	76	27.0		30-40	47	16.7		Single	13	4.6
	50-60	62	22.0		40-50	34	12.1	Address	Chun Hua	32	11.3
	60-70	57	20.2		50-60	19	6.7		South 2nd	35	12.4
	70-80	3	1.1		60-70	11	3.9		South 4th	49	17.4
Monthly	<1000	7	2.5	Educational	Junior school	119	42.2		South 5th	36	12.7
Income	1000-3000	117	41.5	Level	Senior school	115	40.8		South 6th	31	11.0
	3000-5000	100	35.5		Junior College	42	14.9		South 9th	29	10.3
	5000-10000	48	17.0		Undergraduate	4	1.4		South 10th	37	13.1
	>10000	10	3.5		Postgraduate	2	0.7		North 4th	33	11.7

2.2 Study Measurements

The survey method combined subjective questionnaires and semi-structured interviews. The scale used a 5-level Likert scale with the following response options: 1 (strongly disagree), 2 (disagree), 3 (neutral), 4 (agree), and 5 (strongly agree). The questionnaire was completed based on subjective feelings. The questionnaire consisted of two parts. The first elicited basic demographic information from the inhabitants. There were 10 items. The second surveyed the inhabitant social integration response indicators. There were 19 measurement items. SPSS 21.0 statistical software was used to conduct the preliminary collation and inspection of the survey data. The data were checked and corrected, and abnormal data were eliminated. Missing data were replaced with average values. A reliability analysis was performed on the 19 measurement items contained in the questionnaire. The Cronbach's Alpha of the data sample was 0.927, which met reliability requirements. In addition, the results of Bartlett spherical test and KMO value analysis showed that P value was 0.000($P < 0.001$), and the Bartlett spherical test was satisfied. The KMO value was 0.908. Therefore, the sample data were suitable for factor analysis, and the validity of the scale satisfied normal standards.

3. Model and Statistics

3.1 Measurement Model

The hypothetical theoretical model adopted to measure inhabitant social integration is a structural equation model using confirmatory factor analysis. In the model, social integration is an exogenous latent variable that is measured using five dimensions. Behavioral integration, cultural integration, industrial integration, spatial integration, and management integration are assigned corresponding indicators as external observation variables. The final social integration measurement model contains 19 observation variables and five latent variables. (see Table 2).

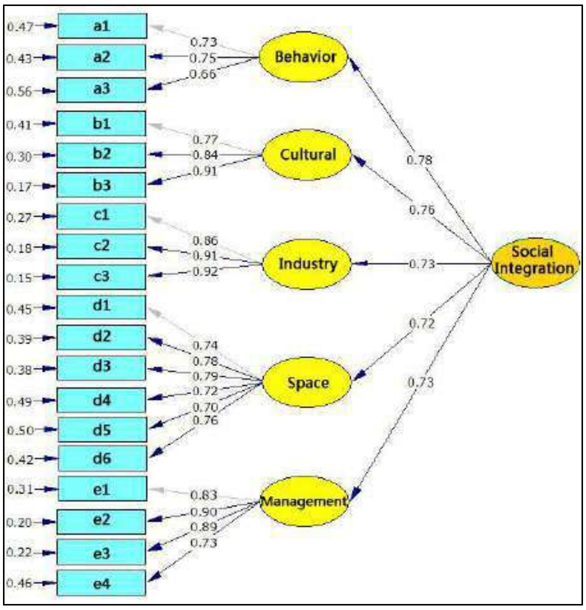
Table 2. Evaluation Model of Inhabitant Social Integration

Latent Variable	Latent Variable	Observational Variable	Code
Social Integration	Behavior	Neighborhood Communication	a1
		Social Community Network	a2
		External Disturbance	a3
	Cultural	Folk Cultural Activities	b1
		Community Cultural Atmosphere	b2

Latent Variable	Latent Variable	Observational Variable	Code
		Local Cultural Elements	b3
	Industry	Degree of Employment	c1
		Degree of Starting a Business	c2
		Traditional Store Management	c3
	Space	Living Infrastructure	d1
		Private Living Space	d2
		Living Environment Quality	d3
		Transportation Convenience	d4
		Public Space Sharing	d5
		Public Facilities Sharing	d6
	Management	Organization Group	e1
		Degree of Participation	e2
		Public Discourse Right	e3
		Management Evaluation	e4

3.2 Statistical Analysis

LISREL8.0 was used to perform the second-order confirmatory factor analysis of the measurement model. The maximum likelihood estimator method was used to estimate the model parameters to obtain the model's parameter estimation results and the standardized path coefficients (see Fig.1). T-test was used to examine the significance of the path coefficients (see Fig.2).



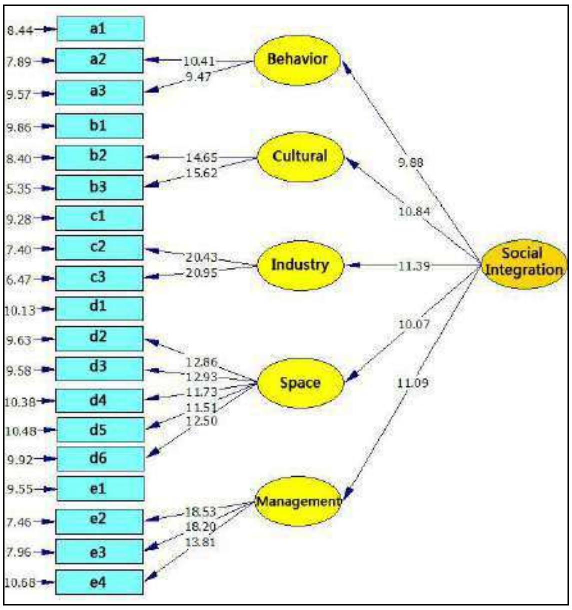


Fig.1. Normalized Path Coefficient of Model *Fig.2. T-test of Model*

The results indicate acceptable model fit. The chi-square value is 307.47, the degree of freedom is 203, and the ratio of the two is 1.51. The P-value is 0.000, and the RMSEA value is 0.043. Other indexes of fit are all within an acceptable range: NFI (0.97), NNFI (0.99), CFI (0.99), IFI (0.99), RFI (0.97), and AGFI (0.89). The overall model fit is good. Therefore, the inhabitant social integration measurement model constructed in this study is statistically supported.

3.3 Results

The study finds that the dimensions behavioral integration and cultural integration have higher path coefficients. Their standardized path coefficients are 0.776 and 0.772 (see Table 3). This outcome indicates that based on the data sample for Harbin's DaoWai historic and cultural blocks, behavioral integration and cultural integration have a more significant impact on social integration. In contrast, industrial integration, spatial integration, and management integration should be improved to more effectively promote social integration.

Table 3. Measurement Result of Structural Equation Model

Observational Variable to Latent Variable				Latent Variable to Latent Variable	
Outer loading (t-value)		Outer loading (t-value)		Path Coefficient (t-value)	
a1←Behavior	0.730(----)	d1←Space	0.737(----)	Social Integration →Behavior	0.776(9.89)
a2←Behavior	0.758(10.355)	d2←Space	0.784(13.224)	Social Integration →Cultural	0.772(10.94)
a3←Behavior	0.660(9.561)	d3←Space	0.788(13.285)	Social Integration →Industry	0.723(11.10)
b1←Cultural	0.771(----)	d4←Space	0.720(12.090)	Social Integration →Space	0.717(10.45)
b2←Cultural	0.839(14.983)	d5←Space	0.693(11.389)	Social Integration →Management	0.730(11.12)
b3←Cultural	0.909(16.048)	d6←Space	0.755(12.401)		
c1←Industry	0.858(----)	e1←Management	0.832(----)		
c2←Industry	0.906(20.290)	e2←Management	0.899(18.620)		
c3←Industry	0.921(21.148)	e3←Management	0.885(18.329)		
		e4←Management	0.733(13.834)		

The explanation of these outcomes can be understood as the failure to reconstruct the existing multi-story residential buildings in the conservation area during the redevelopment of the DaoWai historic and cultural blocks. Some of the district's inhabitants still live there, maintaining their original living conditions and social networks. The neighbor relationships are good, and interactions are frequent. The study period was during block reconstruction, at a time when only two blocks (South 2nd to South 4th Street) had been completed. From the perspective of all the district's blocks, the trade and tourism capacity was small, and there was not much disturbance of the inhabitants. Therefore, inhabitant behavioral integration played a large role in the social integration. The cultural heritage of the neighborhood's original ecology remained intact. Even during the reconstruction period, the original street business culture of the district remained in evidence, and the new tourist and cultural projects did not undermine the original condition of the blocks. These facts highlight the cultural integration of the blocks. However, commercial development did not facilitate inhabitant participation in employment and entrepreneurship. In terms of the space, because redevelopment and reconstruction remains incomplete, separation between inhabitant living space and commercial space has not been achieved. The management of the blocks is dominated by the government office in charge of the reconstruction. A so-called "self-living and self-governing" inhabitant-based management model has not been formed.
Therefore, the variables with higher correlation path coefficients must maintain their current status and improve reasonably as the project continues. Those variables with lower correlation path coefficients represent key dimensions with respect to evaluating inhabitant integration in future block planning.

4. Discussion

There is a statistically significant correlation between the dimensions of the inhabitant social integration measurement and the observed variables in the model. By comparing the loadings of the measurement factors in each dimension, the overall level of inhabitant social integration in the blocks and the factor weight can be quantified. In this manner, one can guide subsequent revitalization planning in the historic blocks and generate ideas for combining theoretical techniques and an econometric model for historic block planning strategies. This paper uses Harbin's DaoWai as an example to investigate sustainable design strategies for historic blocks based on the measurement of inhabitant social integration. From the perspective of improving the infrastructure and spatial environment, the paper suggests integrating social, cultural, economic, and environmental benefits to create a residential, commercial, cultural, and tourism center that reflects DaoWai's traditional business environment and an atmosphere of folk culture and that is adapted to inhabitant needs.

4.1 Behavioral integration promotes interaction and reduces host-guest conflicts

Planning should first consider a compensation plan for inhabitants who had to relocate during the initial stage of reconstruction. This plan should balance the interests of multiple parties from the perspective of interactive decision-making familiar from game theory. It must also reduce conflict as much as possible and retain as many inhabitants as possible, i.e., ensure a stable inhabitant retention rate. The property rights of the inhabitants who choose to stay should be adjusted to protect and preserve long-established houses and courtyards and the ecology of the historic blocks. In consideration of the original texture of the blocks, more public space, such as “pocket parks”, should be laid out spatially, and green nodes with a radius of 100m should be planned (see Fig.3). Green spaces should separate the living space used primarily by inhabitants and the tourism space so as to enhance exchange and communication in the inhabitants’ community and improve the eco-environmental quality of the blocks.

Fig.3. Pocket green space planning

4.2 Regeneration of cultural resources and the creation of traditional folk brands

Symbols of the traditional culture and the identity of the historic blocks should be protected and widely used in the architecture and design of large and small structures to improve the district’s visual and acoustic appearance. The historical and cultural elements in the conservation area should be revitalized, and a reasonable tourism capacity should be planned. Considering the need to reduce the impact on the inhabitants, tourism traffic should be strictly controlled to promote sustainable, stable tourism development in the historic blocks. The tourist routes planned for the conservation areas are shown in Fig.4-5. Inhabitant participation should be strengthened, and emphasis should be placed on creating historic building tourism products, traditional courtyard tourism products, special cultural tourism products, and non-material cultural folk products. These products should highlight the brand tourism image of DaoWai’s authentic and original Chinese Baroque style.

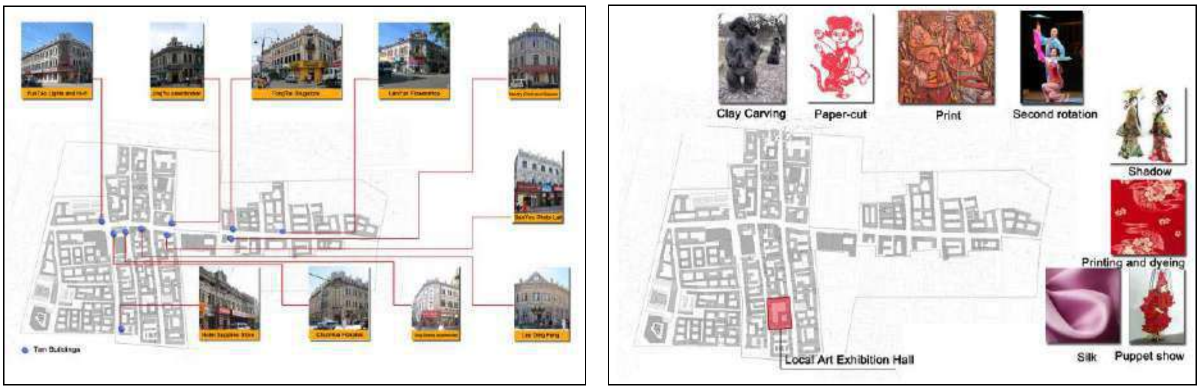


Fig.4-5. Tour of Historical buildings and Folk Art

4.3 Sharing the benefits of industrial resources and promoting innovation and entrepreneurship

The original business conditions in the historical blocks should be adequately preserved. In particular, historic stores with long-established brands and products that exhibit traditional craftsmanship should be protected. The creation of a tourism industry and the selection of relevant companies should complement the characteristics of the local blocks to achieve a distinctive integration and unity. Lifestyle and service business representatives should be improved and supplemented to form an attractive image of the full-scale upgrade and revitalization, giving the blocks appeal as "a place for living, a place for shopping, and a place for tourism". Priority should be awarded to employing local inhabitants and improving their residential areas. The goal should be to realize a lifestyle of "living here and working here". The internal power cycle of the historic blocks should be stimulated. Worn urban spaces should be rejuvenated while retaining historic artifacts. The importance of protecting the material and intangible cultural heritage should be emphasized. A commercial layout with new function implantation, functional replacement, and a functional mix should be implemented rationally (see Fig.6). Inhabitant integration should be the primary goal, with priority given explicitly to commerce, leisure travel, and livability. The vitality and value of the blocks should be increased by emphasizing the development of high-density commerce through a functional and spatial mix of business projects.

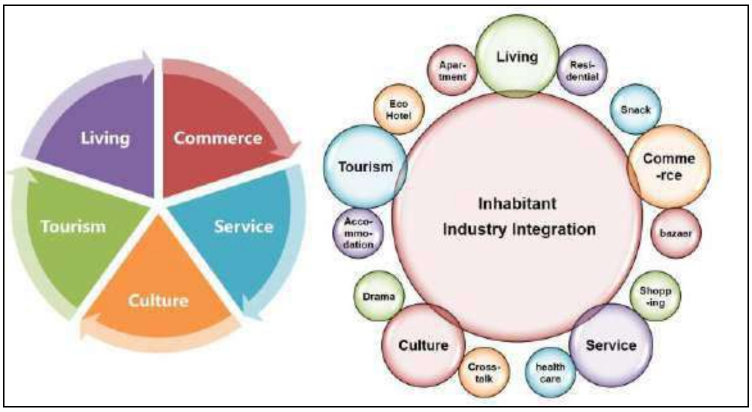


Fig.6. Industrial structure and project planning

4.4 Integrated layout of the spatial environment and people-oriented planning

The planning of historic blocks should divide quiet areas from busy areas to achieve functional separation. In addition to updating commercial areas, residential areas should be updated to preserve their livability for the inhabitants. The first floors of buildings should be planned to host commercial functions, and the second and third stories should be restored to the residential function. A hybrid of commercial and residential spaces should be planned to solve the problem of living space for inhabitants, including renting or selling apartments (Figure 3.18). The plan should emphasize the construction of eco-networks in the blocks and improve the capacity of ecological public services. Plant landscaping and landscaping techniques for small facilities can be used to isolate residential space from business and commercial space. Signs that identify private residences can be used to minimize the conflict arising from the mutual disturbance of hosts and guests in the historic blocks. Within the planning area, there are five functional subdivisions, with Jingyu Street and its traditional commercial axis stringing together various functional subdivisions and forming a spatially integrated tourism-business-residence layout (see Fig.7-8). In addition, the inhabitants' social integration should be incorporated into the planning, and planning decisions should emphasize the measurement and evaluation of inhabitant social integration. The level of detail of the published rules should be enhanced, and the existing approval procedures should be supplemented to benefit inhabitants.

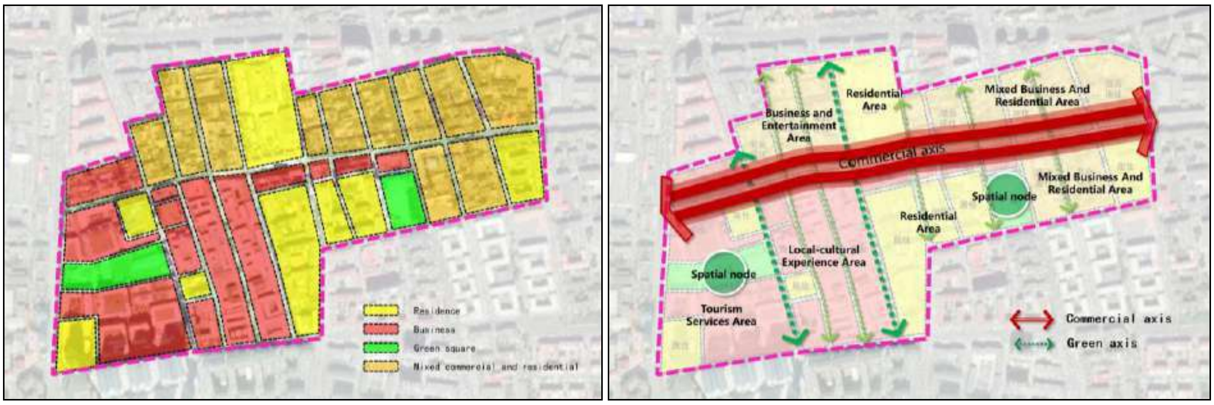


Fig.7-8. Land use and spatial structure planning

4.5 Integrating strictness and flexibility in management and promoting public participation with multiple subjects

A management committee should be jointly formed by inhabitants, business owners, and management decision-makers to uphold the interests of all parties in the implementation of conservation area planning. In addition, community public management entities should be established to supervise the management and development of the conservation area. The long-term follow-up service for planning implementation should be improved, and a long-term feedback mechanism for public planning management should be established. Inhabitant interest groups in the historic blocks should be established, and the financing of the revitalization of the blocks should be formulated and discussed in phases. To improve plan implementation, control must be exercised over the development of the land within the plan's scope, including the environmental landscape. The control management has three parts: prescriptive indicators, guiding indicators, and picture-based guidance. The specific control and management requirements are presented in the form of plans. Planning requirements should be normalized, and planning management should be implemented in accordance with a legal plan to ensure that inhabitant interests are optimally respected in the arrangement of public facilities.

5. Conclusion

With the change of historical heritage protection policy environment in China, the renewal of historical blocks will not only highlight the protection and preservation of the original historical material objects, and also will be more and more towards to the transformation of the traditional cultural protection and community humanistic sustainable development. This paper proposed the evaluation model of inhabitant social integration, and quantify the influence factors and their weights by the confirmatory factor analysis method of structural equation model, then resulted that the point of the sustainable design is the behavior integration and cultural integration according to the evaluation model measurement. Further, we suggest the sustainable design strategy, which provides a new perspective and approach to solve the conflict between trade tourism and inhabitant in the process of renewal and revival of historical districts. It provides new ideas and means for activating historical districts and realizing sustainable development.

Acknowledgements

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Beyond urban segregation: social reproductions and territorial frames of popular sectors in middle-sized towns of Latin America: the case of the neighborhood “Planta De Gas” in the Patagonian-Argentine city of Trelew

De Sousa, Mitchell, BUENOS AIRES, Argentina

ABSTRACT:

South African settlements were planned and continue to develop in maladaptive ways with the most vulnerable households living on the urban periphery in sprawling settlements, far removed from the formal urban economy, public transport and amenities. The spatial configuration and the ways in which land is used and developed in South African settlements is often unsustainable and place communities and settlements at risk of, among others, the impacts of climate change. Place-based adaptation of the built environment, cognisant of the urbanisation challenges, will protect the development gain, contribute to the resilience of settlements and address their development goals. The objectives of the presentation are to: 1) Briefly present the evidence of the future risk trajectory of South African settlements as the rationale for the type of adaptation options that were selected from good practice examples. 2) Discuss the general urbanisation challenges and development goals of South African settlements in light of climate change adaptation. 3) Explain the process of how place-based adaptation options were linked to each settlement’s risk profile. 4) Consider the implications for policy and practice in South Africa as well as other countries with similar development contexts. For this body of work, climate change projections over South Africa were downscaled to an 8x8 km resolution. The projections allowed researchers to model future hazard trends to better understand the impacts of climate changes on settlements. Combined with future vulnerability scenarios, the future risk trajectories of settlements in South Africa could be determined. A menu of adaptation options in the urban planning domain were compiled from examples of good practice. Based on the future risk trajectory, the urbanisation challenges and development goals of South African settlements, specific place-based options were proposed per settlement. The finding include that, based on climate change projections, South African settlements will in future generally become hotter and drier. Risk of future extreme events in settlements include flooding, drought, coastal and inland storms, and heat waves. This complicates the urban context even more. Key challenges include water, food and energy security, poverty, informality, inequality, service and infrastructure backlogs, lack of funding, capacity and political will to implement adaptation options, etc. Adaptation options that are place-based and context-specific will be showcased, while also reflecting on the process of developing these adaptation solutions. This body of work will 1) assist municipalities to adapt urban planning and development practices to climatic changes in line with development goals, 2) influence policy development at the urban planning/climate change adaptation nexus, and 3) identify priorities for mainstreaming climate change adaptation into local development planning. The project findings, methodology and outcomes will be of interest to many other countries with similar development and capacity challenges at the local scale as South Africa.

Towards setting up a contemporary planning system

Cool Planning for Qatar urban future

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Abstract

This paper emphasizes the vital role that the Urban Planning Department – **UPD** of Qatar can play, and how to enable it to implement both the New Urban Agenda[i], and the Sustainable Development Goals[ii]. Such UPD role should be integrating, matching with and responding to the Qatar local planning context.

Throughout this paper, we will show how to assist **UPD** as a professional entity to plan for a sustainable urban future for Qatar. In addition, it will elaborate how to create an effective, efficient and a creative professional atmosphere through building networks and alliances with respectable international, regional and local academic and professional institutions such as (**ISOCARP** – **URA** Singapore – **APA** American Planning Association – Qatar Foundation **QF**– Qatar University **QU**).

This paper attempts to cover the newly emerging planning system in Qatar in an analytical context that highlights the positive aspects achieved in reality and accommodates the challenges. It is expected to conclude with a set of recommendations in which we adopt mechanisms for dealing with those challenges in the future.

Introduction

Over the past twenty years, Qatar's development program has made great strides where it has experienced a rapid growth in the urban areas, which has brought about fundamental changes to the physical built environment. This requires to set up an integrated Planning System.

In order to deliver this goal, this paper is divided into **Four** main parts: the first one provides a synopsis of Qatar (its historical background and existing status), the relevant planning authority "**UPD**" and the Qatar National Master Plan "**QNMP**" project. The second part unveils the elements of the emerging Planning System for the country, whereas the third part highlights several creative tools and mechanisms to strengthen the country planning system. Finally, the fourth part provides set of recommendations to develop the performance of the Planning Department in the context of the New Urban Agenda and the Sustainable Development Goals.

1. Synopsis of Qatar

This part provides a synopsis of Qatar (its historical background and existing status), the relevant planning authority "**UPD**" and the Qatar National Master Plan "**QNMP**" project.

1.1 Brief background of Qatar

The State of Qatar is a peninsula situated halfway down the western cost of the Arabian gulf, bordered to the south by the Kingdom of Saudi Arabia. The coastline is 550 km. long and bounds the county to the west, north and east. With the exception of scattered hill formations in the north west and sand dunes in the south east, Qatar is generally a flat desert terrain.

The state's territory comprises a number of islands. Halul, Shira'wa, Alashat are the main ones. The total land area of Qatar is approximately 11 627.04 square kilometers. Doha is the capital city of the country. For more information the following web site can provide more detailed information https://www.mdps.gov.qa/en/knowledge/Publications/Other/QIF-30-2015-En.pdf .

The development and urbanization of Qatar in January 2003. The priority of the country is to improve the local welfare of citizens, which includes the establishment of health care systems, advanced education and the expansion of the country's infrastructure in preparation for hosting the World Cup2022 Where the people were moved from a traditional closed society to an open, development-oriented society that embraced modernity in its lifestyle. Under the enlightened leadership of HE the Ex – Prince Sheikh Hamad Bin Khalifa Al Thani who sought to establish the rule of law and institutions in all areas and its role in the 10 years of June 2004 under the era of the Emir Sheikh Hamad Bin Khalifa Al Thani, which was adopted by all institutions in the State. Exposing these services in the last three years all over the world.

The country's policy of developing and growing high-tech education worldwide has given Qatari consumers more choices in education, health and social development than ever before. Qatar Foundation for Development, Science and Community Development was established in August 1995, thus promoting the education of the people of Qatar and a strong state institution. This was completed in schools (2004). This opportunity is offered in an educational and sports environment. It also hosted several companies in 2006 and hosted the World Championship in 2006. The World Cup (2022) was hosted in a bid to achieve its support in sports.

The State has not only done so, it sought to pay attention to the health of the individual by providing all health requirements from health care centers and specialized hospitals throughout the country. And to establish the principle of development and maturation throughout the world. The Qatar National Vision 2030 aims at transforming Qatar into a developed country by year 2030, capable of sustaining its own development and providing for a high standard of living for all of its people for generations to come.

1.2 Evolution of Urban Development Process for Qatar:

Since the urban Planning Department (UPD) inception, His Highness Sheikh Khalifa Bin Hamad Al-Thani assumed power in 1972 and followed the rulers of the State to this day (2018), Adopting the principle of the importance of making the Qatari society live in a luxury.

When the General Authority for Urban Planning was established, a consultancy office was contracted to prepare Qatar National Master Plan (QNMP). At the same time, the team of QNMP was formed. The project was Entrusted to enhance and develop a plan for future. The planning system will be addressed in the remaining parts of the research.
The Ministry of Municipalities and Environment has taken upon itself the development of the state and the drawing of lines for future urban development through Qatar National Master Plan, which set a clear vision provided" "Create a Role Model for Sustainable Urban Living and the most Livable Towns and Cities in the 21st Century "

2. Key elements of Qatar Planning System

This part will review the key elements of the planning system currently being established in the State of Qatar, which consists of FIVE main pillars that can be summarized as follows:

2.1 Qatar National Master Plan project: QNMP

The Qatar National Master Plan Project is guiding the physical and spatial development of Qatar from now up to 2032". In other words, it is a program of work to prepare spatial Master Plans to guide the future sustainable development and growth of Qatar, its cities and towns from now until the target year 2032.

QNMP consists of three main parts, firstly, the National Development Framework Document 2032: **QNDF** which is the strategic component of the project and considered a crucial to advancing sustainable development and producing a high quality urban lifestyle. There are 17 strategic planning objectives which have been generated to guide its preparation:
Secondly, the Municipal Spatial Development Plans **MSDP** 2032, which consists of four main parts

1. Vision and Development Strategy
2. Zone Regulations
3. Municipal Zoning Maps
4. Centres Plans

Thirdly, the sectoral strategic studies and projects (including but not limited to: National Housing Strategy, Climate Change Study, National Open and Entertainment Strategy). The project also highlights the detailed planning projects and local plans. In addition, it assesses the contribution of the concerned stakeholders and various segments of society in the course of the preparation and implementation of these projects and schemes.
The project has been approved from H.E. the prince, the cabinet and becomes official guidance for the whole of government ministries and institutions since 2014. Also during the course of the project components a Participatory Planning Approach has been adopted with the concerned stakeholders.

2.2 Qatar Planning Legislation: QUPL

It is one of the strategic studies that It has been preparing in coordination with a local QNMP small team as well as representatives of the legal department of the Ministry of Municipality and Environment - **MME**. The purpose of this project resides in developing planning legislation that will formalise the planning system and give clarity and statutory effect to plan-making, development assessment and decision-making processes.
The ***QUPL*** aims at developing a legal framework that ensures the delivery of **QNV2030** and supporting national, regional and local development policies. Moreover, it activates the role of the concerned stakeholders by conducting consultations with the target ministries, agencies and institutions and integrating them to present their concerns, views and opinions. Thus, the main purpose of the legislation is to formalize Qatar Planning System and legitimize its legal status, as well as to strengthen the application of the law at the level of development plans. In other word, ***QUPL*** provides an effective mechanism for monitoring the implementation of urban development projects in accordance with approved plans.
The law is considered one of the main guarantees for the implementation of **QNMP** project. To put it another way, it is seen as the cornerstone for setting up the emerging Planning System of Qatar to achieve transparency in decision-making; effective evaluation of projects and processes; consistency in the implementation of planning policies. In addition to the clarity of the powers and mandates of the competent authorities in the preparation and implementation of planning projects and development application requests for urban development.
It is also perhaps worthy of note that the final draft of the law is under way, once to be acceptable by the QNMP project Management team, it will be proceeding to the higher authorities for approval, ratification and finally enactment of the law.

2.3 Setting up QNMP Project Local Team

This entity is one of the main sections of Urban Planning Department - **UPD**, whose mandates and responsibilities reside in the formulation of long term planning studies, strategies and urban policies at the national, municipal and local levels. It also focuses on preparing immediate and short term plans. The team are vaccinated with qualified national staff.

This section includes an integrated professional teamwork from various backgrounds and specialties that includes all the whole spectrum of professional specialties related to the urban planning field such as: strategic and regional planning, urban design, environmental planning, socio-economic planning, housing, Public facilities, transportation and infrastructure planning.

To facilitate the flow of work and accuracy of assignment, The QNMP team comprises of main four Groups: Strategic Planning and Studies, Master Planning, Mega Projects and GIS Groups – as shown below.

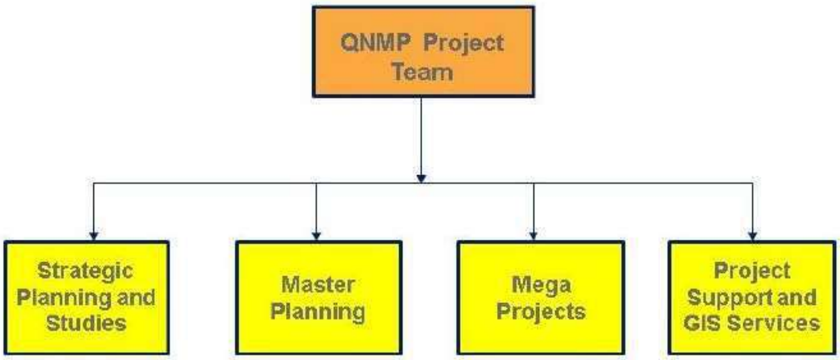

Figure 1: the Organizational structure of QNMP Project

2.4 A documented and reliable Planning Database

The process of constructing a documented and reliable planning database during the previous period has gone through four main stages:

<u>Phase I</u>: During the period (2005-2007), the data were scattered and were available only in the personal computers of the **UPD** staff, where it was difficult to track. Moreover, the data and information of the concerned authorities and departments, whether in the ministry or outside it, were not available because there were no effective communication and effective coordination between **UPD** and the concerned stakeholders.

<u>Phase II:</u> During the period (2008 - 2012), the establishment of the first comprehensive planning database was completed after receiving it from the consultant office entrusted with the preparation of the **QNMP** project. However, such data and information were available only at the national and regional levels, whereas no data available at the plot level. It is worth to point out that such work has been conducted during the preparation of **QNDF** document.

<u>Phase III</u>: Until 2015, the **QNMP** staff provided spatial data up to the plot level during the preparation of the **MSDP** study, where all the data were obtained from the concerned stakeholders and our preliminary database has been updated.

<u>Phase IV</u>: It has been on going up to now, where the continuous updating of the land use database and the planning regulations for each land use at the level of the plot.

This work has resulted in the implementation of GIS-Web-Application, which was built on the Ministry's Website and it is now available to the public with a simplified version whereas a more sophisticated version that includes all the data and information layers have been made available to the concerned stakeholders.

Figure 2: the GIS-Web-Application concept

2.5 Establish a Capacity Building Strategy for the planning local staff

This point deals with one of the most important pillars of the emerging planning system in Qatar, namely "Training and Capacity Building – TCB" unit that was established and approved. This strategy adopted a future vision to establish a teamwork who is keen to practice training and activate capacity building initiatives on a sustainable basis. Moreover, the strategy included three main directions in the field of TCB: firstly, conducting technical training in the field of urban planning. Secondly, refining experiences of managerial capabilities and leadership skills, and finally, consolidating the team spirit and enhancing the teamwork atmosphere.

Example of the workshops conducted during the TCB Program

3. Innovative mechanisms and tools to consolidate the Emerging Planning System

This part of the research is developed to provide assistance to the competent planning and development government authorities through several mechanisms and tools on how to enhance and support the emerging Planning System in Qatar. Such professional mechanisms will cover **SIX** major areas as it will be shown below.

3.1 Stakeholders Consultation Engagement Approach

At the outset, such approach has two levels; the first one deals with the official and formal level through conducting consultation sessions with the public agencies and government departments in addition to the private sector and investors. To a great extent we achieved acceptable results by establishing strong contacts through preparing many planning deliverables.

However, we are in the process of setting up community engagement with a full respect of local customs and common traditions. To apply successful and meaningful consultations and community engagement approach, we are aspiring for applying some international tools that suit the local traditions and common customs in Qatar. They can be briefly explained as follows:

- **Designing Online Applications for community consultation and engagement** in order to engage the widest possible targeted general public (including the marginalized people with special needs who are suffering from vision problems or color blindness). These applications should be visually rich, interactive and visually appealing media in a way to be easily understood and perceived by users.
- **Conducting Pop-Up Engagement** by setting up kiosks or providing tables in a public place or a busy commercial complex where the passers-by are surprised in a funny and cheerful ways. This can be an excellent opportunity to inform the public about the content of the project and its purpose.
- **Using Public Blackboards tool hanging in public areas** where the public is encouraged and stimulated to give their opinions and raise suggestions regarding what they wish to see in the project. Such tactic can resolve several problems and issues of the targeted community.
- **Using Simple Stickers method** in public areas that say “I wish this was… “. By writing these stickers, members of the local community can express their choices and hopes in prioritizing the planning options of the target project for developing their community.

Example of Simple Stickers tool

3.2 Marketing and reach out of QNMP project

The initiative of setting up an informative office for the **QNMP** Project has been introduced during the launching of applying the new planning regulations for all municipalities of Qatar which was inaugurated by His Excellency the Prime Minister on the 3rd of January 2018.

The launching of this unit is considered as a focal contact point between the various segments of the public versus **UPD (**including **QNMP)** staff to respond to all the technical inquiries and questions that to be raised. In addition, to inform and notify the public about the QNMP project's website and how to access the new zoning regulations in order to be aware of the planning and design requirements for developing their plots. This in turn, will consolidate the principles of transparency and credibility as well as enhance confidence and trust between the concerned government authorities (including **UPD**) and the general public.


افتتاح مكتب تعريفي عن الخطة العمرانية الشاملة

Launching the QNMP Customer Service Unit

3.3 Setting up QNMP project Website

The Ministry of Municipality and Environment took care to announce the Qatar National Master Plan (QNMP) by adopting the principle of transparency in setting all the outputs of QNMP on a website that allows everyone to access the documents of it . The site produce the Achievement, Initiatives and other subject related to Qatar National Master Plan.

The site was designed for simplicity and clarity to make it easier for users to access the required information. The aim was not only to use it for citizens and developers, but also to be more comprehensive as a guide for consulting firms working in the field of development to see whether Development of the project can be apply or not through the planning requirements available on website.http://www.mme.gov.qa/QatarMasterPlan/default.aspx

Figure 3: the GIS-Web-Application concept
QNMP project Website

3.4 Enhancing the media role

In order to announce the Qatar National Master Plan (QNMP) the team had prepare a Media plan. The media plan has been aim to awareness the public of Qatar National Master Plan and to inform the community about the date of implementation of the new planning regulations.

3.5 Negotiation as a tool to ease the application of Zoning (Planning & Design) Regulations

Through the practical and professional experience in dealing with daily development application in urban planning department at the Ministry of Municipality and the environment and based on the State's orientation on the importance of private sector participation in development processes in order to reduce dependence on the government support in country development .

In this context, the Urban Planning Department (UPD) has adopted a modern thought in the process of managing the development projects in the State with the participation of the private sector so as not to act in isolation from the wishes of the developers and the needs of the community.

Urban Planning Department (UPD) adopted process of negotiating with owners and developers as a tool in planning field. Where the practices proved successful in the participation and support of the private sector in development processes in line with the realization of the wishes of developers in exchange for providing a public service to the community and the surrounding area to not be conflict with the approved planning Regulations.

4. Recommendations for developing UPD Performance within NUA2016 & SDG2030 context

This part will be concluded with several recommendations regarding how to promote the good governance of the emerging planning system of Qatar, how to develop UPD management performance, and how to develop **TCB** program.

- Ensure that all relevant stakeholders are involved in the development planning processes including public, private as well as community sectors.
- The Urban Planning Law and its By-Law are being drafted,and should be taken to the ratification and enactment processes as soon as possible.
- Improve the level of managerial skills so as to promote the planning decision-making process.
- Giving municipalities more powers, delegations, responsibilities and liabilities to participate effectively in both planning and implementation process.
- Set up the Qatar Urban Observatory - QUO whose purpose is to collect and analyze the available related data & information in respect to all areas of the QNMP Project.
- Seconding competent cadres from the concerned authorities so as to overcome the shortage of staff that UPD is suffering from in several related planning field (such as Socio- Economic planning, Transportation and Infrastructure planning).
- Set up a municipal QNMP unit under the direct chairmanship of the municipality director. Such unit will serve as a link between the municipality and the UPD & QNMP Project.
- Support and strengthen the qualified staff resources of the TCB Unit.
- Create a new organizational unit within QNMP project, to be responsible for conducting and organizing consultation and Community Engagement sessions with the concerned stakeholders.

- Set up a new organizational unit within QNMP project whose responsibility resides in acting as a focal point with the concerned authorities of transportation and infrastructure planning as well as Socio –Economic planning.
- Establish a clear mechanism and work methodology for the negotiation process as a reference for **UPD**.
- Organize a forum to invite accredited consultancy offices in Qatar as well as the Qatar Engineers Association to discuss the problems and obstacles facing the consulting offices in applying the new planning regulations.
- Organize a forum to invite senior developers, investors and real estate finance companies in Qatar through the Qatar Chamber of Commerce and Industry as well as major mortgage banks and companies to discuss the problems and obstacles facing them when implementing the new planning regulations.
- Organize periodic meetings (e.g. twice a year) with engineers working for the municipalities to identify the problems and obstacles facing them when applying the new planning regulations.

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[i]) **New Urban Agenda** was adopted by UN Habitat III in Ecuador 2016

[ii]) **Sustainable Development Goals 2030** were published by the UN to define global development priorities for the 2015-2030 period)

[ii]) Dave Biggs is the Chief Engagement Officer of MetroQuest and an internationally-recognized author and public engagement strategist focusing on the use of software tools to enhance community participation for planning projects.

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INTENSSS-PA: a Governance Approach for Integrating Energy and Spatial Planning. Its Results in Castilla y León (Spain)

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Synopsis

The INTENSSS-PA project has developed and implemented an institutional capacity building approach related to energy and spatial planning, addressed to public authorities and societal stakeholders in order to support them to enter in a new era of holistic planning through a participatory, multi-level, interdisciplinary decision-making process.

1. Introduction

Planning energy matters in relation to their spatial and socio-economic context is normally very complex. This is because it involves and affects a whole range of participants who often have objectives or points of view that do not coincide, or even are diametrically opposed. Consequently, there is a need to explore innovative decision-making processes that cut across boundaries and encourage participation. The intention would be to ensure that energy plans and projects are feasible, viable and acceptable from technical, financial and social angles.

In the light of this, the project entitled INTENSSS-PA (*A systematic approach for INspiring & Training ENergy-Spatial-Socioeconomic Sustainability to Public Authorities*) implemented a process of training aimed primarily at those engaged in public administration. The reason was that they have the competences for setting standards and the greatest capacity to co-ordinate and lead both energy and space planning. Hence, they can encourage participation by others associated with such matters.

The final objective of this process was to build up a new method for designing and for decision-taking based on creative collaboration and participation by all those concerned with this question. It was not so much a case of telling public administrations what they should do, more a question of completing a training process that would lead to new institutionalized decision-making models. These should be innovatory, involve a wide range of social and business participants, and be integrated into any institutional agenda in a way running across bounds.

The project received funding from the European Commission within the Horizon 2020 framework programme. It ran between February 2016 and July 2018, and comprised a consortium of seventeen partners from seven countries in the European Union (Greece, Italy, Spain, The Netherlands, Denmark, Slovenia and Latvia). These partners included various public administrations at regional and local levels, academic institutions, professional associations, and businesses in both the public and the private sector.

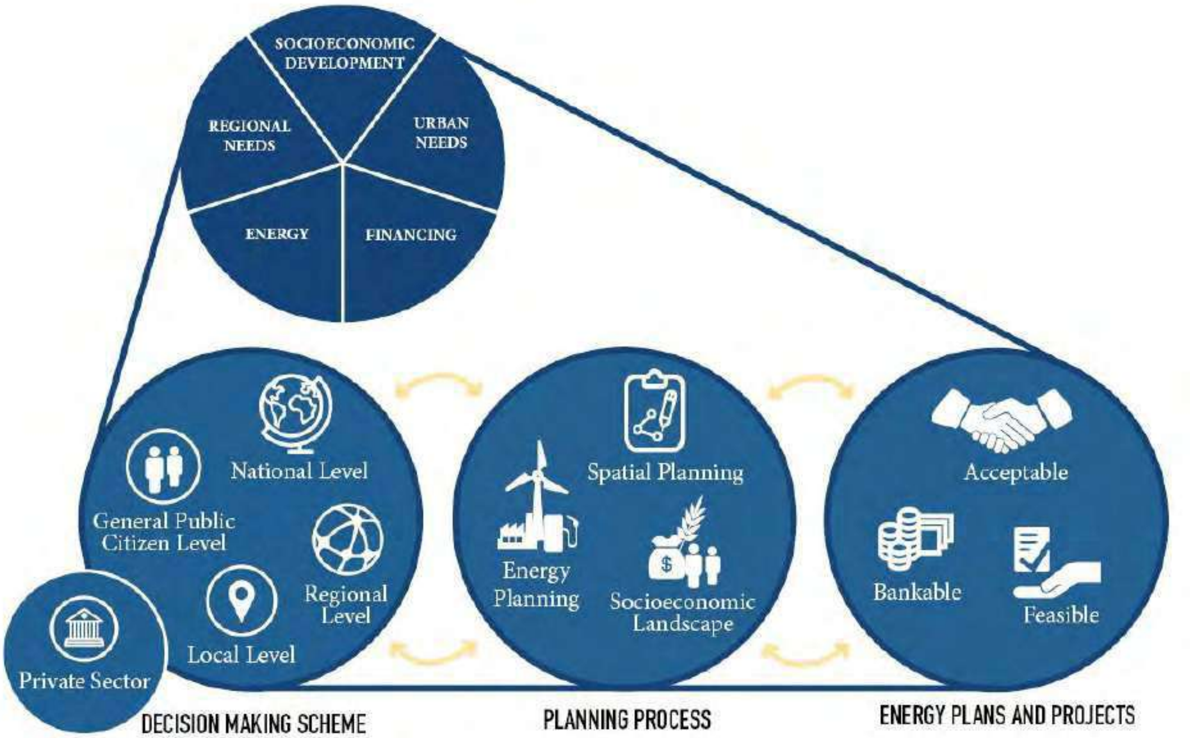

Figure 1: INTENSSS-PA Conceptual Model. Source: INTENSSS-PA.

2. The INTENSSS-PA Project: Objectives and Stages

The INTENSSS-PA project was organized around the following objectives:

2.1 Creating a Cluster of Local Regions and Communities

INTENSSS-PA took as its reference framework for development one region or municipality in each of the seven European countries participating in the project. This was intended to reflect both the particularities of their various systems for energy and spatial planning, and the diversity of their socio-economic characteristics. This variety, combined, however, with a shared working method, allowed continuous exchanges of experiences, advances made, and results obtained in each country.

Specifically, the seven work areas were the peripheral zone of Karditsa (in Greece, within the region of Thessaly), the Calabria Region (Italy), the Autonomous Community of Castilla y León (Spain), the Municipality of Groningen (The Netherlands, lying within the Province of the same name), the Municipality of Middelfart (Denmark, within the so-called Triangle Region), the Pormurje Statistical Region (Slovenia) and the Zemgale Planning Region (Latvia).

2.2 Building up an Online Database of Materials and Reference Cases

The work undertaken within INTENSSS-PA was intended to be supported by all the knowledge already existing with regard to the integration of the energy variable into spatial planning. It was also necessary to take into account related socio-economic variables and the end purpose of contributing to the objectives of energy sustainability (use of renewable sources, efficiency of utilization, and the like) envisaged by the European Union. All these prior experiences were considered from two angles: training materials (publications, methods, tools, and so forth) and instances taken as examples.

Consequently, the first phase of the project, co-ordinated by the *Instituto Universitario de Urbanística* of the University of Valladolid, comprised the carrying out of research procedures and the organized gathering of references useful for the later development of activities specific to INTENSSS-PA. This search for materials and cases was to concentrate essentially on the seven countries participating, so as to remain close to the real context of the regions involved in the project. Nonetheless, efforts were made to incorporate references corresponding to third countries, or of a European or international nature, as well.

To ensure easy interchange and consultation of the materials and cases, a model entry format was adopted for identifying, classifying and briefly analysing each of them. This included the basic data for the material or instance under consideration. It also classified them thematically into three large groups (each split into four sub-groups, with a total of 71 variables established). Finally, it contained short texts describing their content, characteristics and usefulness. Overall, in this first phase of the project 189 items of training material and 134 cases of good practice were analysed.

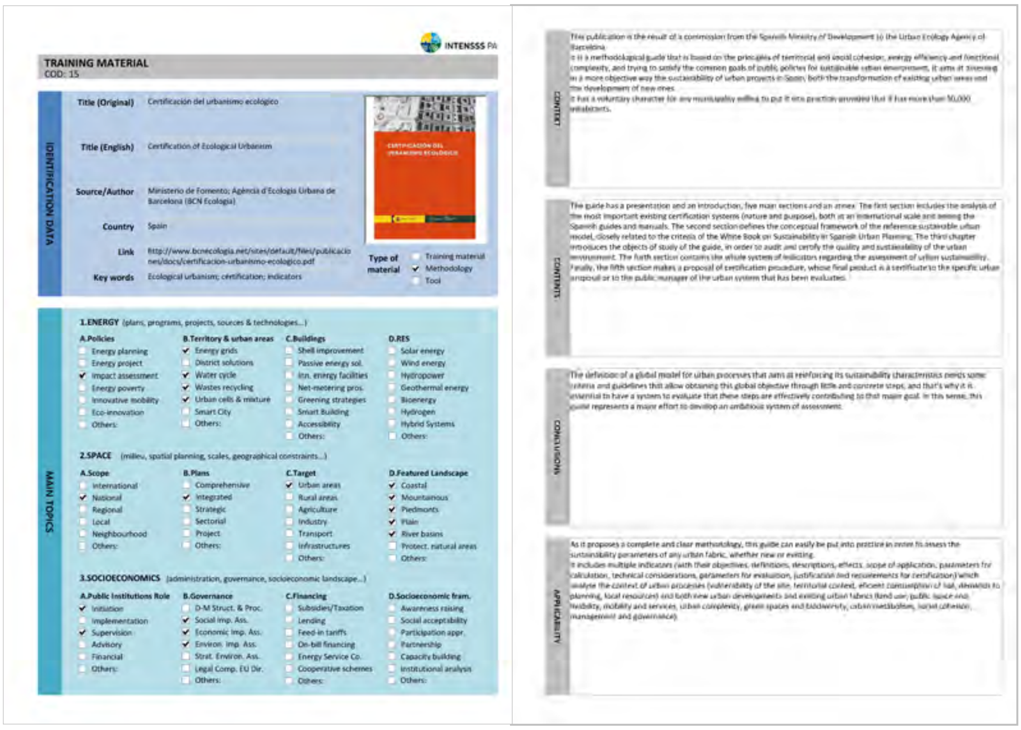

Figure 2: Example of a recorded training material. Source: INTENSSS-PA.

To make consultation of this information simpler for all those taking part in the development of the project in each country, and also to put such information at the disposal of anyone interested in these topics, all the entries were incorporated into a database available from a website permitting open access at no charge. In later phases, as the project progressed, this on-line database continued to be expanded with new materials and cases, both from external sources and generated by the INTENSSS-PA project itself. Similarly, the database remains available for collaborative contributions from third parties wishing to add materials and instances, which will thus carry on enhancing the amount of information it contains.

2.3 Establishing, Co-ordinating and Putting into Operation Seven Regional Living Labs (RLL)

The implementation of new design and decision-making processes, constituting the main aim of the INTENSSS-PA project, was supported by use of the *Living Lab* method, first put forward at M.I.T. in the 1980s. This allowed the building up of an ecosystem based on collaboration between the government and private sectors, and the general public (*public-*

private-people partnership). This was directed towards the resolution of a complex problem (the integration of energy into its spatial and socio-economic framework) in a real context, by means of a specific product, intended to be the outcome of a process permanently open to innovation.

In practical terms, a Regional Living Lab (RLL) was set up in each of the seven regions or municipalities enumerated above, so as to allow trialling of this innovative method of decision-making. The establishment of these RLLs required the bringing together of all those concerned with matters of energy and space planning in each region or municipality taking part, thus defining the panel of participants. To this end, the aim of contributing to the training of public administrators in these matters also being kept in mind, each RLL was co-ordinated by the corresponding regional or local authority, assisted in its work by the other associates in the project.

From here onward, the effective putting into operation of the RLLs consisted of squaring up to the real problem of integration of energy into spatial planning by following a working method comprising four fundamental phases: 1) *Context Analysis:* Consideration of the aspects that in each region proved to be key in making progress in the sustainable integration of energy and space planning, while taking into account socio-economic features. This implied detecting strengths, weaknesses, opportunities and threats (*SWOT analysis*) and defining the specific weighting for each element evaluated (*materiality assessment*). 2) *Co-decision*: The formulation of a problem (*planning focus*) incorporating the needs and expectations expressed by participants in the RLL on the basis of previously completed analyses, such that it could lead to a specific product directed at it and aimed at resolving it. This also required the identification of possible training needs (*gap analysis*). 3) *Co-planning*: The drawing up of a holistic energy plan, that is, the joint defining within the RLL of a plan for solving the problem envisaged in the previous phase, all needful information being provided (*experiential training*). 4) *Evaluation*: An assessment by each RLL of the planning process undertaken.

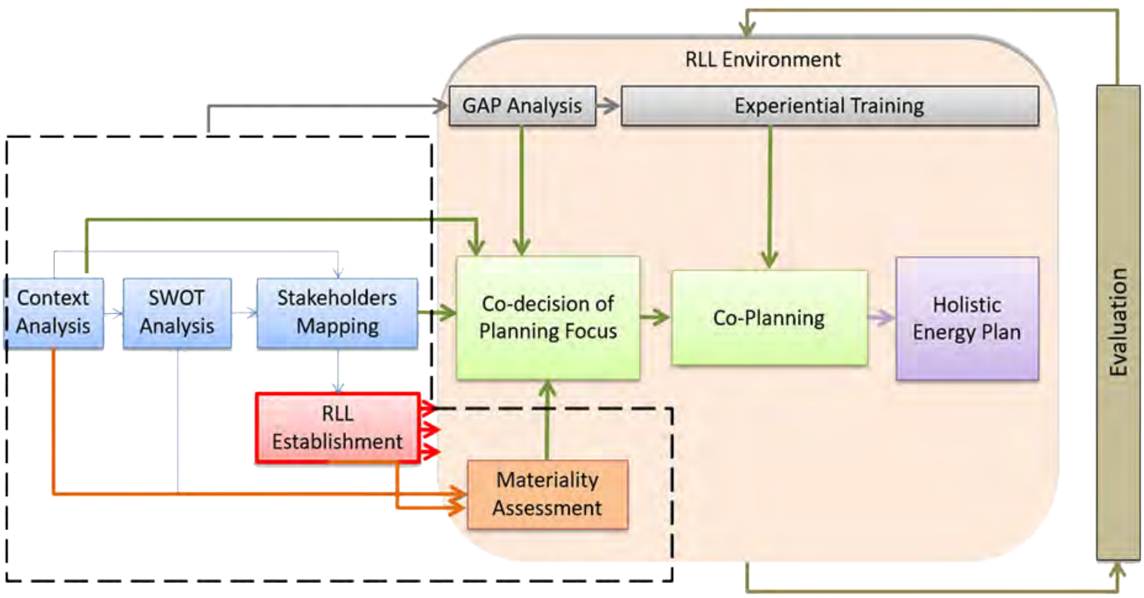

Figure 3: RLL Operation and Work Phases. Source: INTENSSS-PA.

2.4 Designing an Integrated Sustainable Energy Plan

As has just been noted, the planning process carried out in each RLL had as its ultimate objective the designing of an energy plan that would be both sustainable and integrated (*The Integrated Sustainable Energy Plan*). This was intended to respond to the conditions and needs in each region and reflect a consensus between the varying points of view of participants. In this way the plan should be workable, feasible, financially viable, and acceptable, and thus represent a contribution to attaining the aim of energy sustainability in the European Union. Simultaneously, it could constitute proof of the effectiveness of RLLs as a method for designing and for taking decisions.

Hence, the RLL of the Calabria Region concentrated on rural contexts, energy efficiency in public buildings and integrated management of water and waste. The Slovene Pormurje Region the plan attempted to achieve increased exploitation of biomass and hydro-electric energy, offering great potential in this zone. The RLL at Karditsa in Greece also focused on taking advantage of local biomass resources as a positive contribution to its economy. In the case of the Latvian Zemgale Planning Region, the RLL proposed a plan for encouraging use of alternative energy sources for more sustainable transport. As for the city of Groningen in The Netherlands, the RLL allowed the development of new co-operative working methods bringing in the various local agents concerned. The Danish Municipality of Middelfart involved the other municipalities in the Triangle Region in the development of joint actions, mostly aimed at the exploitation of geothermal resources, such as to contribute to the achievement of Danish national objectives for the use of renewable sources of energy. Further details of the approach taken by INTENSSS-PA and the results obtained in Castilla y León in Spain will be provided next.

2.5 2.5 Publicizing Results Achieved and Assessing Incorporation of the RLL Method into the Institutional Framework of the Countries Participating

Once integrated sustainable energy plans had been developed, the INTENSSS-PA project envisaged the possibility of incorporating the planning method constituted by RLLs into the institutional planning and decision-taking frameworks of the seven participant countries.

This first involved an assessment of RLLs as a method, investigating to what degree and in what form it might be possible to include them in the day-to-day processes of design and decision-making in the area of energy and space planning within the various public administrations co-ordinating the RLL in each region. For this purpose, the evaluations made by all of the participants were available. This permitted advantage to be taken of the networks that had been generated and use to be made of their potential to continue contributing to the objectives of energy sustainability in these regions or municipalities.

Furthermore, the INTENSSS-PA project also envisaged that it would be of interest to demonstrate this planning process and the results obtained to other regions in each participating country. This was to be done by putting the public administrations involved in touch with their counterparts in other areas so as to exchange experiences and facilitate possible adoption of the RLL method in contexts initially outside the work of the project.

Similarly, the project put in train a plan for publicizing and communicating the work done and results achieved. This included publications (in various formats), the organization of, and attendance at, events (whether at regional, national or international levels), which comprised informative seminars, open days, trade shows, and international academic conferences, and the creation of an extensive network of contacts to be kept up to date on developments within the project (such as members of other research projects on similar topics, those responsible for public administration in other regions or municipalities, and the like).

3. INTENSSS-PA in Castilla y León: Approaches and Results

Castilla y León is one of the seventeen Spanish regions (termed Autonomous Communities). It lies in the interior of the Iberian Peninsula and is one of the most extensive regions in the European Union. However, it is sparsely populated, having just over 2.5 million inhabitants, and a population density barely more than 25 people per square kilometre. In fact, half of the population of the region is concentrated in its fifteen urban areas exceeding 20,000 residents, whilst its extensive rural zones have for decades been suffering from an ageing and declining population. With these basic data in mind, an explanation can now be given of the approach taken by INTENSSS-PA in this region and the results obtained:

3.1 Structure of the Castilla y León RLL

In accordance with the project guidelines, the Castilla y León RLL was organized to reflect the energy, town-planning and socio-economic panorama of the region, covering three crucial areas: local authorities, the private sector and the general public. The structure of the Castilla y León RLL was also shaped as a function of four main roles. Firstly, co-ordination work was undertaken by the Directorate General of Housing, Architecture and Town Planning [*Dirección General de Vivienda, Arquitectura y Urbanismo*] of the Office for Development and the Environment [*Consejería de Fomento and Medio Ambiente*] of the Regional Government of Castilla y León [*Junta de Castila y León*], the regional authority that was a partner in the project and responsible for town and country planning policies in the area. Secondly, technical support for the RLL was provided by the *Instituto Universitario de Urbanística* of the University of Valladolid, the other Spanish associate in the project.

Figure 4: Structure and members of the RLL Castilla y León. Source: INTENSSS-PA Castilla y León.

Thirdly, in view of the project's focus, it was decided to take as associates collaborating with the RLL two further departments of the regional government directly involved in the matters addressed by the project. The first was EREN, the Castilla y León Regional Energy Board [*Ente Regional de la Energía de Castilla y León*], charged with energy policy in the region. The second was SOMACyL, the Castilla y León Public Infrastructure and Environment Corporation [*Sociedad Pública de Infraestructuras y Medio Ambiente de Castilla y León*], which has a department for energy efficiency and renewable energy responsible for designing, putting into operation and managing a large number of energy projects in the area.

Finally, the RLL was rounded out with a range of participants, corresponding to six large groupings: local authorities and municipal public companies, businesses working in the areas of energy and engineering, associations of various sorts (of ecologists, consumers, neighbourhoods, and similar), professional bodies (of architects, for example), research organizations and foundations (linked to the energy field) and co-operatives.

3.2 Guidelines for Integrated Energy and Space Planning

The Castilla y León RLL had two fundamental benchmarks when drawing up the contents of its integrated sustainable energy plan. These corresponded to the main lines taken by regional policies, firstly in energy matters and secondly in town and country planning.

Of the two, the first is ETR, the Renewable Heat Strategy [*Estrategia Térmica Renovable*] for Castilla y León covering 2016 to 2030. On the basis of an assessment of the demand for heating in the region, this document aims to encourage the production of thermal energy for this purpose from renewable sources, as against the current predominance of fuels such as natural gas, at present accounting for 50% of heat generation. The strategy lays special stress on the role that can be played in this matter by three alternatives: solar power, bio-energy and geo-thermal heat. With regard to the second of these, the document points out the great potential the region enjoys, in the light, for example, of its extensive areas of woodland. At present only a tiny portion of the potential for the production of biomass is exploited for energy, yet this would be an economic activity which would render rural areas in Castilla y León more dynamic, creating new employment possibilities.

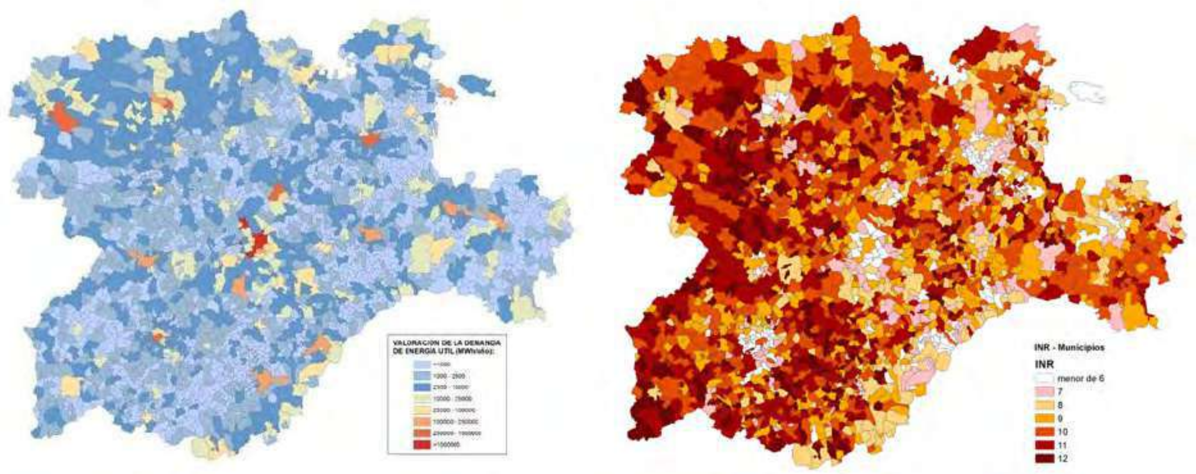

Figure 5: On the left, evaluation of the thermal energy demand in Castilla y León, according to ETR. On the right, index of regeneration needs of the municipalities of the region, according to ERUCyL. Source: Junta de Castilla y León.

The second benchmark is ERUCyL the Castilla y León Urban Regeneration Strategy [*Estrategia de Regeneración Urbana de Castilla y León*], which was adopted in 2016 and marked an orientation of town-planning policies in the region towards urban rehabilitation, regeneration and renovation. After a period dominated by town planning of an expansionist nature, the aim of this strategy is to encourage improvement of existing urban areas by ensuring they are functionally, environmentally and socially appropriate. With this purpose, the strategy focuses on the outer suburbs of towns in the region built between 1950 and 1980. This is because a large part of the population lives in such areas and they are where the greatest problems of urban vulnerability are concentrated, linked to aspects of demographics, such as ageing, of the economy, such as unemployment, or to the very nature of the housing stock, which suffers from considerable deficiencies, for instance with regard to accessibility or to energy efficiency. For its implementation, the strategy has first built up a system for evaluating regeneration needs in every local government area in the region and in all of the quarters of its fifteen cities, so as to concentrate efforts (investment of public funds) at those points where these are greatest. Likewise, it has established a set of criteria for orienting rehabilitation, regeneration and renovation actions, so that they will incorporate an integrated approach that will increase their efficacy. This includes aspects directly connected with energy, whether passive features, such as improving building insulation, or active measures (installations supplied with energy from renewable sources).

3.3 Definition of Objectives for the Integrated Sustainable Energy Plan

The Castilla y León RLL took these two benchmarks as a starting point. On the basis of consideration of the context and of strengths, weaknesses, opportunities and threats it proved easy to decide to orient its integrated sustainable energy plan for the region towards pressing for urban heating networks fuelled with biomass.

In the first place, an increase in the use of biomass to produce energy offers advantages for the extensive rural environment of Castilla y León. This is because it would boost economic activity and employment, as well as facilitating better management of the woodlands in the region, with positive effects such as a reduction in the risk of forest fires. Moreover, biomass is a resource native to the region and a renewable fuel that can easily replace imported fossil fuels such as natural gas.

A combination of utilization of a local renewable fuel like biomass and encouragement of centralized production of thermal energy through heat networks is aimed at achieving both environmental and financial benefits. On the one hand, centralization facilitates optimization of resources and hence increases energy efficiency. On the other, this brings about a reduction in costs together with beneficial effects from a social viewpoint. This is because a reduction in customers' bills provides a contribution to solving problems such as energy poverty, as well as enhancing the level of comfort in homes served by this type of solution.

From the viewpoint of town and country planning, there is also an interesting synergy, since the installation of heating networks can be combined with the urban renewal actions which the regional government wishes to promote. This allows centralization of production to be effected in tandem with complementary measures reducing demand, for example by improvements in the insulation of walls and roofs, normally included in operations of this sort.

Figure 6: Visit of the members of the RLL of Castilla y Léon to the DH of the University of Valladolid. Source: INTENSSS-PA Castilla y León.

Similarly, an additional factor kept in mind was the fact that the regional government, through SOMACyL, had already initiated a policy of rolling out urban heating networks which could thus be reinforced and supported. On this point, the members of the Castilla y León RLL had the opportunity to visit several of these networks. In doing so, they gained first-hand information about the obstacles met by their promoters when attempting to set them up, measures that might aid in managing them, and also good practice that could be learnt from them. Among these visits one highlight was the heating network serving a large part of the buildings of the University of Valladolid, currently among the most extensive networks in Spain. Complementary learning activities were also organised, such as a seminar on the possible contributions from urban planning to energy transition.

3.4 Guidelines for Sustainable Development and Integrated Management of Urban Heating Networks in Castilla y León

Once the work had been given a focus, and as a consequence of the learning activities and later discussions, the Castilla y León RLL decided that its integrated sustainable energy plan should take the shape of Guidelines for the sustainable development and integrated management of urban district heating networks in Castilla y León. The intention was to draw up a document that in itself would represent an integrated and action-oriented approach. In other words, it would be directed towards the putting into practice of specific measures facilitating the rolling out and the most effective operation possible of urban district heating networks in the region.

1. Improvement of Regulatory Framework	1.1 - Develop a regional strategy to promote district heating 1.2 - Promote forest management facilitating sustainable energy use 1.3 - Elaborate specific local ordinances on district heating 1.4 - Regulatory consideration of district heating as an urban service
2. Guidance for energy projects	2.1 - Compulsory participatory localization studies for thermal plants 2.2 - Achieve the critical mass of consumption through public buildings 2.3 - Compulsory completion of feasibility studies 2.4 - Energy optimization and inclusion of complementary solutions 2.5 - Promote bioclimatic solutions in buildings
3. Spatial Planning Strategies	3.1 - Incorporate district heating in municipal urban planning 3.2 - Promote to incorporate district heating in urban regeneration 3.3 - Promote to incorporate district heating in new urban areas 3.4 - Application of good practice criteria in the design and development of district heating 3.5 - Promote a more sustainable design of the public space
4. Good practice of governance of management of projects	4.1 - Adoption of the Living Lab approach in the design and development of projects 4.2 - Creation of interdepartmental working teams in Public Administrations 4.3 - Promotion of the mixed management (public / private) of district heating 4.4 - Advanced use of ICT in the management of district heating
5. Actions of communication and participation	5.1 - Organization of participatory processes during the design and development of each specific project 5.2 - Organization of information and training activities oriented to technicians 5.3 - Organization of informative and training activities oriented to the citizenship, with special attention to the young population

Figure 7: Guidelines for the sustainable development and integrated governance of urban district heating in Castilla y León. Source: INTENSSS-PA Castilla y León.

To this end, a total of 21 guidelines were drawn up, grouped into five main fields of action. These were improvements in the regulatory framework, guidance for energy projects, strategies for spatial planning, good practice in governance and management, and actions aimed at better communication and participation. Each guideline, presented in a record-card-like format, proposed a set of actions to be put into practice. These ran from modifications to certain standards to recommendations for projects or management, based on tried and tested experiences. They also included a number of general considerations, explaining the nature and aims of the measures proposed, the resources and tools affected by them, and an indication of which agents should be responsible for their application. The Castilla y León RLL deemed that effective application of the measures incorporated within the guidelines would boost the number of projects for heating networks in the region over the short and medium term. This would be an outcome of facilitation of services for residential use and the entry of the private sector into promotion and management of such networks. Finally, the guidelines were presented through three roadshows that took place in different cities of the region, and a book was edited to summarise the work and result of Castilla y León RLL.

4. Conclusions

The progress of the INTENSSS-PA project, especially in the case of Castilla y León, demonstrated the advantages of an innovative approach to mechanisms for designing and decision-making within public administration, based on bringing in all those involved in, or affected by, the decisions taken. From the viewpoint of public administrations, the setting up of a participatory forum from the very start of projects guarantees to a large extent the adoption of solutions that are consensual and shared, as well as being technically better informed and more finely tuned, since they are worked out within a framework of collaboration, and of transparent and open debate. In this way, there is a noteworthy reduction in the risk of rejection of, or social protest against, the projects emerging (such as NIMBY). In the specific field of energy, such problems are habitually encountered, very often as an outcome of a lack of any precise understanding of the socio-economic context in which these projects must be undertaken. Similarly, the importance of including spatial, town-planning and territorial variables was made clear, if an overall understanding is to be achieved of the consequences that every project must have in its field of application.

With regard to those actors and agencies involved in the RLL, it was clear that they were strongly motivated to participate, and derived much satisfaction from the fact that their points of view and interests were valued and taken into account. The members of the Castilla y León RLL also rated very positively the training activities occurring as the plan progressed, such as visits to heating networks, and stressed that the principal result of the project was not just the plan drawn up, but also the RLL itself as a forum for participation which also allowed them to get to know one another and compare ideas.

However, incorporation of this method for designing and decision-making into the day-to-day functioning of public administration requires profound changes in the current administrative and institutional structure, no simple matter. First of all, it implies changes in the working philosophy of the administration, which would be obliged to cede part of its prime role and its control, and to open up its operations in a very clear and unrestricted way to the society it serves. From that starting point, there would also be a need to provide some form of structure for choosing, and ensuring participation by, the various members of whatever forums were established, which might be either of a permanent nature, directed towards the production of wide-ranging plans, or linked to the drawing up of specific targeted projects.

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Planning for diversity

Moderator: MAGNUSSEN, Tone (Nordland Research Institute, Norway)
Speakers: FØRDE, Annieke (UiT The Arctic University of Norway); MAGNUSSEN, Tone (Nordland Research Institute); TAFF, Gregory (NIBIO)

ABSTRACT:

Cities in northern Europe are increasingly inhabited by people with diverse cultural backgrounds. The social, economic and environmental sustainability of cities requires capacity to live with differences. Recent increases in refugees and asylum seekers pose new challenges, which adds to challenges already faced by the cities: affordable housing, transport, community meeting spaces and new economic opportunities.

The cold climate of the north brings certain challenges related to creating new meeting places, indoors and outdoors, but the increased diversity has led to a wide variety of new and innovative integration activities, aiming at connecting newcomers and established residents in urban meeting places. This session will focus on exploring the function of and connections between meeting places, interaction and participation in the city. As a part of this broad theme, these questions will be relevant:

How are urban spaces being used by newcomers and established residents?

How and under what conditions do meeting places lead to cross-cultural encounters and interaction?

In what way and to what degree can cross-cultural meeting places and encounters lead to processes of participation in urban life?

The session encourages a wide range of contributions, including from academia, practitioners and civil society. We invite contributions related to new theories or methods for planning for diversity as well as case studies and practical examples, including tools for planning. Both planned activities as well as ongoing or completed activities may be presented.

The session format will be short (10 min) presentations followed by a moderated round table discussion, open for all interested parties. The discussion aims at exploring innovative multicultural integration activities that help us to live with difference, enhance integrative interaction and develop cities' problem-solving capacities. The session will provide a summary from the round-table discussion to be held at the session.

Enhancing urban encounters - the transformative powers of creative integration initiatives

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ABSTRACT:

Sustainable cites requires capacity to live with difference. In a world of increased mobility and migration, our cities become more and more diversified. While national discourses on diversity often are problem-focused, social initiatives are emerging in diverse cities addressing the positive potential of the city as a cross-cultural meeting place. In Norway, such initiatives have increased in numbers since “the refugee crises” in 2015, and we see creative approaches rising from the civil society, the voluntary sector as well as private companies and local government aiming to facilitate encounters with difference. This paper explores innovative integration initiatives in cities in the north, emphasizing how new forms of engagement and responsibility might be engendered. The cities are seen as sites of experiments, where new relations across difference are developed. Framing encounters as emergent, transitory, fragile but yet hopeful, we discuss the transformative powers of such initiatives for planning diverse cities.

Local identities on change: urban waterfront regeneration within the global city Istanbul

(Local identities on chance within the global city Istanbul)

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1. Transformations in Halic

Over the last decades, many cities worldwide have promoted urban waterfront regeneration for a variety of reasons building on the particular scenery of these sites. The success of the first well known urban waterfront regeneration project, Baltimore Inner Harbor regeneration (1960), has served as a prototype for cities around the world with the desire to position themselves in the race to become Global Cities (Harvey 1989) by providing strategically located high-quality investment opportunities to attract global capital, or by constructing attractive spaces to promote tourism and leisure. Nowadays, almost every city at water's edge is engaged in regeneration projects with strong political impetuses and interest from various parties: authorities, developers and neighboring communities (Hoyle 2001).

These developments have been critically examined by many scholars, many of which share the belief that urban waterfront regeneration is often not addressing the underlying, deep-rooted problems of the cities and furthermore, ignoring the socially and economically unstable landscapes in which they often occur, veritably contributing to the escalation of inequality, polarization and deprivation in the city (Harvey 1989; 2005; Brownill 1990; Gordon 1997b; Hoyle 2000; Saarinen and Kumpulainen 2005; Butler 2007; Healey 1997; Gordon 1997a, 1997b; Feldman 1999; Fainstein 2001; Granath 2005; Butler 2007).

Studying urban waterfront regeneration as a complex urban intervention, specifically its special governance, resistance and impacts on the neighboring tissue, could be considered a prism through which broader societal transformation processes and related planning challenges can be understood. For the scope of this study, the empirical research gathered both primary and secondary data through: literature review, review of laws, review of official documents and land-use plans, 31 interviews, 91 questionnaires, participatory- observation, an workshops, observation and photographs.

In order to understand the planning processes of the regeneration of Halic's waterfront, a reflection is done upon the peculiarities of Istanbul's urban regeneration policies and the institutional framework at city and national level that have facilitated it: Istanbul, Turkey has been experiencing a neo-liberal reconfiguration that is now in its final stage. In this context, urban regeneration is steered as a tool for development within a special legal framework and while the purpose of the projects seem to be in the name of upgrading the built environment and improving the living conditions of the poor, the top-down approach, reduce the projects to just transformation of physical space and neglecting the social, economic and environmental dimensions, which along with the unwillingness of government to allow grassroots participation in the planning process become the focus of discontent and protest.

Halic, a 7,5 km bay of the Bosphorus and the cradle of settlement since the birth of the city, was heavily industrialized and contaminated in the 1970s and since then has been experiencing a long process of transformation along its waterfront. In line with popular North-Western examples of urban waterfront regeneration at that time, this process was triggered by Mayor Dalan in 1983 who famously stated his mission: „The water of the Halic will be as blue as my eyes'". Behind the environmental concerns, there was also an economic motivation to bring Istanbul between the competitive global cities with a vision of a "Cultural Valley".

The following forced de-industrialization process of the 1980s was impressive and did indeed improve Halic from an environmental perspective, but the clearing process was pursued with a heavy-handed, top-down governmental approach to planning and the legacy of Dalan is contested: The project created an approximately 50m wide strip of vacant land– a great opportunity in terms of offering open green spaces for the city- but also mass unemployment and poverty in the backstage neighborhoods populated by former dock and shipyard workers.

The following initiatives to regenerate Halic's waterfront showed no intention of resolving the social and economic burning issues of the neighboring communities. Within the same top-down planning approach, as in the 80's clearance intervention, urban waterfront regeneration projects are ad-hoc initiative of different bodies of the government depending on ownership and planning rights over the land, creating developments for middle-high income citizens: "With empty convention centers in the middle of poor neighborhoods, a few art galleries right beside demolished historic buildings, and newly built museums next to squatter housing". (Bezmez 2008 pp. 817).

Still, this 7,5 km green belt of parks and recreational spaces in the heart of the city, represents an enormous opportunity for a congested global city as Istanbul and its citizens, but mostly for its low-income neighboring communities in need of public space.

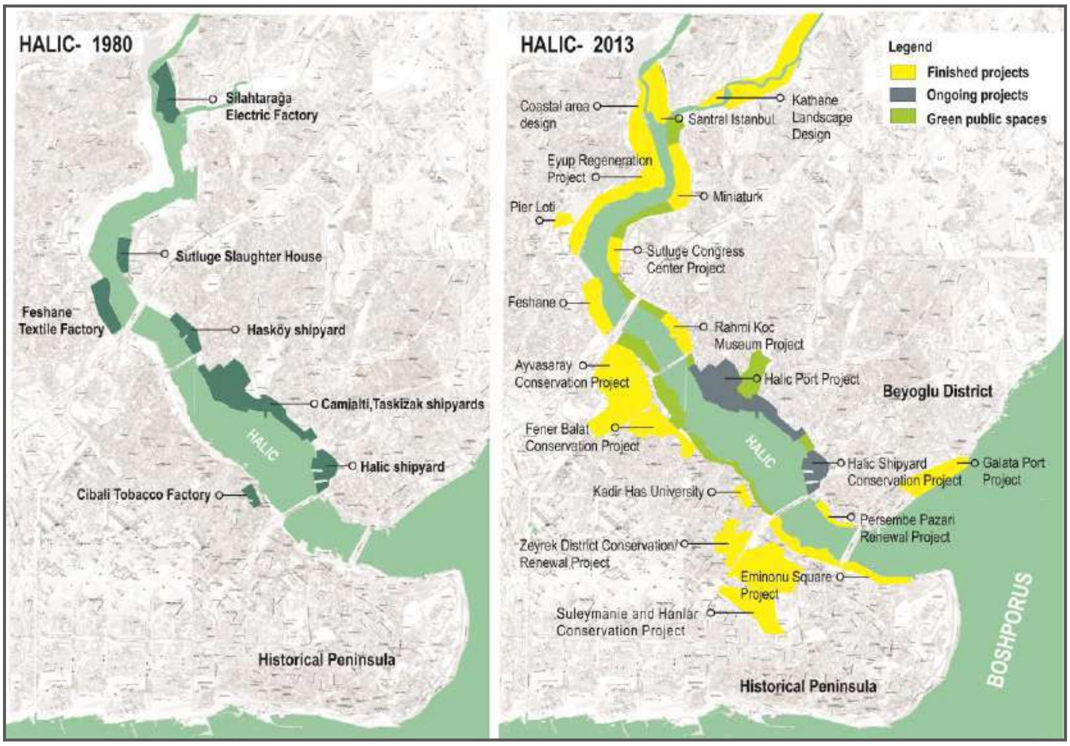

Figure 1: Change of Halic's waterfront from 1980s until 2013

1.1. Halic shipyard conservation project

Halic Shipyard Conservation Project is an urban waterfront regeneration project in on-going planning process, initiated and subsidized by Istanbul Metropolitan Municipality and creates hope in tailored outcomes, serving the citizens interest as a public project, but is missing its transparency.

The site of Halic shipyard was for long under pressure of transformation due to the opportune location and also being one of the last projects that could complement to the “Cultural Valley” vision. For understanding the area of the project and its relevance, it must be noted, that the shipyards aimed to be transformed are also important for their cultural and historical value at global, national and local level. Considering the legal framework, all three shipyards are under Law of Conservation and designated to regeneration and their current function will be changed with the suggested functions from existing plans: culture, recreation areas, commerce and education. Also Conservation Board No. II (representing Ministry of Tourism and Culture) will be added to the planning process.

The ownership belongs to different governmental bodies which makes a collaboration between these actors challenging. Major actors in the planning process of Halic Shipyard Conservation Project are: Istanbul Metropolitan Municipality, the initiator of the project, owner of the land and also the provider of the finance in realizing it.; the Department of Historic Environment Protection managing the project, having mainly the responsibility to assure the conservation and restoration of the historical monuments in the area; the Conservation Board No. II, representative of Ministry of Culture and Tourism, having also the main responsibility to assure the conservation and restoration of the monuments; Istanbul Metropolitan Planning in charge of the plans and design of the project and also IDO (private company), having the tender of the land.

In the interviews with representatives from the planning department of Istanbul Metropolitan Planning, the team planning Halic Shipyard Conservation Project, it has been revealed that the outcomes of the project will take into consideration the previous suggestions. Halic Shipyard Conservation Project will respect the 1/1000 Plans of Beyoglu in terms of conservation of the shipyards, along with the recommendations of implementing cultural and recreational activities. Moreover, creation of green spaces is emphasized, the vision being to open the waterfront for the broad public, the citizens of Istanbul. However, the project contains no analysis of impact assessment such as: environmental, economic or social, this showing the physical focus of urban waterfront regeneration in planning, putting in doubt the success and purpose of this project. Strategies concerning the development have been proposed by Istanbul Metropolitan Planning: "conservation of the buildings, enhancing the transportation in the area, introduction of recreational and exposition areas, bringing the city to the waterfront, protection of green spaces and ensure the participation of the local people of the area." But although these strategic points presented, there was no information for the broader public about the project or the request for any collaboration from the citizen’s side. This leads to questioning the outcomes of the project because of this type of non-transparent planning process that leaves no input from the citizen’s perspective. As seen and criticized in other examples of projects along the Halic, the project could also potentially enhance existing socio-economic problems, a matter that will be presented in the following part of the article, by analyzing the neighboring community in rapport to the project.

2. Bedrettin inhabitants, a neighboring community on struggle

This part presents the evaluation of the Halic Shipyard Conservation Project, considering the impact on the neighboring community. Bedrettin Neighborhood is chosen for analysis because it is the closest community next to Halic shipyard, also being the first group of actors impacted or that could benefit from this project will be exposed.

Bedrettin Neighborhood is a low income neighborhood (according to median monthly household income 2010) at the shores of Halic, in Beyoglu District. It was strongly connected to Halic Camialti and Taskizak shipyards, being occupied by blue collar workers at the shipyards. Therefore, the neighborhood was much affected by the clearance process done by Mayor Dalan in 1983, the first regeneration along Halic, its current problematic economic condition being outcome of the forced deindustrialization process of that time. Today, approximately 1500 people live in Bedrettin Neighborhood and are mostly divided as retired workers from the shipyards, people coming from Anatolian side of Turkey and a considerable group of roma minorities.

Based on the interviews with the "muhtar"(mayor of neighborhood) of Bedrettin Neighborhood, the questioners realized with the community and the personal observations of the researcher on site, is found that the neighborhood is in on-going transformation due to several reasons. First, Bedrettin Neighborhood was declared as Renewal Area in 2005 and, according to Law of Renewal, the neighborhood will go under a process of regeneration which will put in danger of displacement the poor citizens living in the area. Although 80% of the citizens living their own their land, the houses built are not in good condition, being classified as "gecekondu", squatter housing, and have to be renewed and improved for their safety, this being a hard task for the majority of the community which is poor. Second, the increasing prices of land in the area are the proof of the process of gentrification seen also along the whole waterfront of Halic.

These changes bring a strong opposition from the community, who is against this renewal project and afraid of displacement. Together with their muhtar, the community found a neighborhood association named Bedrettin Neighborhood Association. This has the purpose to fight in court, as the only way of challenging decision-making, against the regeneration of their neighborhood and all other regeneration projects that could affect them. All citizens of Bedrettin Neighborhood signed a list opposing this intervention and the municipality’s project was given to court. However, the results were not positive ones and this created mistrust between the community of Bedrettin Neighborhood and municipality along with loss of hope towards the actions of the government. In this context, although the purpose of the urban renewal project seems to be in the name of upgrading the built environment and improving the living conditions of this poor community, the top-down approach along with the unwillingness of government to allow any participation from the citizen’s side can be questioned.

The reason for opposition, from the citizen’s perspective was not only the fear of displacement, but also the difference between the new proposed plans and their actual needs. As reason for this are the un-transparent processes of planning with no collaboration or participation from the community’s side. Public planning policy in Turkey gives rights of involvement in planning process just to the owners of the land and welcomes participation from the citizen’s perspective at the end of the planning process. Still, studying the neighboring community of Halic Shipyard Conservation Project, it was found that the citizens have been informed about the development of the shipyards and active in influencing the planning process. The community doesn't believe that the project will be done for their interest and that will bring them job opportunities or other benefits of such. Also there is a lack of information regarding the project which proves the lack of transparency in planning.

The lack of information regarding the project makes the community come closer to Chamber of Architects, Neighborhood Associations and Halic Resistance urban social movement, the actors currently engaged in a fight against the waterfront regeneration of the shipyards. In the questioners conducted during the meetings of Halic Resistance, besides the fear of displacement answers also as: “to learn the truth”, “because this project is being used strategically against us” were given.

2.1. True needs of the citizens

Looking to Bedrettin Neighborhood, one could see a condensed living environment, trapped between wide boulevards and with a great view towards the shore of Halic. Analyzing the built environment, it can be seen through the narrow streets and lack of public spaces, that it evolved organically and unplanned. The lack of public space and also green areas is a main loss for this neighborhood, but also one of the main aspects that Halic Shipyard Conservation Project could improve.

Although, as previously mentioned, the citizens of Bedrettin Neighborhood are against the Halic Shipyard Conservation Project, outcomes of the questioners regarding what they would need in the future development were: green spaces, culture and education facilities, keeping the working shipyards, health facilities. In the discussions with the community, especially with the group of mothers, mostly staying home and taking care of their children, the need of closer public space and green areas was emphasized. It was found that families go to other parks along the Halic and make barbeques or just bring their children to play, this being the only recreational activity for these families. An intriguing vision of the children is the one of the "fisherman", a symbol of the waterfront of Istanbul which should not be blurred in the landscape of waterfront development for global economic gain given by projects in name of tourism and consumption.

The regeneration of Halic shipyard, is understood to be a big opportunity for the community in terms of creating public space for recreation, improving the quality of their life considerably.

Taking into account the vulnerable position of the neighborhood in terms of economic situation, the on-going gentrification process at Halic's waterfront and the renewal project in the agenda of the government, it can be argued that Halic Shipyard Conservation Project will contribute to this picture considerably, creating social and economic impacts on the community. From the questioners conducted in the neighborhood it is clear that the community is against Halic Shipyard Conservation project, the main reasons being in relation with the mistrust towards the regeneration projects initiated by the government, the lack of transparency in the planning processes, the lack of good quality information and the fear of displacement rather than the project itself or its outcomes. These aspects are also the reason why the neighboring community is engaging with other actors in opposition.

The community of Bedrettin Neighborhood is an important actor being the most affected by the project, but also by its potential to give inputs to the project. Due to the lack of consideration of this neighborhood in the planning process the true benefiting outcomes of the project will not be achieved. Opportunities for more inclusive and transparent processes in planning can be found after analyzing the neighboring community as the openness and interest of the community in participatory planning methods and in expressing their need. The community is not only in need of public green space which can be created with the Halic Shipyard Conservation Project, but also in need of programs and solutions for its vulnerable economic condition. Halic Shipyard Conservation Project, if planned carefully, might satisfy and resolve some of the problems faced by the community, but this is possible only if the community is involved in the planning process.

Urban waterfront regeneration in the context of Istanbul reveals the same features of the popular contested cases of North and Western examples . The leading factors are an entrepreneurial government and also a national policy on urban regeneration designated by the central government. The strong and constantly growing opposition is not only the resistance to this particular urban waterfront regeneration project, but it leads to a bigger picture of urban regeneration projects in Istanbul, realized through a top-down approach to planning, creating major social and economic impacts. One may argue that only through a change towards a more inclusive planning approach, along with clear targets for the improvement of the quality of life for the neighboring community, the urban waterfront regeneration project, Halic Shipyard Conservation Project, will be able to escape the current deadlocks and collisions between government, investors, resistance and local community and might have a chance to actually set an urgently needed precedent of a new planning culture in Istanbul.

Figure 2: Opposites. Right : Renewal Plan of Bedrettin Neighborhood; Left: the garden of a citizen

Source: Geambazu, S (2014), Date: 19.11.2013

Figure 3: Perspectives: Analysis on the urban tissue of Bedrettin Neighborhood through photograps; Source: Geambazu, S (2014) ; Date of photographs: 23.09.2013; 19.11.2013; 11.11.2013

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Category: SOCIAL NETWORKS: Citizen Participation, Urban Governance and Cultural Transformation

Author: Iris Gommers, programleader sustainable city, Antwerp, Belgium

- Governance, management, administration and planning systems

Title: A Green tool to measure the environmental and ecological benefits of green areas and to involve different stakeholders

City, Country: Antwerp, Belgium

Area: 20 450 ha

Population: 510 610 (January 2014)

Signatory to the Covenant of Mayors since: 2009

In a nutshell

Green and blue measures or infrastructures help cities become more resilient to climate change, and they also have many other co-benefits. Antwerp's Groentool" or in English "Greentool" allows urban planners to explore the potential of green to improve the living environment (heat stress, air quality, etc.) in a specific area or neighbourhood. The application is giving an insight in the effects of nature based solutions on the human environment: air quality, heat stress, water run-off, noise perception, biodiversity and carbon sequestration. The application shows which nature based solutions (trees, shrubs, green roofs, green walls, …) can be used where in the city and gives the potential impact. Maps give the user the possibility to check what is possible in specific parts of Antwerp.

Adressing heat and flood stress

Although Antwerp has avoided major floods so far, the city is at risk of fluvial flooding, sea level rise and storms. Antwerp also suffers from increasingly extreme temperatures. In the city, it is up to 8 degrees warmer in the late afternoon, evening and especially at night than in rural areas, a phenomenon called the "urban heat island effect". Only green spaces in the city are significantly cooler than the rest of the urban territory, and also contribute to retain excess water.

One of the main reasons is that the city center of Antwerp is highly petrified. As major threat to the City of Antwerp heat and flooding-risks were highlighted in the Antwerp Climate Adaptation Strategy and the Antwerp Green Plan. Both problems identified can be tackled making use of nature based solutions. Most of the time nature based solutions do contribute at the same time to reducing both problems mentioned.

On top of water management and heat stress reduction, greening the city has other environmental and ecological benefits: it also contributes to reducing air and noise pollution, increasing biodiversity, and capturing CO2. The Antwerp's green plan adopted in 2017 acknowledges these environmental and ecological benefits. However, in many cases, even though those benefits are vaguely known, they are not easy to quantify.

More informed urban planning decisions

To address this knowledge gap, the city of Antwerp has commissioned the creation of the Antwerp Greentool (Antwerpse Groentool), aimed at providing information about blue-green measures and their effect on environmental challenges. Initially designed as an application to help Antwerp administrators make urban planning decisions, it has been adopted by private investors willing to invest in green actions and projects, and by technicians in charge of execution and maintenance. The tool, which is entirely public, contains interactive maps that enable sites analysis. The user can visualise the location's current characteristics (soil, plants, etc.) and discover the effect of existing blue-green measures on seven parameters: biodiversity, CO_2 capture, noise, air quality, recreation and proximity, heat stress, and water management. Each parameter receives a score ranked from 0 to 5. It makes it possible to explore the impact of a possible measure (such as green roofs, water tanks or tree planting) on these seven parameters, compared to the existing situation.

The tool helps users by inspiring the design process, quantifying impact on a specific site, comparing and combining measures, stimulating dialogue between stakeholders, and integrating blue-green infrastructures and challenges into the planning process.

The tool provides inspiration and scientific information on nearly 50 bluegreen measures. It is a pedagogical instrument aimed at informing the cityofficers about such measures and their impact on the day-to-day life of citizens.

Use of the Greentool

The tool is being used by the environment-department in their advisory-process. Spacial planners can also use the tool themselves to analyse projects they are working on and to feed the dialogue about the right green on the right place. Examples are the ‘Zuiderdokken’ and the ‘Groenplaats’.

The greentool was used for instance in the neighbourhood Sint Andries in the heart of the city. In a process from the citylab (Stadslab2050) the city aimed to co-create more space for green by setting up experiments together with the local stakeholders. The greentool showed what the importance of green in this particular neighbourhood was and how for instance green roofs could contribute to especially the heat-stress and the water-retention.

The greentool will also be used in the communication- and planningprocess of the so called ‘gardenstreets’, that will be executed on different locations in the city for a better overall living environment.

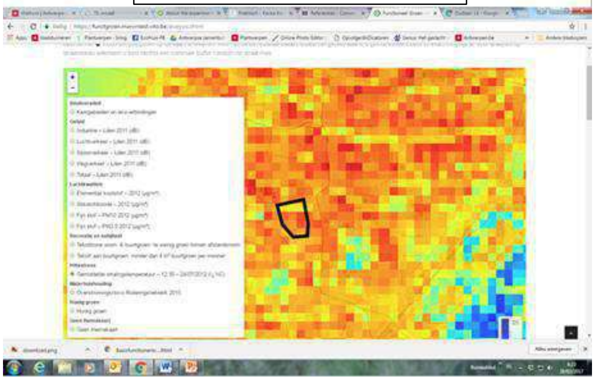
Additional information

Antwerp’s Greentool was designed by VITO (the Flemish Institute of technology and research) and the University of Ghent, and was released in January 2017. The tool was commissioned via a tender. Since 2016, the city of Antwerp is part of the European EnRoute project on urban green infrastructure along with VITO, which maked it possible to further develop the tool. The city of Antwerp decided to develop this instrument because green areas play a mitigating role in every action plan of their environment department. They wanted to make it accessible – together with their mapping-exercises and other research – for every city-officer in an attractive manner.

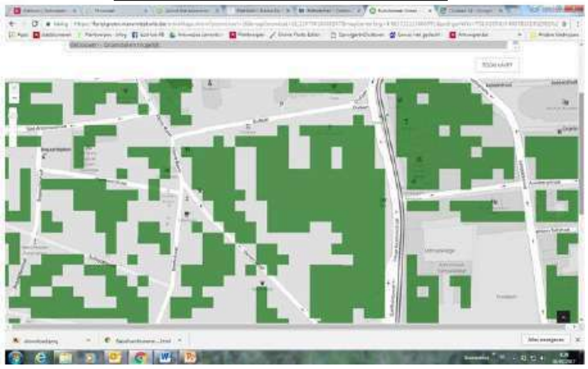
The tool is entirely owned by the city and is free to use for everyone. It was meant for internal use in the first place but the city decided to make it accessible for everybody.

Analysis for Sint Andries

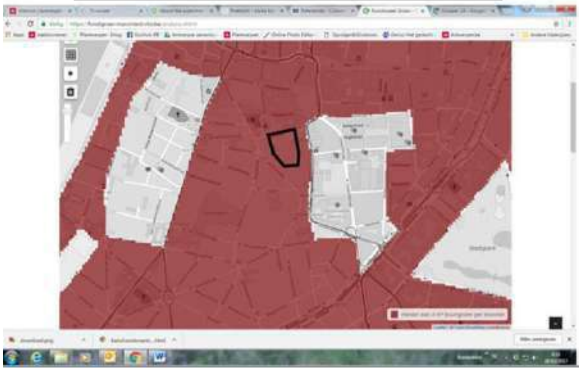
Heatstress



Greenroof possible



Areas with less then 4m2 green / inhabitant



USEFUL LINKS

https://groentool.antwerpen.be/

http://climate-adapt.eea.europa.eu/eu-adaptation-policy/covenant-of-mayors/city-profile/antwe-1

http://www.covenantofmayors.eu/about/signatories_en.html?city_id=4&seap

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Space production: The interaction between social network and community garden

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Abstract

Nowadays, much attention has been payed to health status and quality of life over the world, health problem is increasingly serious. As activity space, community garden represents the role "directly link individuals, social capital and built environment". It has been used to examine people's habitual interactions with their environment. A growing body of literature conceptualizes urban agriculture and community gardens as spaces of democratic citizenship and radical political practice. Urban community gardens are lauded as open space which residents can alleviate food insecurity and claim rights to the city. It also seems to provide an opportunity for reconciliation between the urban and nonurban realm in a densely built, urban environment and the possibility of introducing new approaches to public policies, urban planning included.

This paper investigated the association between the neighborhood socioeconomic environment and physical inactivity and explored the contribution of neighborhood characteristics to this association. We payed close attention on the community gardens in typical old-fashioned worker village community. To determine the role community gardens play in community development, open space, and civic agriculture, we conducted interviews with community gardens from Shanghai, Yangpu District. This paper investigates urban community gardens as spaces of citizenship through a case study of Anshan Forth village, which is an agelong built community. The residents there are long lived and of a high aging level. The Paraquat garden in the third residential area of Anshan Forth village is a typical positive space to promote residents' intercourse through urban agriculture. Through questionnaires and Grounded Theory interviews, the paper is an attempt to answer three questions: (1) The relationship between demographic attribute classification and public space usage. (2) How to develop positive social relations and citizenship among urban residents. (3) How suitable shaping of public space affects the activation and integration of local residents. We try to find out the interaction that urban agriculture brings to citizens' participation and the residents' life style as public space. The gardens can also be viewed as unique "participatory landscapes" that combine aspects of diversity movements, as well as provide a connection between immigrants and their cultural heritage.

Keywords: community garden; public space; health; identity.

1. Introduction

Nowadays, the process of urbanization continues to advance in various countries. According to data provided by the United Nations Department of Economic and Social Affairs, 3.9 billion people are now living in cities, which is equivalent to half of the world's population. It is predicted that by 2050, the total global population will reach 9.3 billion, of which the total population living in cities will reach 6.25 billion. China's urban population has also increased from 457.06 million in 2000 to 77.16 million in 2015[1]. Such rapid urban population growth will inevitably bring about many urban problems and urban diseases. The role of natural ecology in regulating people's health is particularly important in today's society. In addition, people's lifestyles and form of residence are also changing. High-density residential areas have risen. The mobility of urban population is increasing greatly. The social network structure has been strongly impacted, and the neighborhood relationship is gradually becoming weak. Aging trend is increasingly serious. Therefore, all countries have noticed the importance of developing community gardens in cities to improve the health of residents and build an active neighborhood relationship.

The term “community gardens” first appeared during the First World War. Some European and American warring countries triggered a food crisis, forcing the government to encourage the public to cultivate the earth to grow food, and build community gardens to solve the problem of food and clothing [2]. Later, in Europe and the United States, it developed into the public green space that was divided or leased to residents for planting activities. It could help improve the urban environment, create opportunities for communication and education, and promote the residents' positive neighborhood relations. Compared with other forms of agriculture, the characteristics of community gardens are significant. It relies on the background of high-speed development of urbanization. It has good adaptability in high-density compound neighborhoods. It is usually distributed or rented to the community residents by the government or related departments. The management system is bottom-up and community-based. The participants always various in level of income and age, most of them are old people who have a large amount of leisure time.

The urban community garden that has risen in China in recent years is a revival of farming culture. It also originated from the form of green space in European and American countries. It means that idle land is divided into small pieces for cheap rent or distributed to individuals and families for gardening or agronomy [3]. As the representative of China's high-density cities, Shanghai has an average density of 24,325 people/km^2 in the old city (end of 2015, data). With the rapid expansion of cities and the declining open space, how to use community gardens to improve the quality of life of residents and realize cities sustainable development has become a topic of increasing concern. Since 2014, with the gradual advancement of urban renewal in Shanghai, relevant organizations have begun to appear dedicated to the construction of community farms. At present, there are nearly 21 community gardens built or under construction in Shanghai, which are located in residential areas, neighborhoods, parks, and campuses in Yangpu and Pudong District. With public participation as the main driving force, they provide natural space in a dense urban environment and promote the healthy and sustainable development of the city.

2. Community Garden and Health

In 1948, the World Health Organization defined health as " complete physical, mental and social well-being, not merely negatively as the absence of disease or infirmity. [4]" As the largest non-governmental organization in the United States and Canada dedicated to promoting the development of community farms - The American Community Gardening Association, once summarized the benefits of community farms as: Improving the quality of life of participants, promoting the harmonious development of the community, and creating Good community atmosphere, encouraging self-sufficiency, beautifying the neighborhood, producing nutritious food, reducing family food expenses, saving resources, providing leisure, exercise, rest and recreation sites, and educational platforms to reduce crime, protect green space, and create jobs Opportunity and promotion of economic development, reducing car exhaust from streets and parking lots[5]. This reflects the role of community gardens in promoting personal health, community belonging, and even social development.

2.1 Improve Physical Health Level

Today, in many cities in Latin America, people are struggling to survive on the subsistence level. Developing community agriculture can improve people’s diet and improve their physical fitness. For example, in Colombia's poorest district of Bogotá in 2004, Colombia encouraged the cultivation of home-grown kitchen gardens, which was also an important practice in the municipal project of “Bogota sin hambre” [6]. Even in some European countries and countries that do not currently have an economic crisis, it is equally important to develop community farms. Studies have shown that poor diet and living habits have a large number of negative effects on the health of urban residents. Data show that 60% of European urban People's disease and premature is not only a bacterial infection or genetic problems, but because people lack of a "low victimization mode of life" [7]. In short, community gardens can provide people with healthy food and lifestyle. Healthy living habits such as changing the habit of sedentary and maintaining moderate eating can reduce the probability of suffering from cardiovascular diseases and cancers [8].

2.2 Promote Identity and Integration

The North American Community of Farmers Association proposed in 2001 that “a community garden is a place where individuals and neighbors’ children, businessmen, homeless folks, and artists work together side by side. They share stories and shovels. laughter and water. They slowly build relationships, transcend gardens, and integrate into larger communities.[9]” Yuan Pingping reviewed a research on the relationship between the community gardens and the interpersonal interactions from three aspects: communication between family members, different families, and inside and outside the gardens. As an important communicative space, community garden become an important link between family members, community residents and community administrators. [10][11]. These studies and practical cases have proved that community farms can pool a group of residents together with common interests and strengthen their social network to increase the sense of belonging and identity. This kind of emotional consolidation can promote community identity and community spirit, even extend the impact to other communities and improve the harmony of the entire society.

3. Introduction of Baicao Garden

3.1 Construction Background

Baicao Garden is located in the third residential area of Anshan forth village. The third residential area of Anshan forth village was built in the 1950s. It is a typical old-fashioned worker village. In the 1990s, it became a model of the old housing comprehensive reform. The concept of low carbon and environmental protection has been accompanied by the construction of the community. During the “12th Five-Year Plan” period, the community was included in the energy-saving emission reduction model community. In order to demonstrate the new features of energy-saving and environmental protection in Shanghai through the Shanghai World Expo, a number of achievements have been formed in the community, such as spray cooling system, rainwater collecting greening and watering system, solar energy utilization system, insulation renovation of residential outer walls, and construction of environmental monitoring platform. These achievements have enabled the community to achieve initial successes in building energy-saving renovation, new energy use, and energy-saving management, and have taken the lead over other workers' new villages. In 2016, the third residential area of Anshan Fourth Village was included in the “13th Five-Year Plan” low-carbon pilot community in Shanghai. The Department of Landscape Studies in Colleges and Siping Street Management jointly collaborated in building landscape improvement in this community. The surrounding college landscape design team led the community residents, volunteers, and the “Fang Lin Flower Club” designed and built this Baicao garden.

3.2 Design Process

Baicao Garden covers an area of about 200 square meters, and the designers mainly considers the following aspects: First, the per capita public green area of the district is only 2.23 square meters, the central square has poor maintenance and lacks open space for activities. The second is that the community has a high level of aging, with a total population of about 6,800, of which old people over the age of 60 account for 23.5%. Although there are a large number of tenants, the tenants generally live longer, the sense of belonging to the community is high, and the relationship between neighbors is harmonious. Third, the management effect of the community residents' committee is relatively good. Many horticultural enthusiasts in the community are united to form a horticultural autonomy organization – the “Fang Lin Flower Club” [12]. The association was established in 2015 and consists of a group of hobbyist residents. Currently, there are about 40 members, including management personnel, of whom about 17 are active. The Baicao Garden is intended to create a space where residents can propose ideas, participate in design, and provide residents with a horticultural communication platform. Before designing the garden, the team of designers launched a “little landscape designer” event to allow children to create an ideal garden and let them have a sense of expectation and a sense of belonging to the soon-to-be-faced small garden. The design team positioned the garden function to satisfy residents' leisure activities, parent-child interaction and nature education. Residents’ suggestions have been continuously sought such as the use of wood boards can cause noise and disturb residents’ rest. Under the guidance of professional, nearly 1,000 community residents participated to build the garden by their own hands, from drawing on the fences to collecting rainwater, from composting kitchen waste to “drifting” plants. In that summer, under the collective wisdom of everyone, the bare green belt finally became the creative Baicao Garden. Although these jobs can be completed in a week or so if it was done by professional construction teams, residents all say that personal involvement is far more valuable than anything else. In short, the joint construction of residents and professional teams has provided new ideas for the construction of other community gardens.

Figure 1: An aerial view of Baicao Garden

Source: Liu Yuelai, Yin Kejun, Wei Yi, et al(2017). Community Garden Practice in High-density Central Cities —A Case Study of KIC Garden and Herb Garden in Shangha [J]. Landscape Architecture, 16-22 .

3.3 Activation and Operation

The Flower Club played a key role in the construction of Baicao Garden. The president sorted out the name list of the club members, counted the idle time of each person, combined their respective characteristics and the major abilities to make a construction schedule. The table includes a watering group, a fertilizing group and a garbage picking up group, etc. [12]. At the same time, the community has also formed a "little volunteer" team so that children can participate in the construction of the garden and cultivate their sense of responsibility. In 2017, activities about “ The 24 Solar Terms” were carried out, participants took natural observations and notes every two weeks. Baicao Garden is also used as the school natural education base of Dahushan Road Primary School. Besides, it realized the sharing of activity resources with Nongfang Garden in Fushun Road, which brought closer interaction between neighbors[12]. These activities have all strengthened the building of community cohesion. As an organic public space, Baicao

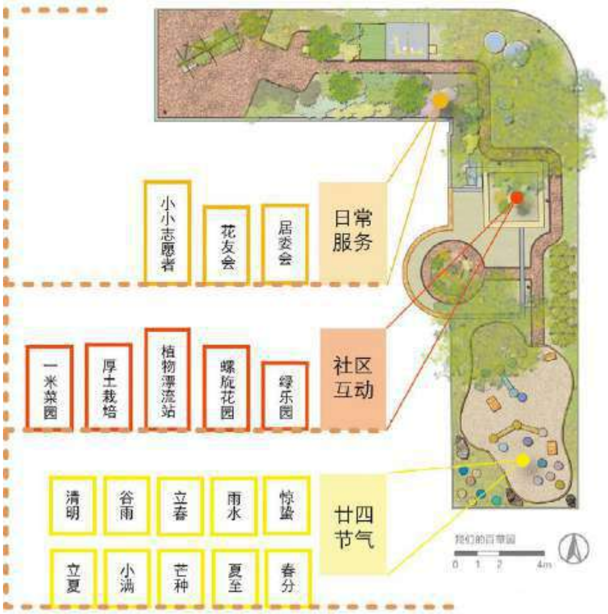

Figure 2: Spatial distribution of community activities in Baicao Garden

Source: Liu Yuelai, Yin Kejun, Wei Yi, et al(2017). Community Garden Practice in High-density Central Cities —A Case Study of KIC Garden and Herb Garden in Shangha [J]. Landscape Architecture, 16-22

Garden is a good place to bring people with common interests together and let them influence other residents so that the community's self-governance ability will become stronger and stronger. It is a good way to change residents from consumers to producers and strengthen their sense of belonging and identity.

4. Health Promotion of Baicao Garden on The Flower club Members

4.1 Basic Information

4.1.1Activities

Although there are nearly 40 members *in* the 'Fang *Lin* Flower *Club'*, which includes many management personnel. There are only 17 people actually participate in the activities frequently, and their basic age is above 60 years old. The person in charge will ask the free time of each member to arrange the worksheets. Every day, two people will maintain the Baicao Garden. Different groups will be responsible for different tasks, such as watering, fertilizing, collecting garbage, etc. The club's core members have a regular meeting once a week. During several field studies and interviews, the author found that the meetings were mainly held in two places. The indoor activities were selected in the activity room for the elderly in the community. Everyone sat together to discuss and exchange the flower cultivation techniques and appreciate the newly cultivated Flowers. They also discussed the difficulties met when maintaining the Baicao Garden and try to find the solutions. Sometimes they would introduce new flower friends to each other and so on. In the recent regular meeting, the members discussed the solution to the theft of two promising roses. They proposed measures such as organizing flower delivery activities and installing monitoring. In some regular meeting, they would hold outdoor activities in the Baicao Garden, such as building shelves for vegetables, watering and fertilizing. Special activities such as the lantern riddles of the Mid-Autumn Festival are held during the festival. The design team will always follow this project. They would make an on-the-spot investigation from time to time to understand the difficulties encountered by residents and would try their best to help solve it. It can be seen that the design team and the residents themselves have a very positive attitude towards Baicao Garden so that it can better become a positive space for residents to communicate.

Figure 3-5: Daily activities of the Flower Club members in the Baicao Garden
Figure 6: University team came to visit Baicao Garden

Figure 7-8: The regular meeting in the elderly activity room
Source: photographed by author

4.1.2 Questionnaire Results

We had the privilege of conducting a questionnaire survey of 9 members of the Flower Club and found that the members who lived in the community for the shortest period of time lived here for 10 years. The longest is up to 50 years. All of them are basically local people in Shanghai. The average age is over 70. They have a high sense of belonging to the community and have certain requirements for their own living conditions. For example, most of them live in multi-storey buildings and they all want to Install elevators in their unit buildings. More than half of the elderly do not live with their children and do not need to take care of their grandchildren. Therefore, they have sufficient personal time and are in close contact with other residents and managers in the community. Most of the members of the Flower Club have smart phones and can use the Internet. They love to participate in community activities and are fully capable of living independently. Only three people often need to go out to see a doctor. Most members go out to take the community activities 1-3 times a day, more than half of them go to the outside of the community every day, and compared to other public space, the green and the elderly activity center become their favorite places for various activities. These elderly people have a high level of enthusiasm for life. Six of them have travel plans every year, and two of them even travel abroad. In terms of their self-perceived health, except for one person who believes that he is particularly healthy and one person who believes that he is unhealthy, most members think that their own health is basically healthy. All members will focus on a healthy diet, and most will pay attention to exercise and regular inspections. In the survey of personal life satisfaction, six members were basically satisfied with their lives, one was satisfied, and two were very satisfied. It can be seen that the overall life happiness is very high.

4.1.3 Health Status Measurement

In order to better study the health status of the members, in addition to the interviews, we also conducted measurements of some health indicators, including height, weight, blood glucose, blood pressure, and heart rate for these 9 members. It can be seen from the table below, the data are similar with the results we get form the questionnaire survey. Most of the elderly people showed a good healthy status in these indicators. Several members mentioned in the interview that they were worried about their own high blood pressure problems. But in fact, there is only one who has high blood pressure and one who has low blood pressure. The good healthy status may be related to their regular inspection and active participation in physical exercise, such as take activities in Baicao Garden. In terms of blood sugar, one of them have a slight impaired glucose tolerance, two of them fasting blood sugar were slightly impaired and no diabetic patients appeared. From the data, most members obtain good health status, which is closely related to their lifestyle.

Form 1: Health indicators of partial members

NN	Birth	Blood sugar (fasting)	Blood sugar	Weight	High	High pressure	Low pressure	Heart rate	Hyper-tension	Hypo-tension	Impaired glucose tolerance	Impaired fasting glucose	Diabetes
F01	1953.05	—	7.6	—	—	122	62	78	0	0	0	0	0
M01	1951.08	—	5.5	—	—	132	72	65	0	0	0	0	0
F02	1955.11	6.8	7.4	—	—	137	74	95	0	0	0	0	0
F03	1947.11	—	5.0	53.5	—	127	87	59	0	0	0	0	0
F04	1949.10	5.6	7.4	61.3	—	149	88	79	1	0	0	1	0
F05	1949.10	—	9.8	70.2	—	125	66	80	0	0	1	0	0
F06	1954.09	—	6.3	60.8	—	127	81	66	0	0	0	0	0
F07	1954.07	5.7	6.5	—	—	107	54	73	0	1	0	1	0
M02	1955.09	—	6.4	53	—	118	74	78	0	0	0	0	0

Source: health status measurement of the Flower Club members

4.2 Influencing Factors

4.2.1 Research Method

The Grounded Theory was proposed by Glazer in 1967. It provides researchers with a complete set of methods and steps for summarizing and constructing theories from the original materials[13]. It uses observation methods, interview methods, etc. to collect data, and explain the behavior of the research objects, construct the concept by coding and summarizing the data, and generalize the concept category to obtain the theory[14]. Therefore, the use of grounded theory to comprehensively understand the influencing factors of community farming activities is a good complement to the previous top-down empirical research methods.

4.2.2 Sample Selection and Data Collection

The sample selection follows the theory saturation principle, and randomly extracts the eligible Flower Club members for one-on-one interview from the predetermined range of interview objects. When the number of respondents reached 17, the theory began to saturate, no new concept appears, so we final interviewed 17 members whose age is between 65 to 75. The samples included 11 women and 6 men, most of them do not need to undertake grandchildren and have a lot of free time.

This study began on May 4, 2018, following the theoretical saturation principle of grounded theory, using open interview to collect data. Through the continuous collation of one-on-one interview data, the theoretical nodes are perfected until the theoretical saturation. In the interview data collection process, in order to get more reasonable interview data, we designed the following several interview questions, and according to the respondents to further questions, so as to obtain more comprehensive data. ①What is your age and self-perceived health status? ②Do you often come to attend the activities? ③Why did you attend the Flower Club at the beginning? ④What impact do you have on your health and relationships after attending these activities? ⑤Are you satisfied with the status of Baicao Garden? ⑥What do you want to improve?

4.2.3 Data Analysis

4.2.3.1 Open Coding

Open coding requires the construction of a concise and comprehensive initial code system. In this study, the original interview data were coded to generate the initial concept, and finally, 17 categories were extracted from the interview data.

Form 2: Open coding normalization

Category	***Initial Concept***	***original statement***
Stability of Organization	*Doubt on stability of organization*	*Many similar organizations do not organize activities often.*
Authority of Organization	*Doubt on authority of organization*	*Many similar organizations have no professional leaders.*
Reliability of Organization	*Doubt on reliability of organization*	*My body may not be able to take part in these activities.*
Value of Organization	*Doubt on value of organization*	*If I feel useful, I will participate occasionally. If it is useless, I will not participate.*
Frequency of Activities	*Frequency of activities*	*The frequency of current activities is suitable for our physical condition.*
Activity Form	*Activity form*	*We have indoor activities as well as outdoor activities, which is very good.*
Actual Effect	*Different actual effects on different kinds of people*	*Some activities are very good, which helps to improve our unhealthy living habits, but it is not suitable for my own physical condition.*

Use	*Help solve the physical problems or not*	*After this year's activities, my hypertension has improved.*
Interest	*Points of interest, hobbies, concerns*	*I really love flowers. I have been paying attention to such organizations before.*
Self-health Awareness	*Self-health awareness*	*I am a hypertensive patient and I am more involved in community activities.*
Free Time	*Having enough free time or not*	*I don't live with my children. I have a lot of free time and want to make new friends.*
Family Support	*Whether other family members support or not*	*My son wants me to join such an organization to enrich my life.*
Financial Ability	*Financial ability can affect the lifestyle*	*I don't have any financial pressure. I usually like to live with these plants.*
Information Sharing	*Information sharing between families and friends*	*I will share the activities with others and ask if they are interested.*
Organization Management	*If the organization management is in order*	*I trust the neighbourhood committee and these partners. We usually help each other.*
College Assistance	*Whether college support is in place*	*We are very grateful for the guidance of the university design team.*
Problem Solved	*Whether the problem is solved in time*	*Recently, some flowers in the garden have been stolen, which make us annoyed.*

4.2.3.2 Axial Coding

The open coding is to explore the category, while the axial coding is to find the main category. The axis coding digs the attribute of category, which can make the category to be more rigorous, and establishes the relation between the category.

Form 3: Main category formed by axial coding

Classification	Main Category	Category
Factors of Organization	*Content of Activities*	*Stability of Organization* *Authority of Organization* *Reliability of Organization* *Value of Organization*
	Quality of Activities	*Frequency of Activities* *Activity Form* *Actual Effect*
Factors of Participants	*Subjective Factors*	*Interest* *Self-health Awareness*

		Information Sharing *Information Sharing*
	Objective Factors	*Free Time* *Family Support* *Financial Ability*
Environmental Factors	*Organization Management*	*Organization Management*
	College Assistance	*College Assistance*

4.2.4 Summary of Influencing Factors
The community garden is one of the most frequent places for members of the Flower Club, they nearly go there every day, it can be said that it has an important impact on their lifestyle. It is mainly reflected in two aspects. First, the daily physical activities produced by maintaining the community garden and fresh vegetables produced by the farm are helpful to their physical health. Second, the community garden provides an active exchange space for members and their interests are promoted. Information is shared to promote the development of interpersonal interaction and community harmony. From the questionnaire survey, we have obtained that most of these members have the will to live independently and are not busy caring for grandchildren, so there is plenty of time for them to realize their self-worth. In addition, the Neighborhood Committee has strong management capabilities. It can bring members together closely and made a detailed schedule. Members are also happy to work in the garden. Occasionally, the community managers organize picking activities when the vegetables are ripe, so that these fresh vegetables can also bring benefits to other residents. In the promotion of human interaction, members always have communication about the selection of seeds and some planting skills. Flower viewing are also a vital activity to the establishment of friendship in the community. In the community garden, the exchange of information, common activities, and home-based participatory learning are all more likely to occur. From the interview of the Flower Club members, we found that they communicated with each other through WeChat group and often discussed the cultivation of their own flowers in the group. Every Thursday, they also took their own beautiful flowers to the elderly activity room to share, and sometimes they would meet new flower friends. They form a very close friendship circle. In addition, because the third residential area of Anshan forth village is the concerned closely by the surrounding universities, sometimes university teams will also come to Baicao Garden to conduct some learning exchange activities. Members are always willing to communicate with the visiting team. Such activities will also deepen their mutual recognition and cohesion. The increasing sense of community identity and pride of residents can improve the effectiveness of the community conduction. Community gardens have changed from the original personal place to a hotbed of community society and participatory democracy[15]. People's interest in urban horticulture also promotes community-based efforts on other social issues[16]. In short, the "successfulness" of Baicao Garden mainly benefits from the following aspects: factors of organization, including content of activities and quality of activities; factors of participants, including subjective factors and objective factors; and environmental factors, including organization management and college assistance.

5. Conclusion

Taking the Anshan Forth village as an example, this article describes how the Baicao Garden promote the physical health of active participants and how to improve their social networks. The main research methods are taking questionnaires, Grounded Theory interviews and health data measurement. They help to understand the health status and community participation of the Flower Club members, as well as the influencing factors of participation. In short, under the background of the lack of green space and the expand of environment pollution, this new agricultural form provides protection for the physical and mental health of residents and opens up new ideas for urban spatial planning.

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Child in the City

Understanding the role of children in Community Engagement
Case of Chara Mandi, Delhi

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1 Abstract

Local governments have always been an integral part of the Indian ethos. The 73rd and 74th constitutional amendments empowered the local bodies to respond quickly and efficiently to local issues rather than relying on a distant central body. Over the years the notion of participation and citizen engagement have been tokenistic. The Local Area Design studio at School of Planning and Architecture, New Delhi have been trying to execute the participatory planning methods in various neighborhoods in Delhi.

This paper is the analysis of a social experiment conducted in ward 99 Karampura as part of the local area design project in 2017. [i] The case study delves into the challenges posed by the complex social conditions in the ward and the methodology by which children were incorporated into the process of participatory planning. The experiment tries use children to engage people belonging to otherwise opposing ideologies in a productive discussion for the better future of the neighborhood.

Keywords: participatory planning, children, Indian cities

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2 Participatory Planning in India

"...in serving the best interests of children, we serve the best interests of all humanity."

- *Carol Bellamy, Chair of the Board of the Global Community Engagement and Resilience Fund.*

In India, the 73rd and the 74th constitutional amendments acts (CAA) enacted on 1st June 1993 extends constitutional status to municipalities, empowering people and locally elected representatives the power to act in common interest and have a say in how their communities should develop. (Hamid, 2004)

Local Area Plan (LAP) is prepared with an intent to respond to the context and ground realities. It involves the local people and their perspective and points of view in the planning process. The LAP aims to achieve a holistic vision for the city keeping the focus on the "people" and not the city as a space. It's a bottom-up approach in planning which holistically delves into the intangible aspects of a human settlement which have rarely been used in spatial planning so far. It is important to quantify the social components of a human settlement which are most important in spatial planning and often not responded to in master plans or regional plans.

In the recently launched Smart Cities mission by the government of India, this emphasis on public involvement has been further improved. It entails the preparation of the Smart Cities plan through citizen engagement framework. Public Participation has gathered a lot of attention in social media and has been showcased by many cities as a part of their branding process. Thus, participation from a being a localized project in small communities has now permeated institutional constructions and planning processes, affecting decision making.

This augmented emphasis on participation which got reflected in the structures and programs at national level, also affected town planning. Hence, participation in development projects and plan preparation needs to be Public Participation in Planning in India. Additionally, in the last decade, "stakeholder consultations" and other forms of participation are beginning to emerge. (Prakash & Kumar, 2016)

When we started our work in electoral ward 99, Karampura, an industrial area within Delhi, our understanding of the process of participatory planning was purely theoretical. During our site explorations we realized the diverse environment and the extremely complicated social networks existing in this nation. Being the largest democracy in the world is an extremely daunting task, especially when you have 1.3 billion opinions on any given issue. Thus, the efficiency of participatory planning system gets questioned at every turn.

3 Chara Mandi – Analysis of its social structure

Karampura situated in west Delhi is a pre-dominantly residential and planned industrial area which is currently undergoing rapid redevelopment. Karampura, literally means 'abode of the workers' was envisioned in 1962 Master Plan as a place of work for the city of Delhi. This vision led to numerous industries setting up in the area

Chara Mandi came up in 1980's to cater to the goods transportation services required in this industrial area. Historically a market for animal fodder, the current business of logistics was a mere change in business strategy by the original inhabitants. With a population 3000 and a density of 500 PPHA, the settlement is unique due to its locational characteristics: its sandwiched between a railway line and two city arterial roads. Due to this, it lacks basic services like water and sanitation; lacks access to social amenities such as schools, parks etc.; faces high levels of poverty and has been seeing a constant rise in school dropouts in the past years.

Figure 1 Chara Mandi

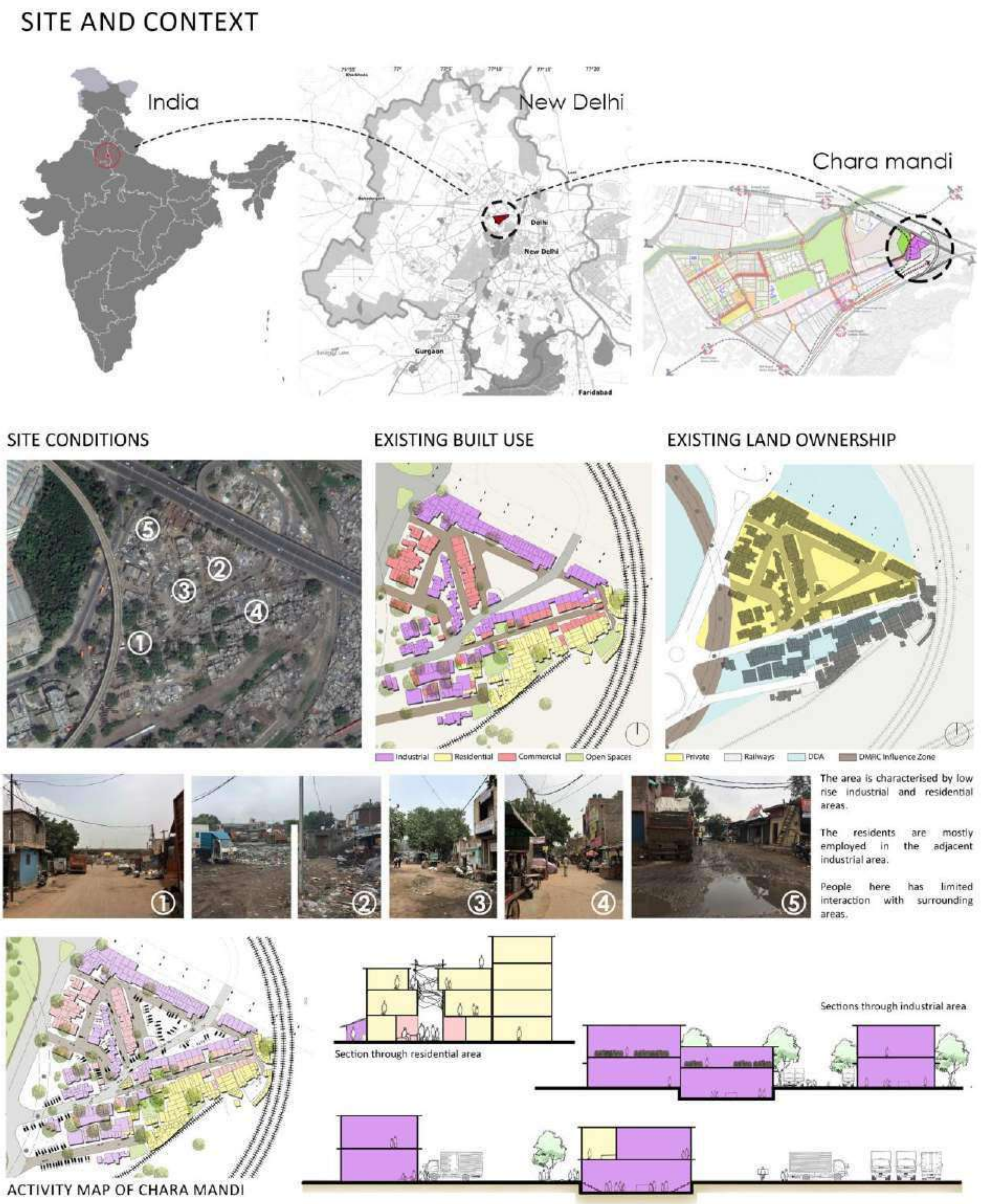

Figure 2 Site Analysis of Chara Mandi

During engagement with the community over a period of two months, we found that beyond other issues that plague Chara Mandi, the key issue was the isolation of this area from the rest of ward 99.

From its emergence as an idea that could lead to the empowerment of the poor and marginalized through the fair redistribution of material resources, participation over the years has been turned into a matter of methods and techniques, rather than influencing radical processes capable of designing fair and equitable decision-making processes with similar material outcomes. (Prakash & Kumar, 2016)

In this context, in order to convey the idea of participatory planning to the inhabitants of Chara Mandi proved difficult. Most people did not understand the need to discuss their issues collectively, some found it time consuming and a hindrance to their work schedule; others were unwilling to sit down with people from other communities and castes. This situation is not unique to this site or Delhi alone. In India we have 9 major religions recognized in the census of 2011. Each religion has many more subdivisions. Hence every neighborhood in India is heterogenous and faces conflict at varying degrees. Complicating the matter further are political parties that propagate opposing ideologies. In most cases these conflicts are minor but they do manifest themselves in the public realm in one form or another.

While initial interactions with people in Focus Group Discussions (FGD's) gave us a broad picture of such conflicts and agendas, we were unable to come to definite conclusions. Further analysis revealed that people we interviewed/interacted categorized themselves as people in power – ward councilor, residence association members, political leaders etc. or as people who are powerless, oppressed or neglected. The issue with this self-categorization is that, the 'powerful' saw their needs as superior to the others since they hold a position of prominence in the society and are considered to be more knowledgeable by the community. The 'powerless' on the other hand, often play this card to excuse themselves of any responsibility regarding their environment and are quick to blame the government or other agencies. Hence, while the former wanted complete redevelopment of Chara Mandi, the latter wanted to retain their place of residence but shrugged off any responsibility of maintaining the place.

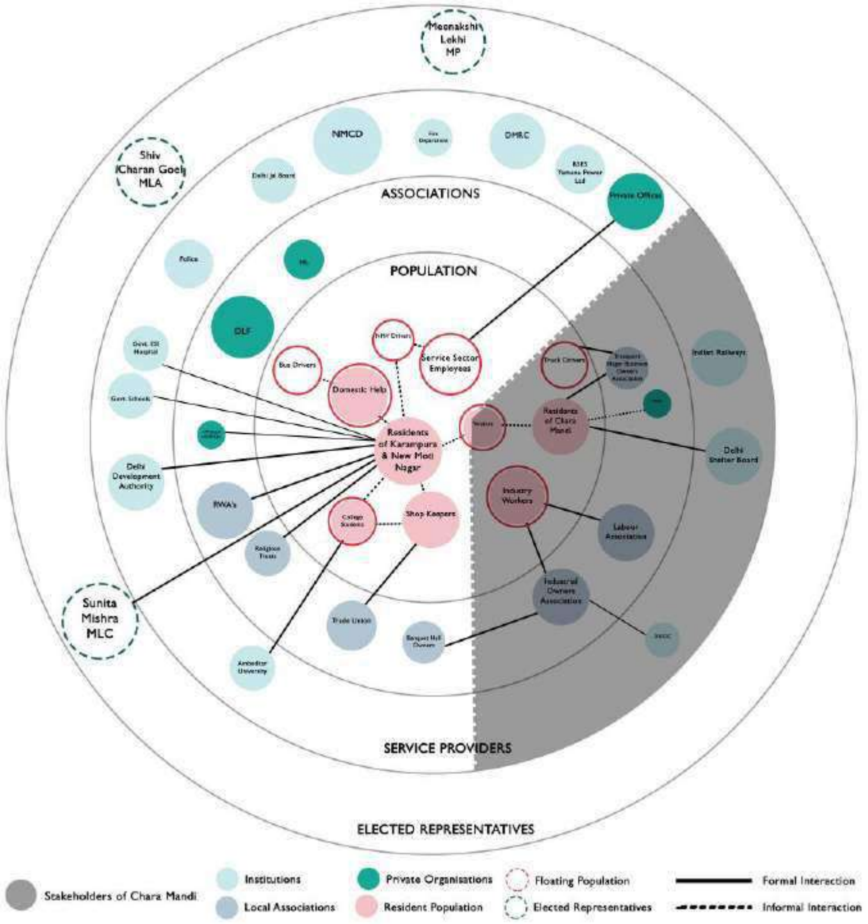

Figure 3 Stakeholder interaction Map for Karampura

3.1 Children as the key for communication

Since Chara Mandi exhibited issues of social segregation and distinct power hierarchy we required the perspective of the un prejudiced: children. It is a well-established fact that children are much more perceptive to their environments than adults. While we try to teach our children all about life, our children teach us what life is all about. Through them we were able to discern the complex social networks and the overlays of attitudes of adults that govern the social structure of a place. The requirement in this scenario was the opinion of an unprejudiced individual who doesn't have specific agenda but can permeate the glass ceiling between the two groups. Children are more perceptive of their immediate surroundings and the behavioral patterns of adults whom they interact with regularly.

3.2 Identifying age group of children using Piaget's Cognitive Development Theory

According to Swiss developmental psychologist Jean Piaget's Cognitive Development Theory, each child goes through the four stages of development, Sensorimotor stage (birth to age 2), Pre-operational stage (from age 2 to age 7), Concrete operational stage (from age 7 to age 11), Formal operational stage (age 11+ - adolescence and adulthood) and child development is determined by biological maturation and interaction with the environment.

Among 2038 people in Chara Mandi, 367 are children, majority (almost 60%) of whom fall within the age group 7- 15 yrs. i.e. the concrete operational stage and formal operational stage.

Concrete operational stage is characterized by the appropriate use of logic. During this stage, a child's thought processes become more mature and "adult like". They start solving problems in a more logical fashion. Abstract, hypothetical thinking is not yet developed in the child, and children can only solve problems that apply to concrete events or objects. At this stage, the children undergo a transition where the child learns rules such as conservation. Piaget determined that children are able to incorporate Inductive reasoning. Inductive reasoning involves drawing inferences from observations in order to make a generalization. During this stage, the child acquires the ability to view things from another individual's perspective, even if they think that perspective is incorrect.

In Formal operational stage intelligence is demonstrated through the logical use of symbols related to abstract concepts. This form of thought includes "assumptions that have no necessary relation to reality." At this point, the person is capable of hypothetical and deductive reasoning. During this time, people develop the ability to think about abstract concepts. This stage is characterized by

- Abstract thought emerges during the formal operational stage. Children tend to think very concretely and specifically in earlier stages and begin to consider possible outcomes and consequences of actions.
- Metacognition, the capacity for "thinking about thinking" that allows adolescents and adults to reason about their thought processes and monitor them.
- Problem-solving is demonstrated when children use trial-and-error to solve problems. The ability to systematically solve a problem in a logical and methodical way emerges.

(Gruber, 2004)

Selecting children aged 7-15 has many advantages, especially from the neighborhood of Chara Mandi,

- They are able to understand the concepts of public and private, home and neighborhood. Also, they actively interact with the public realm on a daily basis.
- Their views are not based on any specific ideology or influenced by caste and gender but mere responses to the stimuli that they face every day.

- They are more educated than most of their parents since 90% of is engaged in loading works in the logistics and warehousing industries population in Chara Mandi and have never been formally educated. hence children can communicate ideas of sustainability and participation with the adults in the community more effectively.

3.3 Methodology

3.3.1 Stage I: Identifying Issues

The first stage in this experiment was to inform the children[ii] about the need for dialogue in improving the conditions of Chara Mandi. In order to achieve this, a painting workshop was conducted with the theme 'my Neighbourhood'.

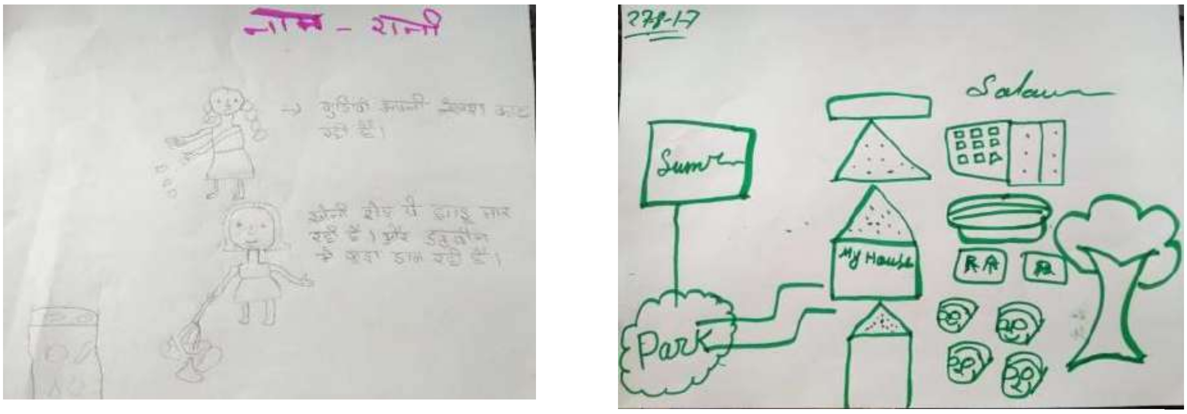

Figure 4 Paintings highlighting the issue of garbage disposal and need for parks

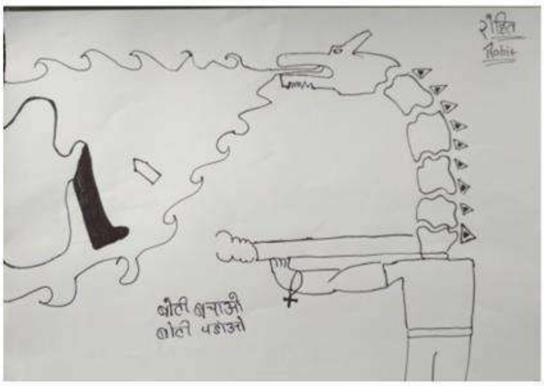

Figure 5 Paintings highlighting issues of female safety

Figure 6 Painting showing the future of Chara Mandi

Figure 7 Children at the Painting Workshop

Outcomes: The competition bought out interesting views about the neighbourhood. Children identified simple issues like lack of playgrounds to complex issues of women safety and water pollution. It was also interesting to note that majority while identifying the issue also presented us with a possible solutions or future scenarios which underlined the fact that they were hopeful of a better future.

3.3.2 Stage II: Design Presentation to Community

In the next stage, the community was presented with possible design solutions to the issues such as lack of housing, unorganised logistics industry and lack of social amenities and open spaces. We first presented to a group of children, explaining the different elements in the design and visualizations of the transformed neighbourhood.

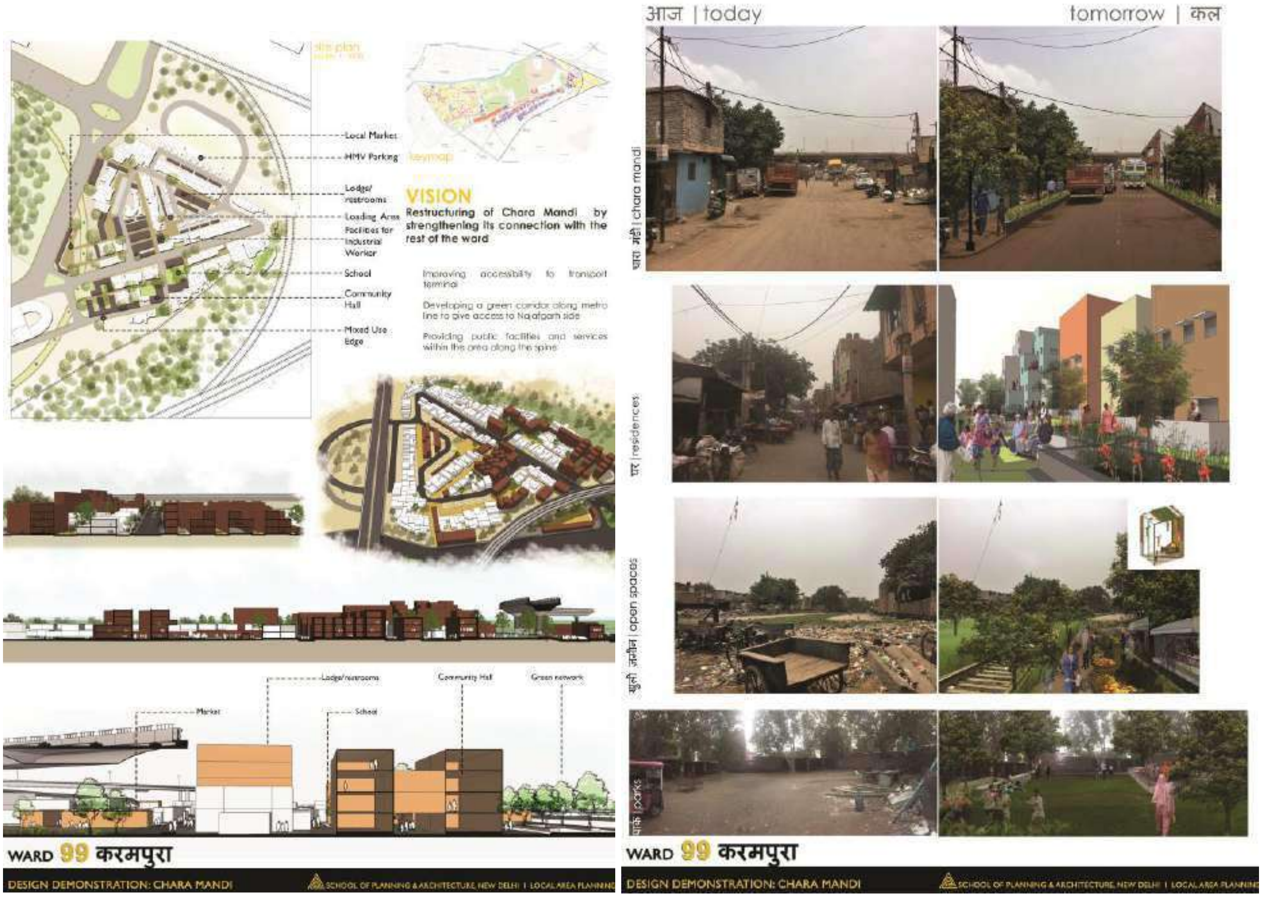

Figure 9 Design Presentation made to the community

Outcomes: After the first presentation children took the lead to explain the design intent and steps to achieve them to the adults in the community. They successfully differentiated between short term goals such as cleaning up streets, planting trees, making sidewalks and long-term goals such as redeveloping housing stock in the area, organizing the logistics industry and improving safety in Chara Mandi. They also started identifying tasks that they could take up individually such planting a tree in front of their house, keeping their street clean etc. and conveyed the same to the adults. This motivated the adults to discuss among themselves regarding the merits and demerits of the design.

Figure 8 Children making a list of short term and long-term goals

Figure 10 Children explaining the design and goals to adults in the community

3.4 Observations

Children Aged 10-15

- Were more active in the whole process and they were willing to take responsibility which inspired the adults to be more involved in the process.
- Were able to connect smaller goals to larger impacts e.g. Planting trees help in curbing soaring temperatures, reduced trucking leads to better air quality.

Children aged 6-9 years

- Were much more enthusiastic participants as compared to older children and more successful in getting the attention of adults.

4 Lessons from Chara Mandi

4.1 Children initiated a conversation between people from diverse backgrounds

The community engagement for the design exercise was based on the social theory of Ripple effect, where the child becomes the initial point of contact with the community. Through him/her we are able to understand the community better and transmit information back to the community.

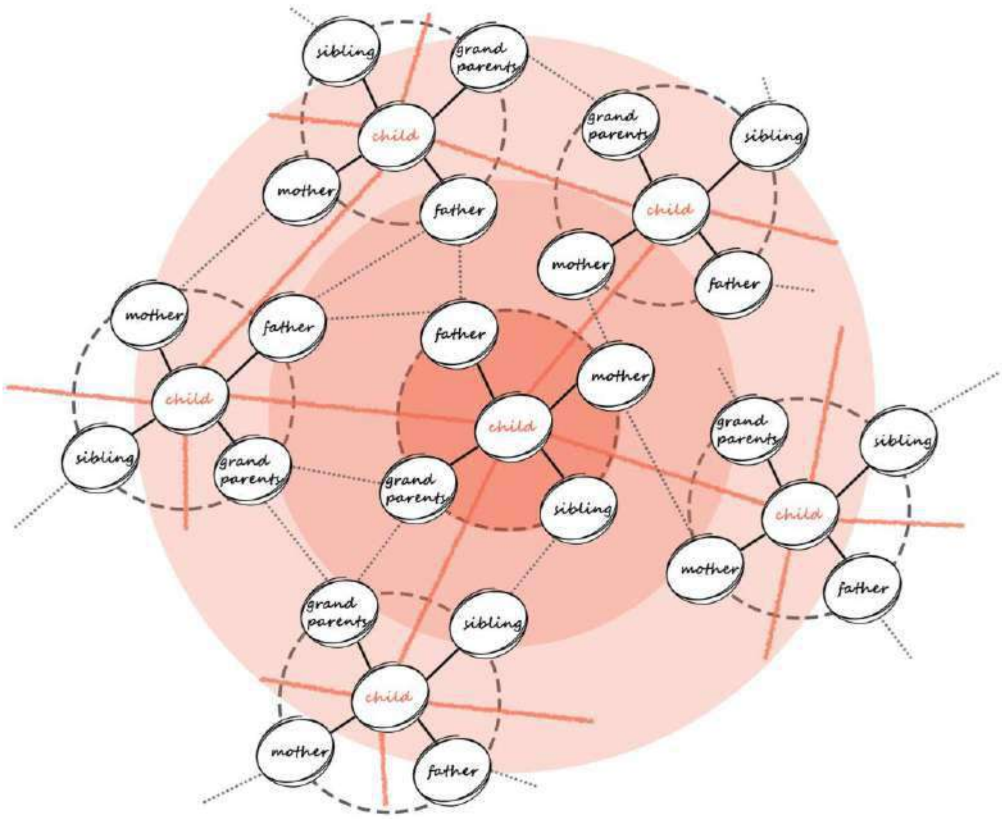

Figure 11 Ripple effect in information dissemination

4.2 Children helped the community to understand different types of goals

Children broke down the final design into two categories: Things we can do and things we need assistance from others. The categories were fairly resembling the technical terminology of short term and long-term goals.

Things we can do now	Things we need assistance for
Plant more trees	Systematic Garbage pickup
Avoid Littering in public places	Developing Housing stock
Reroute trucks from certain areas	Providing deficient social infrastructure

This helped the adults (majority of whom have no formal education) understand the possible course of action to be taken to achieve the goals, e.g. The members of Transport Owner's Association discussed the advantage of designating one area for truck parking, loading and unloading activities after the children pointed out they don't want truck parking in the residential areas.

4.3 Children as agents of change

According to philosopher Jean-Jacques Rousseau (1712–1778) children were innately good and willing to learn for which reason children should interact with their environment (Palmer, Bresler, & Cooper , 2001). They are also largely unaffected by the political, religious and economic biases that govern most of the adult interactions. They have increased sensitivity to nature and environment, they promote social equity and well-being of others and hence act as a catalyst to bring communities together.

If children are given the opportunity to design, plan and perform study with adults, then adults must admit children as involved and capable delegates and be eager to entitle the child as the 'expert'. Such experience would be very influential for a child who may not have ever been in similar situation. (Masri, 2017)

The realization that urban form has a bearing on the psyche of a child and through the child were able to bring the adults to the discussion table were two important findings from our study. The very act of seeking input from children can make an entire community more aware of and responsive. More importantly, the experience of participation is extremely positive for children. At the age of ten to fifteen years old, many are beginning to develop a sense of their own identity. This is precisely when increased interaction with the world may be reinforcing feelings that their particular awareness of place will always be disregarded. By contrast, participation in environmental decision-making fosters self-esteem and self-efficacy, and may lead to a greater appreciation of democratic values. (Moffat, 2002)

An appeal for basic public services will always be stronger if it is backed by the voices of children. It was very evident that few officials will overtly oppose the reasonable requests of a group of children who want to cooperate to improve their environment.

5 Acknowledgement

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Endnotes

[i] The studio exercise was executed by a nine-member team of urban design students guided by Prof. Manu Mahajan, Prof. K.T Ravindran and Prof. Sanjay Kanvinde at School of Planning and Architecture New Delhi

[ii] Henceforth the term 'children' denote all children aged 7 to 15 in Chara Mandi.

How local re-commoning initiatives set a spark for global challenges

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Climate change has been described as the ultimate tragedy of the commons, in which we observe on a global scale how the use of scarce resources in self-interest often develop in contradiction to a collective use of resources (cf. Hardin, 1968; Paavola, in: Cole, Ostrom, 2012). The mitigation of (and adaptation to) climate effects are discussed at international environmental conventions, yet also deployed in many local communities. We argue here that a good share of answers to climate change, and closely related also to the problematic use of scarce resources such as land, can be found in active (re-)commoning practices, where citizens act as responsible stewards for land uses.

Contemporary practices of 'commoning' depart from shared ownership and/or shared use rights by a 'host community' of commoners who collectively agree on a set of rules, which mobilize the existing institutional-political system and who intervene for the maintenance of a collective good. The operational implementation of these grand principles of landed commons for a series of micro-cases in Flanders region (Belgium) have been extensively studied in the INDIGO- project[1]. Based on this research of landed commons, we here elaborate on three domains where commons have been negotiated to intervene in (peri-)urban metabolisms, i.e. in organic farming, in social housing and for slow roads. The (re-)commoning initiatives in these domains develop as sustainable practices to directly or indirectly slow down climate change. Re-commoning is equally raising awareness of communities and the resilience of places, and as such, it is contributing to capacities for adaptation. We briefly discuss the values in which commoning practices are rooted, and how the underlying value patterns can be relevant for the wider discussion on climate change.

1. Structure of the paper

We start from a concise overview of the 'grand principles of landed commons', and we then introduce three commoning examples in Flanders, i.e. on Collectief Goed in the city of Antwerp, on the micro-case Wervehoef with stakeholder 'De Landgenoten' in Wijnegem and on the micro-case Hoofse Hoek with stakeholder 'Trage Wegen' (i.e. 'Slow roads'). In this, we briefly present the main actors and stakeholders in the negotiation of landed commons, and their respective roles as stewards, custodians or users, as well as the role of local authorities to support citizen-led initiatives on commons. From this, we move a step ahead to elaborate on the institutional diversity and on the hybrid forms of governance for (re-) commoning initiatives. Last but not least, we briefly discuss how single cases can set the spark for a more generalized practice, and how the cumulative effort of relatively small scale interventions can possibly

[1] A collaborative research project, with partners from the Katholieke Universiteit Leuven, OMGEVING cvba, Universiteit Antwerpen and Harokopio University, from 2015-2018.

contribute to wider societal challenges. We here assume that a large, encompassing problematic such as global warming requires a fundamental change of behavior and lifestyle of users, which is stronger if rooted in a multiplicity of bottom-up initiatives such as the citizen-induced initiatives on landed commons.

2. Grand principles of landed commons

The Grand Principles of Landed Commons (GPLC) describe the nature of the Landed Commons (LC), and refer to ten principles which are at the core of any discussion on the commons (P1-P10). They are based on a survey of academic literature on urban and rural commons, experiences of activist agents, policy documents, etc. (Saavedra Bruno e.a., in: Van den Broeck e.a. (eds.), forthcoming). The following briefly explain the ten principles, which are listed in table 1. We 'reshuffle' the list of principles to create a match with three widely recognized core features of commons, i.e. the common-pool **resources**, governed as commons by a group of **commoners** and developed within the possibilities and/or boundaries of existing **institutions** (i.e. commoning practices).

Resources

Landed Commons develop as a **collectively agreed or mediated system of inclusive land ownership and/or shared rights of use (P1 and P3).** This diversity of uses, access and management of land develop beyond the current market-oriented dichotomy between private and public ownership. Landed Commons arise where public authorities and the market fail, and where individuals unite to deal with these shortcomings. With this, they attempt to answer to contemporary economic, ecological or social issues, where adequate formal frameworks are lacking, e.g. in taxation, legal rules, organizational forms or land use conditions. Both private and publicly managed goods have been increasingly subject to commodification for several decades, i.e. enclosure, privatization and marketing, which are affecting natural resources and lead to the disappearance of collective spaces. A characteristic incorporated in the landed commons assets, is their 'sharable nature'. Landed commons are sharable in the sense that the resources can be accessed and used by multiple users; at the same time however these resources vary in their capacity to accommodate different users, exhibit different consumption/ valorization thresholds and embody variable reproductive potential.

The **community-based use and/or ownership of landed commons (P2)** depart from two constellations. There are, on the one hand, places that can be regarded as 'community goods' by their nature, such as a coastal strip and dune belt, the banks of an inland lake or a river, the rivers themselves or large areas of nature and forest. In practice, we also see exclusive access rights here though, e.g. with gardens of private homes near riverbanks, private catering establishments along lakes, on beaches and in dunes, e.g. along the Belgian coast, or in privatized green areas. On the other hand, there are also landed commons based on a specific recognition of shared ownership or shared use for a specific group of users (e.g. a passage that remains open on basis of customary law).

Commoners

Commons ask for commoning: in order to develop shared use or shared ownership, **a host community (P9)** tries to obtain user or property rights, and to govern the property carefully. A host community can be a collective, a group, a community, an association, a movement or for instance a cooperative. Landed commons develop where a social-ecological relationship is established between the country and its multiple resources and a group of people who take on the **stewardship for these resources (P6).** Openness and inclusion are important values in managing it. It is the host community and not the market or the government, which is responsible for the governance of the Landed Commons. The collective is a group of people with the same value orientation regarding the use of certain goods. **Collectively agreed rules (P10)** should prevent from the alienation of rights and they should foresee exit and entry rights.

Institutions

A landed common aims for a diversity of **more inclusive property and land use regimes (P4).** For example, a tenant cooperative involves its members in the ownership of its homes and land, and this is not the exclusive right of individual families. Commons usually require a (re-)interpretation of property or user rights, supported by the intervention of a collective and often leading to collective agreements. Landed commons equally require **a hybrid form of 'governance' (P5),** with arrangements that combine hierarchical relations, market regulation, self-organization, affective relations, etc. In order to develop such inclusive regimes and hybrid governance arrangement, **the existing institutional-political system is mobilized (P8)**: which interpretations of laws and rules are possible? Is an adaptation of the current regulations necessary to organize shared land use in a flexible way?

P1. **Diversity of use:** 'Landed Commons' are a collectively agreed or mediated system of diverse land use rights practiced individually, jointly, interactively or in a time-sharing mode.
P2. **Community-based use and/or ownership,** based in two possible perspectives, i.e. as resources which by their nature and use may be regarded as more naturally communal, or as resources that are acknowledged in the context of communal ownership.
P3. **Institutional diversity:** Landed Commons cover a wide array of ownership regimes between private and public, defined by mixed legal arrangements (e.g. the situation of a tenant, of a landlord, situations of usufruct, etc.) and institutional configurations.
P4. **Inclusiveness**: The Landed Commons involve more inclusive ownership regimes which make the practice of shared individual land use rights or the benefiting from common pool resources easier and more efficient in use.
P5. **Hybrid governance arrangements:** Governance as a commons is usually a hybrid relationship combining hierarchical relations (state, corporate structure), market regulation, self-organization through networks and associations, affective relations….
P6. **Stewardship:** The landed commons should be considered as a social-ecological relationship between land, its resources and a group of people who accept stewardship over the resources.
P7. **Resource-based governance arrangements**, which are related to the nature of the resources, the manner in which the resources are utilized, the extent to which they generate value, their institutional and community setting.
P8. **Application of the institutional-political system:** The institutional-political system of spatial planning, property laws and regulations must be mobilized and modified to make the smooth functioning of existent and desired landed commons possible.
P9. **Host Communities mediate use claims**: These communities should by preference be communities in a position to establish the aforementioned social relationship.
P10. **Rules of exploitation:** Landed commons should be governed not just through open access, but by clear rules to prevent overexploitation.

Table 1: Grand Principles of Landed Commons (based on Saavedra Bruno e.a., in: Van den Broeck e.a. (eds.), forthcoming)

3. Commoning examples

The Grand Principles of Landed Commons (GPLC) can be used as a tool to assess the features of Concrete Landed Commons (CLC), in terms of governance, resource use, commoning practices, etc. These features evolve as the commons develop. Over the last fifteen years, we see many different landed commons initiatives appearing throughout Europe in many different domains, e.g. community land trusts and cooperatives in housing, collaborations on energy provision and/or projects in circular economy, cooperative land funds and consumer-cooperatives for organic agriculture, community gardens, negotiations and user groups for the use of open spaces – whether private or public- or for instance negotiations over slow roads. The initiatives differ largely in how they apply and develop various principles of landed commons from temporary shared use to formally agreed inclusive ownership (P1), from naturally communal spaces to privately owned spaces that are forcefully reclaimed for collective use[2] (P2). There are commons that develop within existing institutional boundaries and at times with the support of it, as well as commons-initiatives that powerfully complement, challenge or stretch existing configurations, ownership regimes and governance arrangements[3] (P3 to P5, and P8). There are initiatives with relatively small host communities where stewardship is quite literally 'guarding' a space to the more abstract stewardship through participation in a larger cooperative (P6 and P9), with initiatives that hardly formalize agreements over the use up to initiatives that have clearly formalized rules and explicitly articulated values[4] (P10). Whereas the versatility of new commons as well as re-commoning initiatives risk to stretch the notion of commons, there is also a richness and explorative power in this multitude of actions. We will back to this in the concluding reflection. We first want to zoom in on three micro-cases in Flanders, which we studied in the INDIGO research project.

Three Flemish cases

We studied three cases to see how a host community forms, how ownership regimes are interpreted, and through which hybrid form of governance the land-based common property is managed. The three cases apply a landed commons perspective to contribute in different ways to a more sustainable use of land. The housing cooperative 'Collectief Goed' promotes the re-use of existing housing units and stresses social sustainability. The land fund and cooperative 'De Landgenoten' invests in organic farming and attempts to preserve agricultural land for local, sustainable food production. 'Trage Wegen' then intervenes in the intertwining of different open space claims, and aims at the creation of networks of slow roads at the benefit and health of the most vulnerable traffic users, e.g. hikers.

Commons and housing

'Collectief Goed' is a recently established housing cooperative in Antwerp aimed at providing qualitative and affordable dwellings for large families with low incomes. The cooperation renovates the accommodations and rents them out to vulnerable households. Because of this focus on people in poverty Collectief Goed is rather an exception amongst housing cooperatives, who generally work with middle-class families.

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[2] Cf. Picnic the streets and picnic the park in Brussels
[3] Cf. the Ghent transition plan as compared to the Commonslab Antwerp
[4] Cf. Bologna manifesto

Protagonists in the construction of a housing cooperative

The origins of Collectief Goed lie in the association ‘Arm in Arm’, where fathers of families with a low income talk about the problems they confront and help each other to find solutions. The association is supported by social work organization Samenlevingsopbouw Antwerpen. An often-recurring theme in these sessions is the problem of inadequate housing. Bad quality housing affects every aspect of life: health, social life, job chances, school performance, etc.

For these families the search for affordable housing in Antwerp is virtually hopeless. It is impossible to find accommodation for less than 700 or 800 euro a month, which is unaffordable for families with a total monthly budget of 1200 euro. Meanwhile the waiting lists for social housing are extremely long, in particular for large families. Social housing societies simply have too few dwellings and struggle to keep up with necessary renovation work.

This situation led Arm in Arm to start searching for own solutions. In 2012, not by chance the year of the cooperative, the idea arises with the fathers and social workers of Arm in Arm to establish a housing cooperative. One year later, resulting from a cooperation between Samenlevingsopbouw Antwerpen (city administration) and social housing agency De Ideale Woning (DIW), a temporary solution is found: large low-budget families can take residence in empty social housing that is awaiting renovation. During this collaboration it became clear that DIW was struggling to keep up with renovation work and Samenlevingsopbouw saw an opportunity to include them in the housing cooperative: DIW would provide the dwellings, the cooperation would take care of the renovation and support matching tenants. In return for providing the dwellings, DIW receives shares and becomes a partner. The cooperation is called ‘Collectief Goed’, a clever play on words on collective good(s).

One of the biggest challenges for Collectief Goed was to establish a financially stable model. Creating affordable housing means that the amount of money going to rent cannot be bigger than one third of the total budget, for most families around 400 euro. By adding a rent subsidy to that amount, the cooperation arrives at a rent of 600 euro, just enough to stay financially healthy. But the cooperation also finds more innovative solutions. To reduce the costs of the renovation, Collectief Goed works with internships under the guidance of a professional renovation instructor. An added renovation subsidy of the city of Antwerp reduces the costs even more. This allowed to start with a first project of 9 housing units in Merksem.

The long-term goal however is to become completely independent by 2021 from the support of Samenlevingsopbouw, i.e. for the structural costs of personnel. 1. To reach this goal, the cooperation has to grow at a relatively fast pace of ten dwellings a year. The ‘Achilles heel’ is not the provision of houses ready for renovation, but the speed of renovation with trainees. Additionally, the guiding and mentoring of suitable candidates consumes time and energy, introducing a certain inertia in the process.

Even though the cooperative Collectief Goed inevitably comes with a certain fragility, it is still an innovative and truly social housing model. Over time, Collectief Goed will have to outgrow its niche character to make a significant societal impact on the lives of the most vulnerable citizens of Antwerp.

Commons and agriculture

A second case is the fund and cooperation 'De Landgenoten'. This Flemish organization attempts to grant access to agricultural land for organic farmers. The plots are purchased with money from the shares of the cooperative, and the farmers sign user agreements for the use of land. Whereas the agricultural land is usually rented by farmers from the CPAS, church property or private landowners, the land at De Landgenoten is owned by a cooperative. This ensures that the current and subsequent generations of farmers will only cultivate the land organically. A number of projects are also self-harvest or CSA-farms, where the farmer's income is supported by a community and a multi-level shared ownership arises. In the case of self-harvest, this group of shareholders also literally has access to the land for harvesting.

Commoning land for agriculture at Werve Hoef in Wijnegem

The site 'Werve Hoef' in Wijnegem is one of many micro-cases of De Landgenoten. It is located in the urban fringe of Antwerp. The name 'Werve Hoef' refers to a farm from the 16th century on the site of the current farmhouse. There were also medieval traces of a cemetery and an associated church from the 15th century on the other side of the site. With about 11 hectares in the middle of a densely build-up 20th century suburban area with a multitude of local facilities, the site of Werve Hoef is a premium location for housing development in Wijnegem. Today, the area presents itself as a vast open space, with only one building left that could be used for agriculture. Whereas the area is largely intended as a residential expansion area (and as such defined in terms of land use), the vacant lots are mostly used today for agriculture.

The local authority of Wijnegem and the social housing company De Ideale Woning (DIW) intend to jointly develop a sustainable neighbourhood at Werve Hoef. There has been a chain of interactions with different actors towards a commons-inspired use of the site. Many steps towards communing hold a fragile, future-oriented and at times utopian promise of commoning, without certainty to actually translate grand principles into concrete landed commons. We can distinguish five stages of interaction in this "run-up towards commoning": (1) First, the social housing company De Ideale Woning (DIW), who is the owner of the plot, takes the initiative to develop the site. (2) When 'De Landgenoten' (DLg) joins the negotiations, different plans have already been drafted. (3) The next stage then is to draft a shared project description with DIW and DLg, (4) which equally allows to screen different farmers and to select one. (5) The provisory last stage finalises a series of formal consolidations between the owner, the cooperative and the farmer. An important stage to come is the construction of the social housing units, the actual farming activities and the links with the new inhabitants.

Throughout these interactions, there are three important dynamics in the development of agricultural land as a concrete landed commons. First of all, there is the discussion on the use of land with the social housing company DIW, the cooperative De Landgenoten, the new farmer, the current users of the land and the local community. The discussion is mainly about the collective character of land use and particularly about the link to the existing and the new community. Secondly, the interactions focus on building a host community to govern the agricultural land as a commons. Thirdly, there is a long run-up needed to get to an agreement about the ownership regime, which develop with relatively few actors.

Commons and slow roads

The projects of the 'Slow Roads' organization is another central case in the INIDGO-study.[5] Slow paths are roads that are not accessible for motorized traffic. In the case-study, it is being investigated how shifts in the use of land in private as well as other ownership regimes contribute to making a Flemish network of slow roads accessible (or keeping it) and to increase the collective space. It is not excluded that other, more "common" forms of ownership may arise in the long term.

Commoning slow paths in the case of Hoofse Hoek in South of Antwerp

The Hoofse Hoek path is connecting the municipalities of Hove and Lint in the peri-urban South of Antwerp. The wider area already came under the attention of the newly established inter-municipal network ‘Landschapspark Zuidrand’ in 2012, when 9 municipalities agreed to collaborate to create a regional landscape, i.e. preserving the region-specific open spaces. Slow roads could become a ‘capillary system to the open space’, that would serve to ‘counteract the creeping urbanisation of the region’ (Saavedra Bruno e.a., in: Van den Broeck e.a. (eds.), forthcoming). It took three years from the start of the project to create slow paths to the official opening of the Hoofse Hoek path (May 2012 untill October 2015). The project team with a project facilitator from the ‘Trage Wegen’ organisation, a representative of the inter-municipal network and members of the municipal public administrations of Hove and Lint organised the collaboration with both local and supralocal actors to make this happen, e.g. with farm tenants, with the Flemish Agency for Forestry and Nature, as well as with the environmental organisation Natuurpunt. The definition of the trajectory required in-depth analysis of options based on site visits, public advisory rounds and many separate talks with land owners and land users. Even if it only concerns a relatively short trajectory of 400 metres, it required a relatively broad scope of collaboration, i.e. also including the social welfare organisations from Antwerp and Lier as owners of major parts of land across which the path would run, as well as the Dienst Integraal Waterbeleid since this water management agency demands a 5 meters strip for service next to a brook across which the path would run. The organisation Trage Wegen drafted a ‘use right package’ to be negotiated individually with land owners and land users (e.g. including a right of pasage to be reviewed after one year, and to present the idea of local stewards to guarantee enforcement of the agreement). They equally discussed issues of maintenance, issues on constructions, inclusion in a regional hiking map, etc. The process of negotiating use rights reveals ‘how delicately the project team had to manoeuvre in order to deal with property issues, emphasizing the predominance of the logic of ownership’ (Saavedra Bruno e.a., in: Van den Broeck e.a. (eds.), forthcoming).

4. Lessons learnt from the cases

The three micro-cases from different Flemish organizations illustrate how concrete commons-initiatives mobilize different principles of landed commons, which requires negotiations with a variety of actors to develop tailor-made approaches and hybrid governance arrangements (cf. P5) for particular land uses (cf. P1) and/or ownership regimes (cf. P3). The arrangements need

[5] The main researchers for this case are Sofia Saavaedra Bruno, Pieter Van den Broeck, Constanza Parra and Frank Moulaert (and untill 2016 also Mattias Bussels), also KULeuven.

to comply with the specificity of the targeted common-pool resource (cf. P7), with local conditions and spatial claims of respective host communities (cf. P9) as well as with conditions from the wider institutional-political system (cf. P 8). Whereas commons are a category 'in-between' public and private assets, commons-initiatives clearly also relate to market or governmental practices, to hierarchical and market-led structures, as well as to self-organization and specific affective relations.

Tailormade hybrid governance arrangements

For instance the hybrid governance arrangement of Collectief Goed involved the city of Antwerp as a partner with a management role (i.e. Samenlevingsopbouw), as well as the social housing company De Ideale Woning and the association 'Arm in Arm'. Crucial in this micro-case was the decision to renounce from selling plots at market values, and instead to convert the value into shares for a cooperative, in which also the social housing company is involved as a shareholder. Even if converted: the market logic and value of the plot has been relevant in the calculation of the shares. Collectief Goed stresses social objectives: the involvement of tenants in the renovation of their houses is but one example of how to implement these aims in a tangible way. It incorporates a logic of social economy and of self-organization. Last but not least, the hybrid governance arrangement for Collectief Goed also relied for a large part on the personal commitment of particularly one person: also affective relations and involvement can explain an important share of the tailor-made approach.

We detect an equally large hybridity in the arrangement for De Landgenoten: the fund receives donations as well as incomes from the share of the cooperative in order to purchase agricultural land (at market prices). In its functioning, the cooperative partly relies on government subsidies. On top of this, local authorities can be a partner in a project as a land owner or a mediator. In order to create public support for specific cases, that also leans upon the voluntary commitment of 40 ambassadors, and the support of many interested people and organization for crowd-funding actions. Whereas each micro-case for De Landgenoten knows its particularities, and requires a tailor-made approach, the Werve Hoef case is a novelty for three specific aspects: for the first time, De Landgenoten would agree on a long lease for the land instead of being the owner of the agricultural land. This novel constellation also has a financial impact, since the annual payments for a lease require much less financial means. With the owner still involved when the land is used for organic farming, the owner also has a say over land use and the hybrid arrangement thus is somewhat more complex.

Likewise, the case of slow paths lead to hybrid governance arrangements, which are constructed with the owners and users of paths, who were previously largely disconnected. It is a truly collective, and therefore also fragile endeavour to agree on use rights and ownership regimes. It is desirable to find a stable agreement for these linear structures, which are part of a larger network, also for the case that one or more owners would decide to sell their land.

Renewed interest despite little legal anchoring

If you depart from the strict legal theory, there is currently no room for landed commons in Flanders: there is a finite number of separate legal figures (e.g. in commercial law), that regulate property and use, including naked ownership, easement, leasehold, tenancy rights, co-ownership and usufruct. The 'collective' is largely abolished by law as an organizational form and a legal figure at the beginning of the 19th century. For instance common meadows, guilds or beguinages received a private or a public owner, and well-defined rights. The renewed interest in the Commons, for example in cooperatives, guarantee funds or trade unions, for the collective provision of energy (Ecopower), food production (CSAs) or housing (e.g. Samenhuizen), puts pressure on existing legal restrictions. We witness the emergence of intermediate forms and interpretations of existing legal figures, often starting from commons-based remnants in legislation, such as easements, municipal goods and co-ownership. The question is how from such legal figures the common good can again be given a formal place in the legislation, in order to better support the complex reality of (shared) ownership.

Towards a generalized practice

The different cases and particularly also the organisations behind the case have one shared and recognisable pressing concern, which is to ensure the long term survival for commoning initiatives, or – more optimistically- the growth of the organisation and the evolution towards more generalised practices. This can lead to a scaling up, i.e. a larger organisation or to a process of scaling out, i.e. with a multiplication of the number of micro-cases. All three main INDIGO-cases are confronted with these issues, at time with both scaling up and scaling out. This challenge of organisational positioning leads to different issues[6]:

1. How can a stable financial model and flow of means be built that leads to self-sustaining organisations? Whereas a cooperative or association may at first rely on starting grants or subsidies, this usually does not provide a sustainable perspective for the long term. A financial strategy towards a self-sustainable organisation often implies economies of scale.

2. Building and strengthening an organisation equally requires a widening of the host community. This implies issues of mobilisation, communication and participation, but possibly also issues of consistency and continuity. How can tenants become responsible stewards for the common good? How can a large group of ambassadors for De Landgenoten and farmers be up-to-date with the organisations' evolution? How can be assured that 'road spotters' share the (evolving) concerns of the slow road organisation? What are the limits in upscaling a participatory model to involve commoners?

3. Last but not least, shifts in scales also change relations with other actors, which possibly also forces a transition in the own organisation. A cooperative or association moves beyond being a niche player when it becomes recognised as an actor in a larger transition, but possibly also perceived as a 'competitor' or even 'threat' to mainstream approaches. With this, the organisation's own logic might shift, e.g. from a small-scale movement that emphasised solidarity and sustainability, towards a larger upscale organisation, that equally reflects on economic rational, scientific validity and a business-like project-based logic. Is this a true shift in focus or can it be reconciled with the initial ambitions? For instance the relations of Collectief Goed with other parties would possibly change when it becomes a bigger player for the supply of housing. Targeting at a more general approach in terms of audience (attracting higher incomes) and marketable activities (the provision of services by the residents) may perhaps strengthen the capital base and ultimately help more large poor families from their housing problem. But does it distract from the core aims? Similarly, the cooperative De Landgenoten is expected to grow faster through an alliance with actors from local food strategies, whereas it has to recognise that these actors not necessarily also subscribe to organic farming. At what cost is upscaling defendable?

[6] These issues where developed at a workshop, which was organized by the INDIGO-consortium for the IASC conference on commons, Utrecht, July 2017.

The ambitions towards more generalised practices differ in the three cases. For instance, the cooperative De Landgenoten expects to be able to run autonomously with at least 100 ha of land (i.e. to receive a return from user agreements with farmers large enough to support the operational costs of the cooperative). The organisation Trage Wegen is equally involved in the realisation of different micro-cases, but there is no direct relation to the income of the organisation. Also, the micro-cases ideally contribute to a larger network of slow roads.

Also Collectief Goed illustrates that changing scales does not necessarily lead to more means for an organisation: the tenants cooperative uses rent income to renovate the houses in a breakeven way. Introducing a more generalised practice would imply a multiplication of projects such as the housing project in Merksem, probably still within the same cooperative. In the long run, the cooperative can try to become an institutionalised partner in the housing system, and possibly even a third pillar to private and public/social suppliers.

5. Commons-practices as a game-changer for climate issues?

In a brief epilogue, we would like to link the here described practices to the ‘cool’ theme of the conference, i.e. the role of urban planning for climate issues. We here focused on commons-initiatives, which generally start from civil actions, although the hybrid governance arrangement proved that all projects also have links to public authorities as well as to market logics and market actors. Whereas the projects are no direct contributions to climate action plans, the development of landed commons principally does contribute to a logic of sustainable use of land, involving many different actors as stewards for sustainable use, and therefore also relate to issues of climate issue. The first question of the fifth conference track suggests to consider how climate change can affect citizen participation. Based on the study of the relatively small-scale commons-initiatives, we here would like to invert this question into an active bottom-up perspective: ‘How can citizen participation affect climate change?’

The British professor for Environmental Social Science Jouni Paavola[7] addressed the relation of Commons and Climate Change in the book “Property in Land and other resources”[8]. He states that *“Climate change can be understood as a problem of using common-pool resources”* (Paavola, p. 422), but that *“Land use and land use change (…) are examples of issues that remain wholly or largely unaddressed by the current climate change regime.”* (ibid.). The different examples of *landed* commons take land use and ownership as a point of departure to foster sustainable use of common-pool resources.

Time and scale of commons initiatives matter in this, since they are rooted in local host communities, who act as stewards for a specific common-pool resource. The local communities develop a socio-ecological relationship concerning a specific common-pool resource, for which they agree on a set of rules, based in a consensus on the interests and claims of the various communities of practice and individual users involved. Host communities become effective agents of sustainable development, mediating in possible social or environmental conflicts, ideally not overlooking minority voices. The relation to the resource is developed on the local scale, i.e. a scale that allows for consensus over a detailed scheme of regulations and a scale that allows enforcement.

[7] Professor of Environmental Social Science at the University of Leeds
[8] Published by the Lincoln Institute of Land Policy in Massachusetts

Agreements on the scale of planet earth, with a vast multitude of actors and socio-spatial claims risk to strand on lowest denominators[9], and/or to actually repeat the tragedy of the commons. Over longer periods of time and in a larger scale, one risks to have situations of free-riding, over- or underuse, or even a majority acting according to individual rationalities.

SMALL SCALE COMMONS **Joint use as a commons** **= favorable to all people in a given community, possible to reinforce rules**	Scaling up and/or long term use Joint use with a risk of free-riding and over-use
Scaling up and/or long term use Joint use with a risk of under-use	**GLOBAL COMMONS** **Risks that a majority acts according to individual rationalities > tragedy of the commons?**

Table 2: Commoning practices in small and large scale.

The swiss-based scholar Anthony Patt[10] argues in this that the 'tragedy of the commons' is no longer a relevant problem frame for climate issues when every country and every single household has incentives to actively contribute to climate measures, regardless of what neighbors do (Patt, 2017: 2). He equally stumbles over the idea of negotiated binding agreements when it comes to global targets, and instead, proposes to base policy instruments in an evolutionary approach. We here want to argue that the tragedy of the commons-framing allows to understand why global agreements as well as the implementation thereof risk to be poor. At the same time, the narrative can – as an alternative 'invisible hand'- mobilise many different new commons and re-commoning initiatives on a local scale, which jointly contribute to a polycentric approach for climate governance (cf. Paavola, 2012: 429). Similar to the covenant of mayors for climate and energy objectives, the multiplicity of commons-initiatives that intervene in (peri-)urban metabolisms can have an important accumulated and systemic effect for global common-pool resources. It allows to raise awareness, change behaviours, lifestyles and practices starting from small, tangible examples, yet leading to a multiplication (and not necessarily always also to scaling-up) of collective action interventions that can add to the resilience of places and communities.

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[9] Cf. Paavola on this, who compares the Montreal and the Kyoto protocol: "The MP (…) has achieved Greenhouse Gas emission reductions four times greater than those of the KP. The MP was easier to negotiate because (it) involved fewer parties." (Paavola, p. 422)

[10] Full professor of Climate Policy at the Institute for Environmental Decisions at ETH Zürich.

The INDIGO-consortium will publish main results from the analysis of Landed Commons in a special issue in the professional journal 'Ruimte' (September 2018). In November 2018, EPO will publish the book 'Op grond van Samenwerking: Open ruimte, Landbouw en Huisvesting als commons', in a collaboration between Dirk Holemans (Oikos) and the INDIGO research consortium. In addition to the cases from this research, we also involved a number of external partners, including Michel Bauwens about P2P, Geert Depauw about Community Land Trust in Brussels, Griet Celen about the toolbox of the Flemish Land Agency or Michiel Dehaene about Agro-ecological urbanism. The INDIGO research consortium is equally preparing an English academic volume on Landed commons, to be published with EE publications in 2019.

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Adaptable Planning Strategies of Urban Sport Spaces in Cold Regions for Climate and Citizens' Needs: Case Study of Songyuan, China

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1. Introduction

Over the past few decades, the role of fitness, recreation, physical activity and sport in improving health has been increasingly recognized (Sawyer, 2013). That high levels of physical activity benefit people's health have been well documented (WHO, 2016; Thompson et al, 2003). The pursuit for health has led to a rising demand for urban sport spaces (Lin et al, 2005). As one of the most important carriers for citizens to participate in sports, exercise and recreational physical activities and enhance their physical fitness, urban sport spaces are now closely related to citizens' health and quality of life (Nicolai, 2015; Fahlén, 2011).

Nowadays, with the development of mass sports and leisure sports (recreational sports), the scopes represented by urban sport spaces have been expanded from the specialized spaces (such as sports venues, gymnasiums) to public spaces (e.g., free sport parks, squares, green spaces and other non-professional sport spaces) in the city which can offer important opportunities and spaces for citizens to participate in sports, exercise and recreational physcal activities (Nicolai, 2015; Villanueva et al,2015; Jin, 2013). Evidence regarding the built environment and leisure sports activities is also beginning to accumulate on urban public spaces and urban public open spaces (Koohsari,2015; Florindo et al, 2017). However, no matter how urban sport spaces expand, their nature is always to serve their users—the citizens (Hassani & Golizadeh, 2016; Liu et al, 2013). To meet the real needs of the local population is an essential goal in the construction of urban sport spaces.

At the same time, as a natural condition of a city, climate acts directly on the leisure sports behaviors of citizens, the efficiency of urban sport spaces and the urban vitality, especially the unfavorable climate conditions (Luo & Li, 2015; Leng et al, 2017). In cold regions for example, clod climate in winter has been proved to reduce people's participation in physical activities (Merchant, 2007). In recent years, with the planning concept of cold cities, such as 'Liveable City', 'Winter-friendly City' and 'Healthy City', increasing importance has been attached to the planning of urban sport spaces in cold regions.

In a review of climate, urban sport spaces and users of sport spaces, relevant literature mainly focuses on two perspectives: one is concerned with the relationship between climate and users including the relationship between climate change and social background (gender, income, age, etc.) (Mizumoto, 2015; Eisenberg & Okeke, 2009; Dunn et al, 2012), and that between climate change and physical activity level (frequency, intensity, etc.) (Merchant, 2007; Nasir et al, 2013); the other pays attention to the association between climate and urban sport spaces such as accessibility (Westhuizen, 2010; Giles et al, 2003), space types (Schebella et al, 2012), and landscape activity (Watanabe & Jin, 2016; Zhao et al, 2018) under the influence of climate conditions. However, there are few extant data describing urban sport spaces in cold regions, especially the regional adaptable planning of urban sport spaces which is brought by the needs of citizens' sports and recreational physical activities under the influence of cold climate.

Under the above background and in China, with the promotion of the National Fitness program and the implementation of the Healthy China strategy, the demand for urban sport spaces in cold regions is more obvious because of the large sports population (Liu et al, 2015). However, due to the traditional making system and backward planning thought, the construction of urban sport spaces in China's cold regions still adopts the 'top-down' supply mode, and this means that the allocation and spatial layout of urban sport spaces are fully determined by the government (Zhang et al, 2017). To satisfy the needs for competitive sports events is still the only target in some cold cities (Yan et al, 2015). These problems of urban sport spaces seriously ignore the effects of regional climate and citizens' needs and hinder the development of cold cities and citizen's physical health.

Therefore, by investigating the characteristics of citizens' fitness behaviors in regional climate, as well as the public preferences and needs for urban sport spaces, this study will focus on a clod city in China as a case study for the adaptable planning strategies of urban sport spaces, underpinned by the Chinese National Fitness policy context. These strategies may be applicable and relevant to other similar cities.

2. Methods

2.1 Study area

For the sake of the surging demand for national fitness, during the 2015-2016 period, as entrusted by the Songyuan government department (Songyuan Sports Bureau), we have prepared the planning of public sports facilities in Songyuan. The process has provided an important opportunity for exploration and research in this study. Songyuan, located in the north east China, between the north latitude of 43°59′-45°32′, is a prefecture level city in Jilin province of China. Under the influence of a temperate continental monsoon, Songyuan has four distinctive seasons, but its winter is cold and long. The cold climate in Songyuan lasts for 5 months during which the average temperature is lower than 0°C from November to March next year.

This study selects the central city as the study area with a relatively concentrated population and a large demand for daily fitness in Songyuan. The study area consists of 23 communities and 48 recreational areas, and had a resident population of 499,600 by the end of 2015. As a whole, the population size and climate conditions of the central city of Songyuan are representative of those of small and medium-sized cities and winter-cities in China. Considering that winter is long and quite different from other seasons in temperature in cold regions, to investigate the characteristics of citizens' sports and recreational physical activity behaviors and the preferences of urban sport spaces, questionnaires and field surveys were conducted during winter (December 2015-January 2016) and non-winter time (May 2015-July 2015).

2.2 Data collection

The data in this study were collected by questionnaires for citizens in the central city of Songyuan. Social characteristics, physical activity characteristics, preferences and needs of the respondents are mainly included in the questionnaires. Social characteristics include the sex, age, education, income, etc. Physical activity characteristics contain the current status of citizens' sports and recreational physical activities in winter and non-winter time, such as frequency, travel mode and activity items. The citizens' preferences and needs for urban sport spaces are reflected in terms of the travel distance, space type, space environment, activity items, etc.

With the help of the Songyuan Sports Bureau, one typical recreational area was selected from each community in the study area to conduct questionnaire survey, and 20-25 questionnaires were randomly issued at each survey point. A total of 500 questionnaires were handed out and 438 valid questionnaires were collected, at an effective rate of 87.6%.

In the valid questionnaires, the youth (under 45 years old), the middle-aged (45-60 years old) and the aged (60 years old and over) account for 36.1%, 35.2% and 28.7% respectively; males and females take up a proportion of 57.3% and 42.7% separately. The questionnaire survey covers different demand groups.

3. Results

3.1 Characteristics of participation in sports and recreational physical activities under the influence of cold climate

1) Seasonal changes in the activity frequency

The cold climate has a negative impact on the citizens to participate in sports and recreational physical activities. In winter, it's found that the severe weather environment in cold regions is considered to be the biggest factor affecting citizens' enthusiasm for participating in physical activities (Fig. 1). At the same time, the frequency of participating in physical activities has distinctive seasonal features: frequent participation in any sports and recreational physical activities (three or more times a week and at least 30 minutes each time) is 26.5% more likely in non-winter seasons than in winter; and the proportion of citizens participating in physical activities less than once a week in winter is nearly three times larger than that in non-winter seasons (Fig. 2).

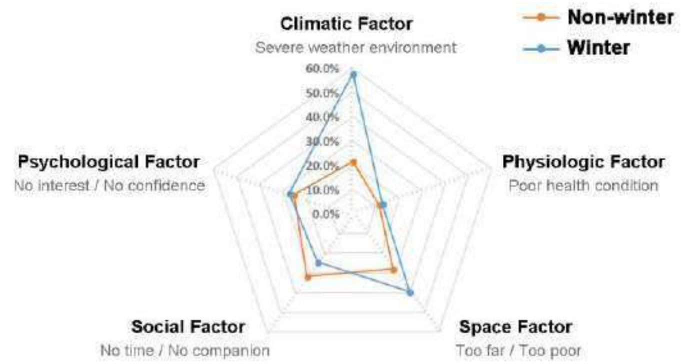

Figure 1: Comparison of the obstructive factors for citizens of Songyuan to participate in physical activities in different seasons

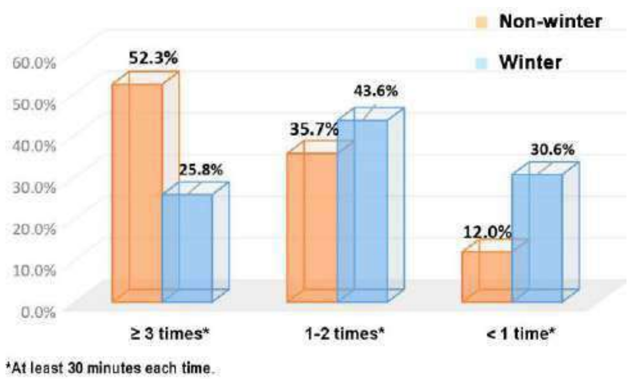

Figure 2: Weekly frequency of physical activities by season taken by citizens of Songyuan

2) Relatively stable choice of the physical activity items

Based on the field surveys on the participation in sports and recreational physical activities in the central city of Songyuan, the physical activity items are divided into seven categories according to the characteristics of sports and recreational physical activities: ball sports, aquatics, ice and snow sports, chess and card games, folkloric activities, walking and running activities, and activities on fitness equipment. It's found that the choice of the physical activity items has the two following characteristics (Fig. 3):

a. Walking and running activities always enjoy the widest participation. In winter, although walking and running decrease significantly compared with that in non-winter seasons, they are still the first choice of citizens in cold regions, taking up a proportion of 50.3%.

b. In addition to walking and running activities, participation in ice and snow sports is most obviously influenced by cold climate, in comparison with other categories of physical activity items. The proportion of citizens in cold regions who participate in ice and snow sports in winter is eight times higher than that in non-winter seasons.

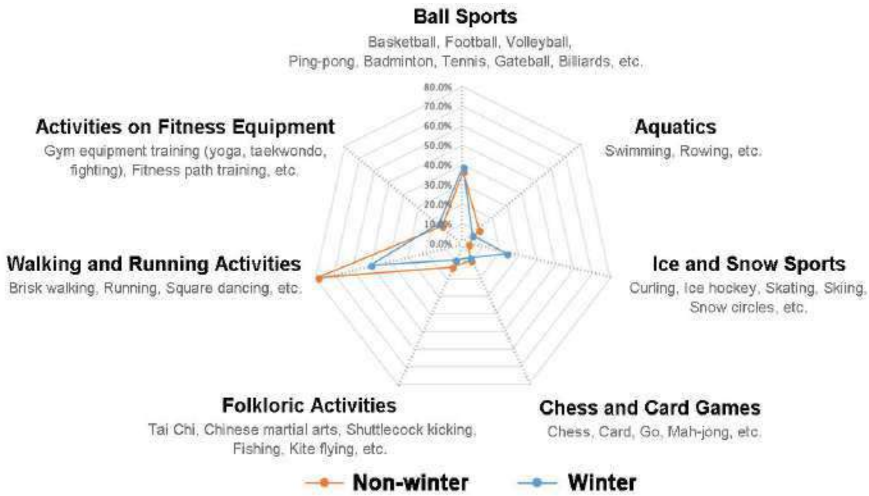

Figure 3: Comparison of participation in various physical activity items by citizens of Songyuan in different seasons

3.2 Needs of citizens for urban sport spaces in cold regions

1) Pedestrian (walking) traffic

It's found that under the influence of cold weather in winter, the choices of citizens of Songyuan for the traffic mode to go to urban sport spaces have changed compared with those in non-winter seasons. However, no matter in winter or in non-winter seasons, the proportion of walking to urban sport spaces is always the highest, which means citizens' need for pedestrian (walking) traffic is the highest (Fig. 4). The choice of walking to urban sport spaces is positively related to the preference of the citizens in cold regions for participation in walking and running activities. In addition, the close distance and easy accessibility is the most important principle for citizens in cold regions to choose urban sport spaces due to the cold weather (Fig. 5), and the distance within 1km is thought by 59.5% of the citizens to be the best coverage. Combined with the previous walking mode which is the most commonly used by citizens, the walking distance of 1km can be controlled within 15 minutes at the normal walking speed of 4-7km /h.

2) Green landscape

Through the field surveys on the citizens participating in sports and recreational physical activities, urban sport spaces are divided into two major categories and six types according to their space attributes and functional characteristics. The first category is green spaces and includes three types: parks and squares, residential green spaces, and green spaces attached to streets. The second category is venues and facilities, including public sport venues, educational sport facilities and private fitness clubs.

From a survey on the demand intention of space type, the need for the type of parks and squares among citizens in cold regions is the highest in winter, followed by the public sport venues and residential green spaces. From the overall categories, the need for the category of green spaces is 7.4% higher in winter than that for venues and facilities (Fig. 6). The interviews of the respondents show that the green spaces are the most needed urban sport spaces mainly because of their beautiful green landscape and larger fitness vitality, and because they can meet the various needs of life, such as fitness, social communication and recreation.

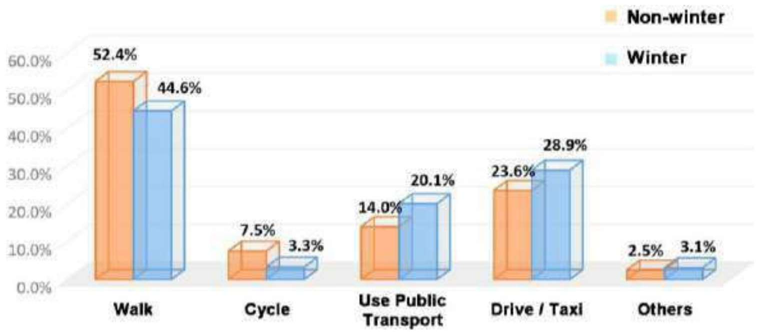

Figure 4: The main transportation modes for citizens of Songyuan to go to urban sport space by season

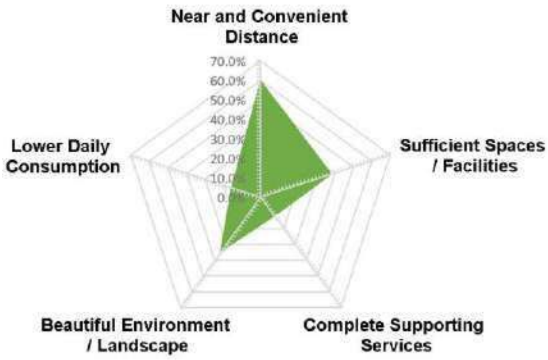

Figure 5: Comparison of factors that affect citizens of Songyuan to choose urban sport spaces in winter

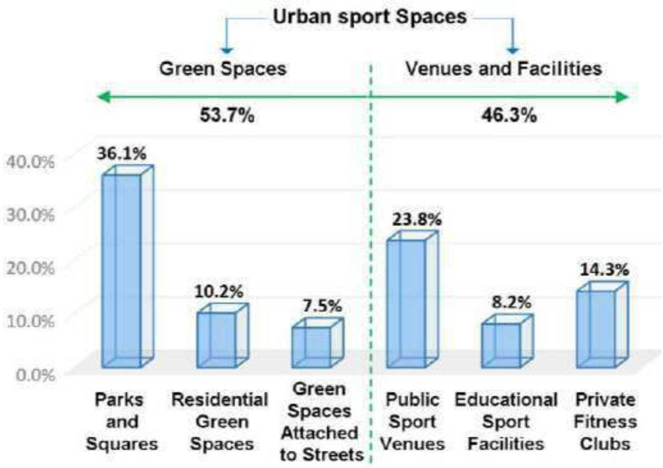

Figure 6: Citizens' need for the type of urban sport spaces in winter of Songyuan

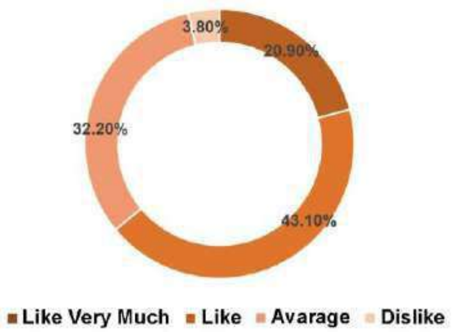

Figure 7: The enthusiasm of citizens of Songyuan for ice and snow sports in winter

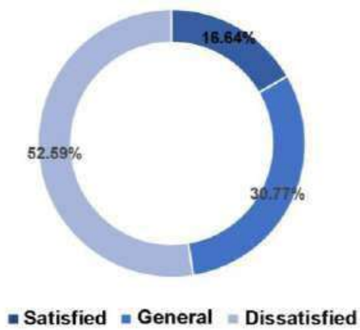

Figure 8: Citizens' satisfaction with ice and snow sports facilities in Songyuan

3) Ice and snow sports

The unique regional environment creates different sports activities, and ice and snow sports are the representatives of sports in cold regions. Considering the unique cold climate and ice and snow environment in Songyuan, it's found that 64.0% of citizens in cold regions prefer to participate in ice and snow sports in winter (Fig. 7). However, their satisfaction with ice and snow sports facilities is negatively related to their enthusiasm for ice and snow sports, and more than half of citizens are less satisfied with the ice and snow sports facilities in Songyuan (Fig. 8). According to field investigations and statistics, the number of ice and snow sports facilities in Songyuan is very small. By the end of 2016, there were three sites of ice and snow sports facilities in Songyuan, including zero ice sports venue and three skiing resorts, while the total length of snow trails in each skiing site is no more than 1km. The lack of ice and snow sports facilities has caused a serious problem that participation in ice and snow sports is lower while its need is greater.

4. Discussion and suggestions

Compared with the non-winter seasons in cold regions, the cold weather in winter is more likely to cause various diseases (Hassi et al, 2012), and the lack of physical activities will aggravate this risk (WHO, 2016). The planning of urban sport spaces should pay more attention to citizens' needs for fitness in winter, so as to improve the activity frequency and increase the vitality of citizens' sports and recreational physical activities in cold regions. Therefore, based on the results of surveys and combined with the project practice in Songyuan, the following adaptable planning strategies of urban sport spaces in China's cold regions are put forward for regional climate and citizens' needs:

4.1 Urban non-motorized traffic system should be linked to improve accessibility and efficiency of urban sport spaces in winter.

In view of the citizens' needs for pedestrian traffic in winter and the preference for walking and running activities, a convenient and comfortable non-motorized traffic network should be established by optimizing the proportion and quality of the urban non-motorized traffic, to enhance the effective connection between various kinds of urban sport spaces and between sport spaces and public service facilities. Thus, it can improve the accessibility and efficiency of urban sport spaces while promoting the vitality of public travel and participation in physical activities.

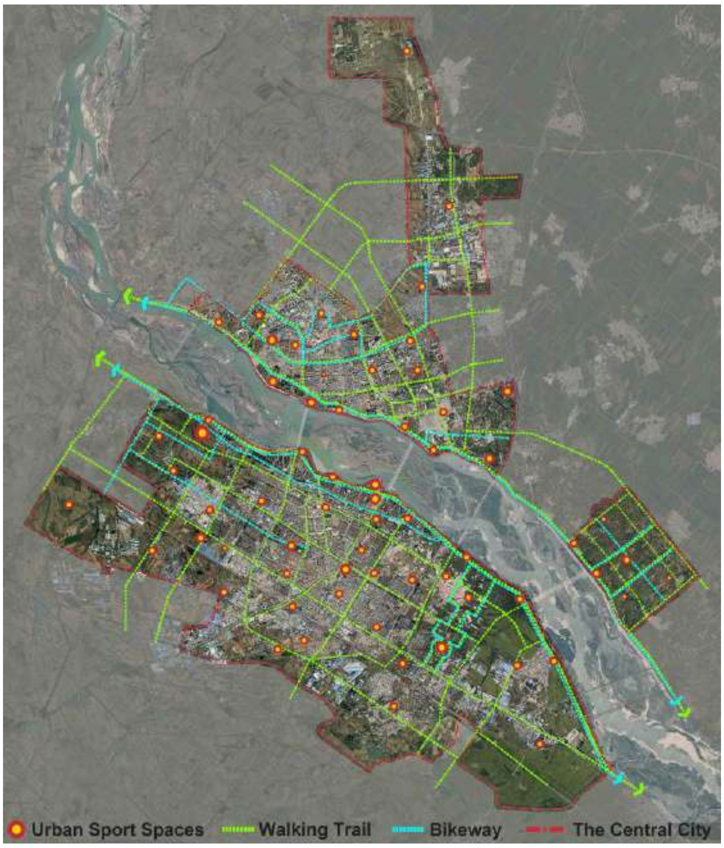

Figure 9: The planning map of the non-motorized traffic network in the central city of Songyuan

In the planning project of public sports facilities in Songyuan, after analysis of the comprehensive traffic network system and the status of urban sports spaces in Songyuan, a convenient and comfortable non-motorized traffic network with the goal of taking walking trail as the main structure and supported by the bikeway has been constructed, which is aimed at building a 15 min walking fitness circle and improving microcirculation of traffic network. The non-motorized traffic network has been designed with climate friendly methods which concern durability, cold resistance and slip resistance, and connect dot-like urban sport spaces to linear spaces and provide more sport spaces for walking and running (Fig. 9).

4.2 Urban green open space should be redesigned to raise enthusiasm for participation in sports and recreational physical activities in winter.

Urban green open space can provide natural ecological sport environment and improve ecological health for citizens (Zhao et al, 2018). Importance should be attached to the fitness function of urban green open spaces and integrating green spaces with urban sport spaces. Therefore, in view of citizens' need and preference for green landscape, two riverside and sports landscape belts have been redesigned by fitting for the urban green space system and closely taking advantage of important urban green space—the Songhua River.

Figure 10: The planning and construction intention map of riverside and sports landscape belts in the central city of Songyuan

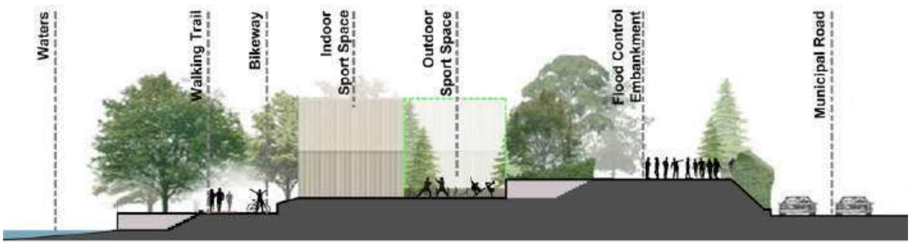

Figure 11: The cross section diagram of riverside and sports landscape belts

The riverside landscape on the both sides of the Songhua River is fully integrated with the national fitness functions, and a variety of functional values such as sports, entertainment, recreation and ecology are added to the green space. While extending along the riverbank, two riverside and sports landscape belts also link up more than ten important parks and squares, which is the most needful type of urban sport spaces, and continue to permeate into the city center (Fig. 10). The quality of riverside and sports landscape belts is optimized by the methods of space enclosure, vegetation protection and overall planning of indoor and outdoor sport space, so as to create a compatible and suitable composite space of sport and ecological functions (Fig. 11). As a result, the landscape belts will not only improve the value of green space, but also meet the need of citizens' sports and recreational physical activities. Finally, they will achieve the win-win goals of enhancing ecological value and boosting enthusiasm for participating in sports and recreational physical activities in winter in cold regions.

4.3 Natural ice and snow resources should be combined to satisfy citizens' need for ice and snow sports in winter.

The unique climate environment in cold regions provides natural conditions for the development of ice and snow sports. In view of the popular demand for ice and snow sports in winter, the structure of urban ice and snow sports space should be established based on regional characteristics, which can fundamentally improve the low and monotonous situation of the ice and snow sports industry in the city, and then actively and healthfully guide the development of ice and snow sports in cold regions.

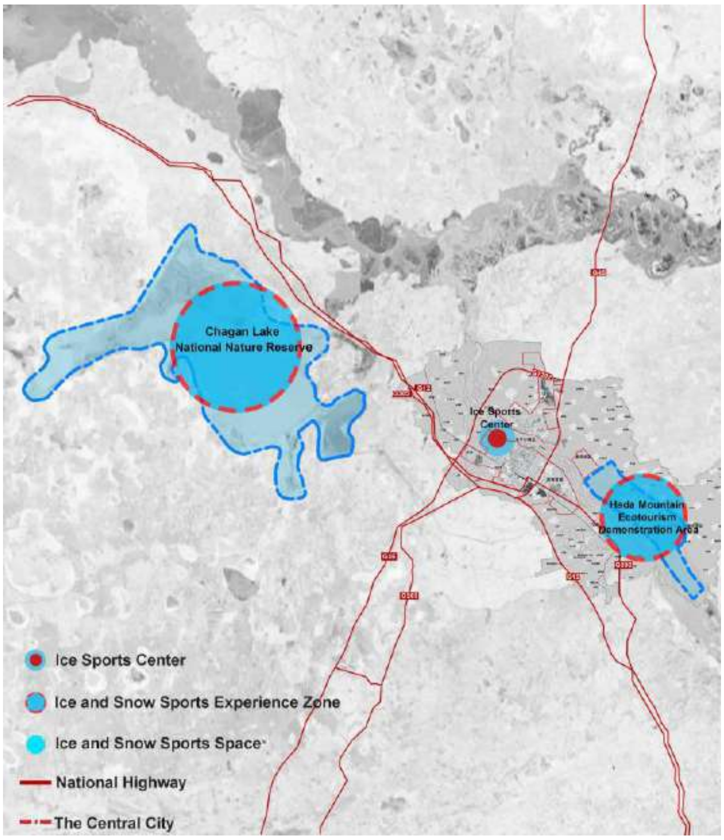

Figure 12: The planning structure map of ice and snow sports spaces in Songyuan

Considering the various forms and different site specifications of ice and snow sports, and after studying the conditions and potentials of natural ice and snow resources in Songyuan, a framework featuring "one heart, two zones and multiple nodes" for ice and snow sports space has been created, to meet the citizens' needs for different properties (such as professional or amateur, recreational or competitive) of ice and snow sports (Fig. 12). In the framework of ice and snow sports space in Songyuan, “one heart” is the construction of ice sports center in Songyuan. On the basis of competition and training, it can maximize the provision of sport spaces for activities such as speed skating, ice hockey and curling. “Two zones” refer to the establishment of professional ski field and ice and snow sports experience center, which respectively rely on the famous Chagan Lake National Nature Reserve and the Hada Mountain ecotourism demonstration area in Songyuan and take advantage of their unique geomorphological conditions. They can also develop the ice snow sports industry in the city while meeting the demand for skiing in winter. “Multiple nodes” are the pouring seasonal ice fields by using frozen waters, idle squares and other space in winter, so as to create a number of sport spaces for ice skating, ice carving and snow carving, and energetically stimulate the enthusiasm for participating in sports and recreational physical activities in winter.

5. Conclusions

Urban sport spaces are important for the development of city, and have been associated with health and wellbeing. However, as urban sport spaces are used to serve the citizens, the construction of urban sport spaces in cold regions has the limitation of cold climate and pertinence of citizens' needs. It cannot simply apply the planning strategies and design methods adopted in other climate regions. Due to the small size of the sample analyzed and the limited statistics performed, we have put forward corresponding adaptable planning strategies of urban sport spaces for specific situations in cold regions of China, based on the investigation of real characteristics and needs for participation in sports and recreational physical activities in Songyuan. These strategies may provide inspiration for the planning of sport spaces or sport facilities in other cold regions, and can be improved for application in other cold cities with the same needs of their own citizens.

Acknowledgements

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Civilizing the public participation practice in post-transition countries

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1. Introduction

Public participation is nowadays commonly understood as the key issue in contemporary planning theory and practice. This relates especially to the well developed planning systems and democratic cultures of the so-called Western World. But with the political, social and economic changes of the 1990-ties this practice has become a part of the global planning agenda. And also the societies of the so-called post-transition countries started to ask for including this into their planning systems.

Although, it can be noted that the local communities in post-transition countries are much more demanding in this respect that societies that were enjoying this practice for decades. In result, new tools and approaches regarding organization of public participation had to be developed. This was due to rapid increase in social demand for organizing massive participation processes and also in relation to the change of the opinion of the politicians regarding the phenomenon itself. In short, from the position of the denial the local politicians have switched to the position of appreciation and promotion of such practices. Same relates to the central governments, which started to consider the public participation processes a regular and obligatory part of the urban planning and development processes.

The main aim of this paper is to discuss the emerging every-day practice of public participation in the so-called post-transition countries and to present current models of its organization and execution. Since the Author of this paper has extensive experience in leading the participation processes, most of the conclusions presented within the paper (including the case studies) are based on His own experience and real-life cases.

2. The phenomenon of public participation

The phenomenon of public participation is not so new to both planning theory and practice. In fact, involving local community in the decision-making process regarding local urban development directions is widely discussed and a number of various forms of these are being introduced. Some of the innovative initiatives associated with this were also promoted by ISOCARP (as i.e. the WikiCity initiative of the City of Amsterdam – 2008). Moreover, developing various forms of public participation in this matter has become a standard planning practice in many countries and communities.

But it has to be noted that public participation may play different roles and – depending on the level of development of the public discourse on development issues as well as on the specifics of local democratic control mechanisms – may be regarded as just an addition to the regular planning procedures or as a some sort of substitute to them [Miessen, Schumon, 2006].

3. Traditional vs. modern approaches to city planning

Although public participation is not a novelty and is widely used in urban management, in the urban planning processes it is still to be grounded. In fact, in many cases we can still observe the presence of the “traditional approach”, based on the so-called “command-and-control system”, associated with allocating the decision power in the hands of the government. In this scenario all planning activities are performed by highly-skilled professionals, in many cases in coordination and discussion of city officials. Due to this fact this is also named the “technocratic approach”, since the planning debate is performed only within the relatively closed circle of urban development technocrats. Of course, in this case there is no public involvement in discussion on the principles and directions of local urban development, and the general public is usually informed about the solutions only after the decision is made.

Described above traditional approach is frequently contested due to an emerging array of possible issues and concepts associated with the traditional planning questions. Also, there is a growing amount of stakeholders interested in solving these in line with their interests and expectations. In addition, some representatives of local communities – frequently named as “urban activists” – are also keen on taking floor within all these debates.

In result, one can state that the “technocratic approach” – based on expert-made decisions – is not valid any more. Moreover, it is also possible to conclude that each of the planning problems and issues may be considered and solved in many ways, which means there is no single “correct” and “best” solution to it. This is also associated with a major paradigm shift – nowadays, the modernistic city planning paradigm (as expressed in the Athens’ Charter) is not the only one source of ideas about urban form and mode of development; on the contrary, many ideas regarding the future of cities compete and many urban development paradigms may be considered while talking about planning of the future city.

In these realities the new planning approach shall be developed. It may be different in case of each of the cities, or even in case of each of the planning problem that has to be solved. Therefore, urban development stakeholders – instead of focusing on the predefined, “blue-print type” solutions – should adopt a flexible method allowing developing the most viable – in given realities – decision. Therefore, it should be based rather on **revised planning method** allowing defining local solutions to local problems, taking local community and local stakeholders’ opinions into account as well as allowing planners to deal individually with particular local problems. This approach asks for the new planning methodology. It should be based on:

- Safeguarding public participation in planning;
- Adopting the different approaches to different types of planning exercises;
- Understanding that planning goes far beyond just policy making and includes both design for high quality of space as well as implementation methods;
- Understanding the differences in methodologies used for developing the “structure”, “regulatory” and “action” plans.

As can be derived from above mentioned list, one of the key issues is safeguarding the “public participation in planning” which means including the local community in the planning process.

4. Public participation in action

As discussed in the previous parts of this paper, public participation may be part of both urban planning as well as of the decision making processes regarding particular urban development initiatives. At the same time, it may be used in the process of defining both the character of the large–scale urban development projects (also referred to as Large-Scale Urban Interventions – LSUI-s) and the new architecture of particular public spaces and sites. Also, it may be employed in the process of shaping the solutions for larger scale planning exercises, like i.e. urban centers and sub-centers, housing districts, regeneration sites etc.

What is important in these cases is that public participation can both mitigate problems which appear along with planning and development of the particular interventions (both large- and small-scale) and help solving them BEFORE they actually appear. This last feature is especially important in case the proposed development or planning initiative is expected to generate a number of issues for local community and stakeholders. What is also important is the fact that properly designed public participation process – which involves all possible stakeholders but does not allow “capturing the participation process” by the so-called “wanna-be stakeholders”[1] – helps in building community and stimulating partnership between key actors on the stage [Miessen, 2013].

As discussed above, the necessity of discussing the key decisions regarding spatial development with local community is obvious and part of contemporary planning and management practice. But what has to be stressed is the fact that it may take very different forms, depending on the level of involving the community. And, according to the so-called “participation ladder”, these forms include:

- Informing – based on simple presentation of the solution adopted; in fact this form of participation does not allow community to influence the decision;
- Consulting – based on presenting the possible solutions to the particular problem and selecting the best possible one (according to the stakeholders’ opinion); in fact, in many cases the outcomes of this process may be in conflict with the opinion of local government or investor willing to implement the cheapest possible solution;
- Participation – based on the direct involvement of the local community in shaping the possible solution to the particular problem / issue; in this case the stakeholders group is frequently confronted not with possible and pre-defined solutions but with the problem itself. In these cases the planning group is asked to solve the problem in dialogue with other decision makers, which allows both parties understand each other and work out the joint proposals;
- Co-investing – based not only on the public dialogue regarding the particular problem or issue, but also on involving the stakeholders (and their resources) in the implementation process; in this case particular stakeholders not only discuss and decide about the shape of the particular decision, but they are part of the implementation process.[2]

As one can note, discussed above forms of participation can be used in different contexts and situations. In fact, not all of them can be employed to each case, and also not in each case it is possible to identify the proper group of stakeholders. This may create the situation that – instead of the real ones – the so-called “wanna-be stakeholders” take the floor.[3]

5. Including the local community into the planning process

Involving local community and stakeholders in public participation process – and in this case by participation I mean real involvement of the stakeholders in the decision-making process – may take different forms. Of course, it can be used only in selected cases, but in case it is decided to employ public participation into the planning process the following key steps should be included in its preparation:

- starting the planning process with the group of local leaders, constituting the planning group;
- carefully drafting the plan of the participation process, including various forms of possible community involvement (workshops, site visits, public discussions etc., which allow stimulating the discussion on key components of the project) as well as a number of sociological surveys (which allow gathering the opinion of the wider scope of stakeholders – including the so-called "silent" ones);
- involving local mass media and asking them to convey information about the process;
- making outcomes of the process available for local community via different forms of publication and announcements.

In case planning process is undertaken directly by the representatives of the local community, it has to be supported professionally. Therefore, it must be coordinated and supported by the competent expert group – responsible for the final success of this undertaking. Otherwise the process may not bring the results as expected and even finish in a not expected way.

6. Post-transition countries

In case of so-called post-transition countries (which include post-socialist states as well as countries facing just economic transformation without the political change) the demand for public participation is extensively and rapidly growing. It has to be noted that just a few years ago involving local community into the urban development decision-making process was regarded as a kind of novelty and rarely treated seriously [Pawłowska, 2008].

But along with development of the democratic societies, understanding by the people that their opinion matters as well as growing mistrust to the local planning and municipal management elites completely changed the situation. Local communities started not only to question the development and planning decisions but also to demand more participation in the decision making process. In many cases this has led to the situation that no planning or development decision could be made without a public consent, which – in realities of diversified opinions and interests represented by different groups of stakeholders – had led towards stopping any development and not making any decisions at all. This means that development of the civil society – in realities of the lack of political and democratic culture – led to the paralysis of the decision-making process, which especially relates to the most disputable projects and plans. And one has to note that in many cases lack of the democratic tradition led to the situation within which anyone whose ideas were not included in the final solution / decision was contesting it and protesting loudly. Also, planning professionals and local government officials started to be accused of lack of professionalism as well as – in some cases – of being corrupted by developers or particular groups of stakeholders [Pawłowska, 2010].

Of course, this issue has not been left unnoted by both central governments and by local municipalities. Also, various groups of local activists have understood that negation of any plans and decisions made (especially) by local governments is not a solution and can lead towards stagnation. Therefore, various programs and initiatives leading towards making public participation part of the "civilized" planning and development decisions-making process were introduced. One can mention here a number of different forms and initiatives of different magnitude, which are currently changing the decision-making procedures. This relates especially to the issues associated with urban and spatial development as this is the key area of potential conflict [Siemiński, 2017]

One of the most interesting is the Polish case, which is due to rapidly increasing demand for participation (rise of the so-called "city movements" – groups of urban activists representing various ideas and concepts regarding local urban development processes), diversity of forms of public participation introduced, an array of practices tried and tested, and – finally – due to making this a part of the formal urban regeneration planning process [Żylski, 2016].

7. Public participation methods in post-transition countries

In case of the post-transition countries, and having in mind the specifics of the public participation processes in these, it was necessary to search for the method allowing – on one hand – full participation of the local community in the planning process and – on the other – getting the process completed in a predictable time. Therefore, the strategic planning methodology was chosen. This method, developed for business management, later on was adapted for the purposes of managing the socio-economic development of the municipalities. It is associated with three basic steps, responding to key questions:

- Where are we now? – meaning, in what situation the particular project / area is right now;
- Where we want to get? – meaning, what is the vision of the future state of the site / project that we want to achieve;
- How to make it? – meaning, how can we implement the conceptualized solution in the given realities.

This method may be implemented in various ways. Having in mind the specifics of public participation in planning / urban development process it seems that the best work methodology is associated with crafting the design workshops – "charrette style" – which allows fulfillment of the following objectives:

- Defining of the basic assumptions and concepts regarding proposed planning solution / project development BEFORE the design is ready;
- Defining – on this basis – a number of possible solutions / scenarios, as well as various priorities;
- Selecting the most appreciated solutions of the ones discussed;
- Developing the final concept – accepted by local community – to be furtherly elaborated.

In this case a number of techniques had to be employed, including public discussions, group works, general presentations as well as voting.

Fig. 1. Discussing and selecting development priorities during the workshop process. Photo credit: Piotr Lorens (2006-2010).

8. Exemplary Planning Workshops structure

Following the adopted methodology, also the experience gained during the process of developing the strategic plans for Polish municipalities was used[4]. In result, it was concluded that the planning process should be structured in form of a sequence of carefully planned workshops, during which the particular elements of the program / plan / strategy are defined. Such a program may also be supplemented by a set of necessary sociological surveys – which, as discussed in preceding chapters – may help providing opinion of the “silent” stakeholders.

Usually – before the real participatory process starts – the so-called Stage „0” of the process is concluded. This usually includes the desk research allowing survey and analysis of the existing planning documents. It may also help in developing the expert analysis of the problems to be solved as well as definition of the intervention area[5].

The second stage of the process is the cycle of workshops. The usual structure of those includes:

- I workshop
  - Group analysis of the problems of the given area
  - Development of the intervention goals
  - Development of the SWOT analysis
- I stage of the sociological survey
  - Getting the people's opinion on the basic problems and issues that have to be solved
- II workshop
  - Selecting the priorities for intervention
  - Identification of the specific projects and other undertakings necessary for implementation of the goals
  - SWOT analysis for the particular projects
- III workshop
  - Creating the „logical matrix" for all projects
- II stage of the sociological survey
  - Defining the priorities according to the population of the area
- IV workshop
  - Developing the final set of priorities
  - Developing the schedule of implementation actions
  - Developing the monitoring and implementation system
- Defining the financial plan
  - Defining hte sources and level of necessary / available funding for projects implementation
- Summing up the works
  - Presenting the outcomes in the form of comprehensive document

After the workshops themselves are concluded, it is possible to finalize the process in a form of written report including all conclusions. In case necessary, this report may become a basis for drafting the final policy / planning document, which can be adopted by municipal administration. In case of planning for urban regeneration, this is demanded by law in Polish planning system.

9. Selected case studies

In order to illustrate how the public participation process may be part of discussing the various types of interventions, three case studies were presented. Within the following parts of the paper only the selected aspects of these were presented. Also, due to space limitations, no conclusions achieved or detailed workshop structure were discussed.

9.1. „Katowice workshop” Reshaping the Korfanty Avenue

In case of Katowice the public participation process was organized to discussed the publicly contested outcomes of the architectural competition for the new development concept of Katowice City Center. This plan, developed by one of the leading Polish architecture office (Konior Studio), was discussed as a problematic solution, especially in regard to the ideas of reshaping the main urban axis of the city – the Korfanty Avenue.

Fig. 2. Aerial view of the Korfanty Avenue. Photo credit: Konior Studio (2006).

Within this plan it was proposed to narrow down this modernistic street and make it more pedestrian-friendly. At the same time the plan allowed massive development of new urban quarters on nowadays vacant areas, which were considered as green spaces by local community. In addition, during the workshop local stakeholders their sympathy to the present layout of the street, which came from feeling that its dimensions reflect the importance of the city. The workshop allowed discussing these issues and understanding the nature of the protests, as well as reshaping the plan and its detailed solutions.

Fig. 3. Street view of the Korfanty Avenue. Photo credit: Piotr Lorens (2006).

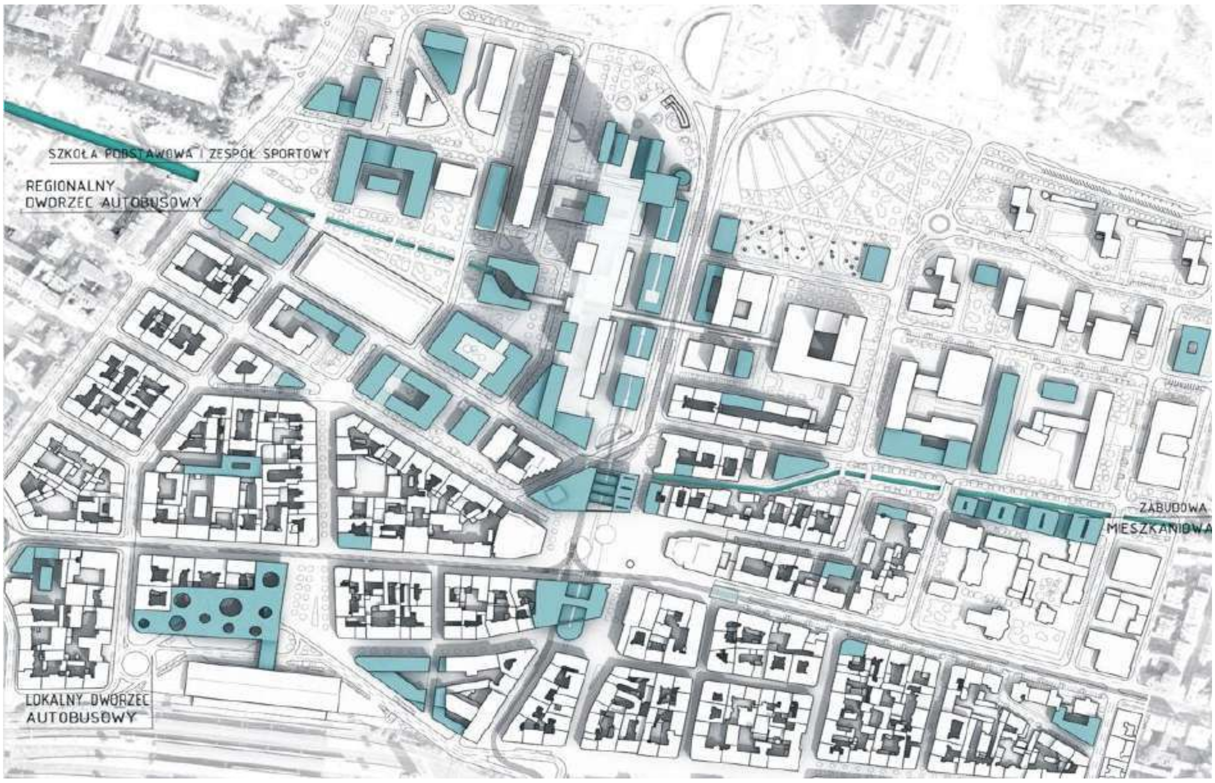

Fig. 4. Proposed redevelopment plan for Katowice City Center, including reshaping the Korfanty Avenue. Photo credit: Konior Studio (2006).

9.2. Redevelopment of the public spaces in the city of Starogard Gdański

The second case study is associated with the process of redeveloping the public spaces of the small-size city (approx. 65 000 inhabitants) of Starogard Gdański in the Pomerania Region. Within this process two key city spaces were subject to participation efforts: the Old Town Market Square and Wojska Polskiego Avenue. Although the latter case is still in the design process, the redevelopment of the Market Square has been completed. One has to mention that public participation helped identifying a set of possible solutions regarding this site as well as extensive discussion on the finally selected proposal.

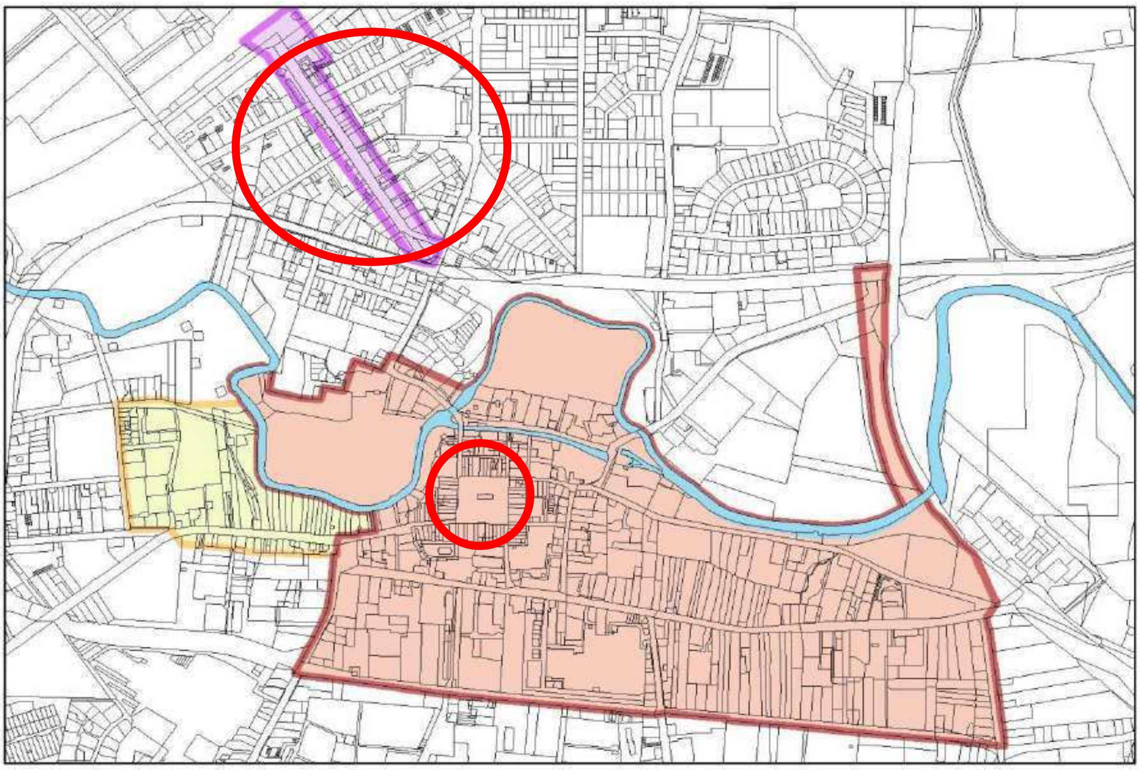

Fig. 5. Central part of the city of Starogard Gdański with marked location of both projects. Photo credit: Piotr Lorens (2014).

Fig. 6. Various concepts for redeveloping the Old Town Market Square in Starogard Gdański – outcomes of the participatory design process. Source Transforma G. Pęczek (2009)

Fig. 7. New design concept for redeveloping the Wojska Polskiego Avenue in Starogard Gdański – outcomes of the participatory design process. Source Transforma G. Pęczek (2009)

9.3. Replanning the Gdansk City Centre

Third of the case studies is associated with replanning the Gdańsk City Center. This project was coordinated not by the Gdańsk Development Office (an "official" planning agency for the city) but by the group of "urban activists" (associated within the NGO called FRAG – "Gdańsk Agglomeration Development Forum"). Development of this project was made possible due to a grant received from the Batory Foundation. Within it a local stakeholders group was working in order to define the new planning principles for the area. The outcomes of this were later on used in the formal planning process for the area.

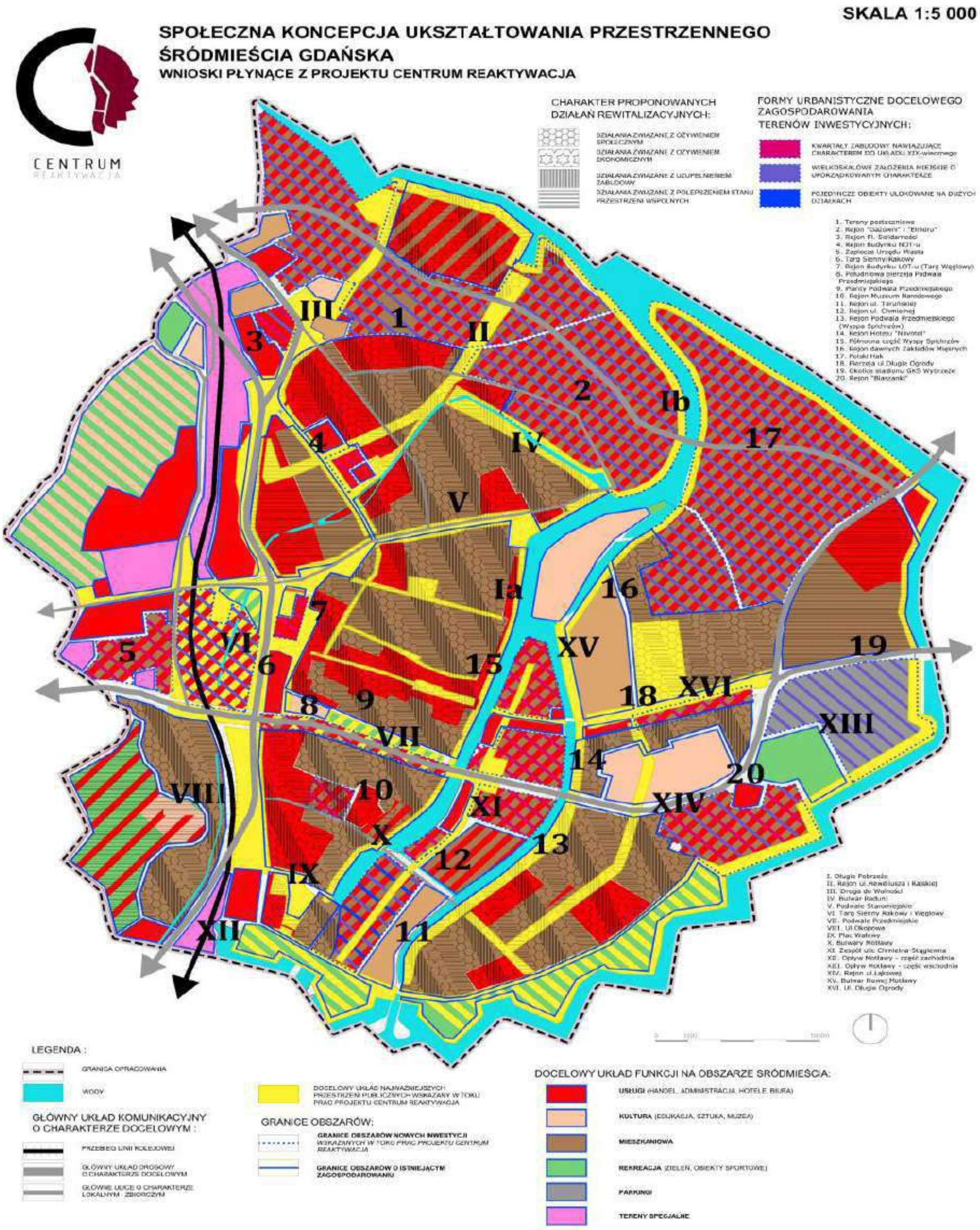

Fig. 8. New design concept for Gdańsk City Center – outcomes of the participatory design process. Source: Piotr Lorens and FRAG (2014)

10. Conclusions

As it can be derived from this paper, public participation is one of the possible tools used nowadays in order to discuss the possible planning solutions. It is associated with direct involvement of the local community in the decision – making process. In case the "solid" results are needed as well as an array of stakeholders has to be involved, participatory process should be based on the methodology of strategic planning . In these cases good results can be achieved through organization of the „planning / urban workshops". This was especially important in case of the "post-transition" countries like Poland.

At the same time Polish experience in this matter proved that there is a need of so-called "strategic approach" in public participation processes. Otherwise, there is a danger of wasting the efforts made and finishing with no substantial results – meaning no decisions and no points made. Results discussed and presented in this paper shall allow discussion of the possible inclusion of the Polish experience in the planning practice of other countries and regions, with a special focus on countries in transition.

Finally, experiences analyzed also proved that both the scope of participation process, results expected as well as group of stakeholders involved have to be defined locally, as there are no two similar situations. This means that also outlining the participation process should be crafted individually and that there are no "blueprints" that can be used.

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[1] One can define here three major groups of stakeholders: "real stakeholders" (meaning – people and institutions really affected by the proposed action and willing to participate in the participation process), "silent stakeholders" (also affected but do not willing to participate) and "wanna-be stakeholders" (not affected directly but asking to be part of the participation process).

[2] The best illustration of this process is the situation when the local stakeholders not only discuss the solution but also participate in its implementation, i.e. mobilizing their own resources in order to facilitate the urban regeneration process.

[3] This is the case of various post-industrial sites.

[4] I.e. please see the works of the UNDP Umbrella Project.

[5] This is especially import ant in process of shaping the Local Urban Regeneration Plans, which – according to the Polish Parliament Act of 2015 – requires an expert definition of the intervention area based on the statistical analysis.

Constructed and contested legitimacy in urban governance

Moderator: BRYNILDSEN REINAR, Mathias (Norway)

ABSTRACT:

Cities in northern Europe are increasingly inhabited by people with diverse cultural backgrounds. The social, economic and environmental sustainability of cities requires capacity to live with differences. Recent increases in refugees and asylum seekers pose new challenges, which adds to challenges already faced by the cities: affordable housing, transport, community meeting spaces and new economic opportunities.

The cold climate of the north brings certain challenges related to creating new meeting places, indoors and outdoors, but the increased diversity has led to a wide variety of new and innovative integration activities, aiming at connecting newcomers and established residents in urban meeting places. This session will focus on exploring the function of and connections between meeting places, interaction and participation in the city. As a part of this broad theme, these questions will be relevant:

How are urban spaces being used by newcomers and established residents?

How and under what conditions do meeting places lead to cross-cultural encounters and interaction?

In what way and to what degree can cross-cultural meeting places and encounters lead to processes of participation in urban life?

The session encourages a wide range of contributions, including from academia, practitioners and civil society. We invite contributions related to new theories or methods for planning for diversity as well as case studies and practical examples, including tools for planning. Both planned activities as well as ongoing or completed activities may be presented.

The session format will be short (10 min) presentations followed by a moderated round table discussion, open for all interested parties. The discussion aims at exploring innovative multicultural integration activities that help us to live with difference, enhance integrative interaction and develop cities' problem-solving capacities. The session will provide a summary from the round-table discussion to be held at the session.

Session conveners: Marit Aure (UiT The Arctic University of Norway), Anniken Førde (UiT The Arctic University of Norway), Tone Magnussen (Nordland Research Institute), Gregory Taff (NIBIO)

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Associations of active ageing; a potential tool for local development

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Abstract

It presents a ongoing research on the potential role that "senior universities" can play as tools for the preservation of tangible and intangible heritage in some urban or rural areas, in Portugal. Senior citizen universities as active entities that promote the healthy active ageing of the population are associations with a very significant potential for the recovery of some cultural practices in the territories where the elderly population is dominant.

The cultural activities linked to the preservation of the heritage, namely traditional music groups and respective instruments and in general their contribution to healthy ageing communities can have an interesting role to support touristic activities. The creation of groups of students who are organized to participate in local and regional events promote the process of active aging and create a motivation that spreads in the surrounding communities.

Key words: Active ageing, Citizen participation, Senior University, Tangible and intangible heritage,

1. Introduction

This paper is the first approach of a research about the role that senior universities (SU) can play as instruments for promoting local development especially in the areas of valuation of heritage and tourism.
Such associations have been studied in their social role, directed to an age range increasing, but are not considered as active partners in local development.
In many regions the numbers of the people with more than 65 years old are really impressive, so they must be considered as part of the solution to increase local development.
Some of the elderly populations that currently live in rural areas have developed their productive activities in urban areas, having no direct relation with agriculture and, therefore, need to maintain different social activities and relationships.
They use their time in a different way from the population that always lived in rural areas and that even being old maintain subsistence agriculture activities, keep out of need or pleasure.
The more urbanised population has led to the creation of many nuclei of senior universities with multiple values.
The universities or academies of the elderly, are entities that promote the active and healthy ageing of the population, but till now they don't assume their role in the territorial valorisation of the community;
These are associations with a very significant potential for the recovery of some cultural practices in territories, especially where the elderly population is dominant.
Cultural activities linked to the preservation of heritage, namely traditional musical groups and respective instruments are one of the programs of the US.
The creation of groups of students who organise to participate in local and regional events promote the process of active ageing and create a motivation that involves the communities.
The methodology adopted for this research focuses on the analysis of the impact at local development level, in a set of municipalities where there are senior universities, in areas of low density and permanent loss of population since the mid-50s of the last century.
The SU are characterised by the type of offer they present and the participation they have in community life.

2. Origin and Role of Senior Universities

The Senior Universities or Universities for the third age (U3A) appeared in France, firstly in the Faculty of Social Sciences of Toulouse in 1973 as a movement to promote university-like teaching linked and organised by some Universities.
The origin of this organisation model called "Modèle Vellas" has three objectives:
1. The training of seniors through the university;
2. Research in areas related to seniors, namely health, psychology, legal and the social field;
3. Training of employees and stakeholders working in the field of seniors training

The organisation of the activities was very similar to the traditional university pedagogy with master classes. ((AUTANB), Juin 2013)
Nowadays with the increasing numbers of SU and not all near universities, this view has been changing, and a more friendly approach is developed.
In England, in the University of Cambridge, in 1981, Peter Laslett developed the concept of "self-help" The self-organised learning groups on subjects that interested them and with voluntier teachers who are part of the group; They are not called students but members, this model is called Cambridge Model.
Many of the US are united in an international organisation "Association International de Universités de Troisième Age" (AIUTA) which shows the great importance and dissemination that this type of associations has had in the last decades around the world.
On the generic role that the US has in the territory, these may resemble the local intervention NGOs, as an emanation and representation of the community. (Cernea,1988).
Independently of the functioning model, all aim at the well-being of the elderly and their integration into society, promoting active ageing.
From the activities or courses given by the U.S., the areas related to culture, namely local culture, either local history itself or cultural manifestations such as traditional music, are regularly present.
The increase in the longevity of the population associated with the improvement of their physical condition allowed the development of recreational activities by this group, with age +50 years and functional retired or part-time workers.

3. **Ageing of the population in Europe**

The evolution of median age of the population in Europe is, according to with Eurostat increasing in the last decades, because of the decrease of birth rate and at the same time the increase of life expectancy(Fig.1).
In 2016 it was in Europe of 42.6 years, with some countries like Germany with 45.7 years and Portugal 44.4 years (Beira Baixa 50.3., Alto Alentejo 48.4 and Lezíria 45.6) (Eurostat,2017).
If it is analysed the importance of ageing people, Europe has a substantial population weight of +65 years (19.3%) and has been increasing, distributed very unequally between the countries (Pordata).
In Portugal, the situation is similar, 20.9% of the population are +65 years old but distributed very unequally in the territory. As it can be seen in fig. 2, only a small coastal strip has a younger population.

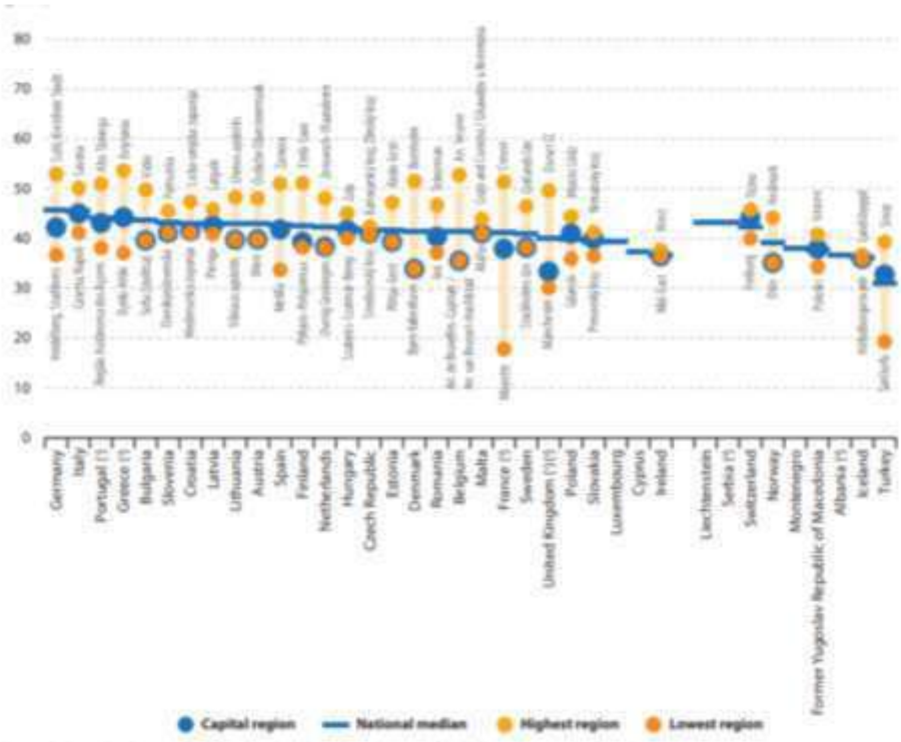

Figure 1: Median Age of Population, By NUTS 3 in Europe, 1 January 2016

Source: Eurostat

A significant part of this population can remain active, and in good physical and psychic conditions, this is the group that the active ageing programs are designed for, like the SUs.

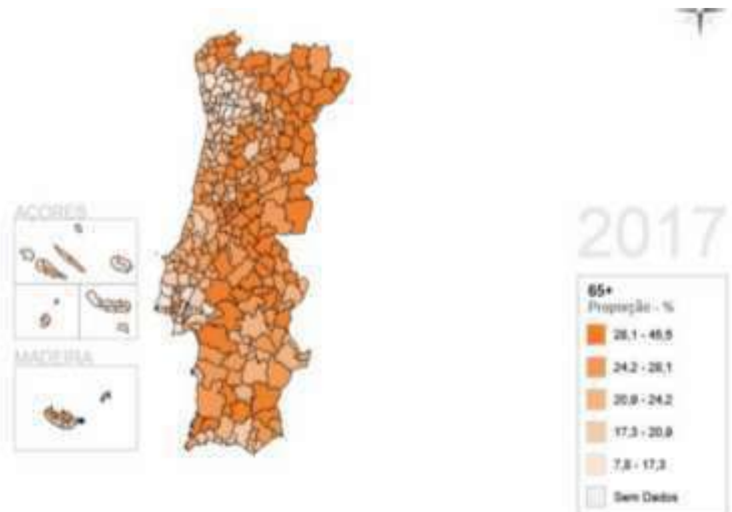

Figure 2: Percentage of the population with more than 65 years old

Source: Pordata

With this demographic characteristics, the population with more than 65 years must be looked at with a different approach. This population should be valued, within the area of this research project, for its numerical importance but above all for its capacity to evaluate local and regional heritage. And the areas where it is almost half of the entire population, and there are no large urban agglomerations, can be considered an endogenous resource of great importance.

4. Senior Universities in Portugal

The movement of Senior Universities in Portugal began, in the 80s of the last century supported mainly by the social sector and local authorities concerned with the quality of life of the elderly population.
Based on the demographic data presented above, in Portugal, the movement of Senior Universities has a great potential for development.
According to with the legislation the Academies and Senior Universities (SU) are "as socio-educational responses that aim to create and streamline activities regularly in the social, cultural, knowledge, and social areas, from the age of 50, pursued by public or private entities, with or non-profit " in RCM 76/2016.
They are very well distributed in the territory, in 2015, they were in 171 municipalities, 60% of the 278 municipalities in the continent.
They are organised in 300 associations with + 45000 students and 5500 volunteer teachers. With groups of theatre and music; with music in 67% of the SU and theatre in 47% of them. (RUTIS, 2015).
The SU is organised according to both models, the French and the English models if they are more connected with universities or self-organised groups.
In the territory chosen as the first approach of this research where don't exist universities is the English model that is in use.

5. Municipalities and Senior universities

To study the potential of SU in the local development and the positive impact, was chose a group of six municipalities with rural characteristics (low density and without cities) on the banks of the Tagus River and with SU.
These municipalities belong to three different NUTS 3 and are in:

Beira Baixa – Idanha-a-Nova e Vila Velha de Rodão,
Alto Alentejo – Gavião e Nisa,
Lezíria do Tejo – Chamusca e Golegã

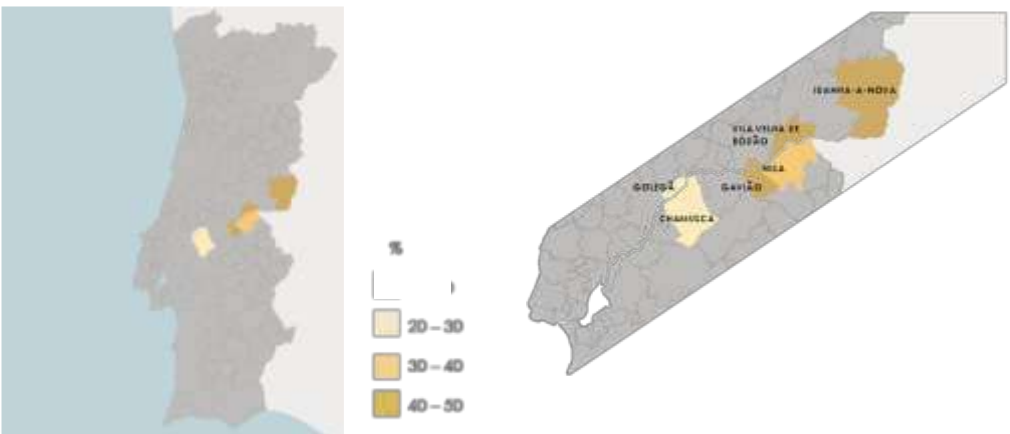

Figure 3: Municipality case studies and % of the population with +65years

Sorce: INE 2011

All of them have a population of over 65 years old, above the national average, Golegã as 25% till Vila Velha de Rodão with 44% (fig. 3) and a negative variation of the population between 2001-2011 (fig 4).
The more the municipalities are far from Lisbon, the more is the negative variation of the population. Golegã has only -4% of the variation of the population and Idanha-a-Nova in the border with Spain has -27%.

Municipality	Var. Pop. 2001-2017
Chamusca	-17%
Gavião	-28%
Golega	-4%
Idanha-a-Nova	-27%
Nisa	-26%
Vila Velha de Rodão	-21%

Figure 4: Variation of the total population in the municipality (2001-2011)

All the municipalities have at least one SU, some with the designation of Academia others with University in the name.
The first SU appeared in 2003 in Golegã, the municipality nearer Lisbon, and the last in Nisa in 2017. The number of students is very disparate (fig.5) and not directly related to the amount of total population of the municipality.

SU Designation	Municipality	nº students/ members	year of foundation
Universidade Sénior Da Carreira - Chamusca	Chamusca	68	2014
Universidade Sénior da União das Freguesias da Chamusca e Pinheiro Grande	Chamusca	100	2016
Universidade Senior do Gavião	Gavião	68	2008
Academia Sénior da Golegã	Golegã	102	2003
Universidade Senior de Idanha a Nova	Idanha-a-Nova	34	2015
Universidade Senior de Nisa	Nisa	294	2017
Academia Sénior de Vila Velha de Ródão	Vila Velha de Rodão	123	2015

Figure 5: SU characteristics

All the SU offer training in cultural areas linked to local heritage like musical instruments, coral, lace and embroidery, gastronomy, local history or theatre in addition to other topics more related to current needs such as information technology or foreign languages. The tourism activity is also considered and is important to keep some areas and functions with clients in dead days.
As for the form of organisation of the SUs (fig.6), they correspond more to the model of self-organisation, similar to the English model, but with the logistical support of the municipal or parish councils. Teachers either belong to the group itself or are made available by local power, such as a teacher to lead the choral groups.

Figure 6: Examples of SU logos
Source: sites of the SUs

The research is now trying to relate the offer with the characteristics of the population and make a more detailed analysis of the subjects.
When is compared to the offers of training music (coral or instruments) and theatre are common to all. The subject bullfighting and gastronomy are specific to a single SU.

Figure 7: Participation of the SU of Idanha-a-Nova in a public festivity of a village of the municipality

Many of the groups (musical, coral or theatre) organized around US activities actively participate in various cultural events in their communities and municipalities promoting shows that are seen by the entire population (fig.7).

6. Conclusions

The associations which promote the active and healthy ageing of the population have been multiplying, around the world and in Portugal, even in municipalities with substantial population losses, in this century.

From the analysis made, it can be concluded that the Senior Universities are valuing the local culture.

All make shows or participate in traditional public festivities that disseminate the cultural characteristics of each municipality.

The research will continue with a more detailed analysis of these associations in low-density areas, but it would be interesting to study the associations of some towns and cities to evaluate their potential to the local development.

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Spaces of Non-State Actors in the Urban Development Process: Rethinking the Community-based Planning in the Housing Sector

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Abstract

This paper examines how community-based planning in Indonesia changes with the shifting roles of non-State actors in the development process and the introduction of international urban development agenda and approaches focusing on sustainability and resource efficiency approaches. Within this period, Indonesia planning system went through decentralization and transition. By using longitudinal study as a heuristic device, the paper aims to capture a more nuanced model of community-based planning. This paper intends to identify the key factors of systems changes and the realization of collective action that facilitate acceptance of sustainability and resource efficiency approaches for urban development.

1. Introduction

For the last half century, urban development theory and practice has increasingly focused on how people engage in the planning and implementation processes. Citizen participation in planning and development, in turn, is continuously being influenced by changes in urban development approaches, from participation for incremental to radical and transformational change. This focus is exemplified by works on community-based planning in synoptic planning, radical planning, and collaborative planning. Taken together, this continuum represents the varying degrees of citizen participation depending on their agency and power and social and political consciousness.

Recent international development approaches following the development and implementation of global agreements (e.g. Habitat Agenda, Millennium Development Goals, Rio+20, and as recently the 2030 Agenda, Paris Agreement and the New Urban Agenda) increasingly require collective action in delivering and managing urban area to attain its goals and, in broader context, sustainable development. These pressures from international community has influenced the way urban development approaches are taken, particularly through development assistances and introduction of new development measures. From the socio-economic and political administrative point of view, the decentralization which took place in Indonesia in 1999 has further accelerated the role of community and non-state actors in the planning system. These have inevitably changing the relationships between the State and non-State actors in approaching planning and development. With presence and participation from non-state actors continue growing, the government is moving away from their traditional way of working with non-State actors; from consulting to policy-making; from beneficiaries to partners. Amidst increasing demand of resources to catch up with rapid urbanization, it is expected that spaces are opening up for non-State actors to actively participate the development process. However, the questions remain whether the new approaches will contribute to urban development in a collaborative manner for the community.

While collective planning presence in development gain broader audience, constraints continue to exist throughout the changes of development approaches. The externalities affecting collaborative planning relies on the local circumstances and context where the planning takes place. To understand these constraints, there is need to understand local collective action initiatives in the context of government policies, to explore ways in which such policy is interpreted and enacted by strategic actors and to examine the perception of members of the society themselves. As planning exists in a multi-level governance setting, it is pertinent to also examine government policies at its vertical interplay, between the national and local government. In the community-based planning, it means to take account of the perspective from the strategic actors in the community and examine the perception of deliberative community. Furthermore, the implementation of any policy, in turn, is influenced by different factors, one of which is assumed to be people's acceptance (Ekins, 2004).

Building upon this understanding and challenges, the paper examines how community-based planning in Indonesia changes with the introduction of resource efficiency as a platform to achieve sustainable urban development. It tries to understand how innovation and implementation of integrated resource efficiency measures on an urban scale shift the roles of non-State actors in delivering urban services in the housing sectors. At the community level, it looks at the intersection between community collective action and resource efficiency by identifying the residents' acceptance of resource efficiency and the ways of incorporating the concept into community planning, using waste management in the social housing as a case study

Following this introduction, this paper is elaborated into four parts. First, it looks into literature covering resource efficiency in the housing sector, its linkage to sustainable development concepts and the role of social acceptance. Second, it attempts to conceptualize the role of non-state actors in the community-based planning. Third, examine the space of non-state actors in the community-based planning through the case study. The final part offers conclusion on how to move forward with the community-based planning in the housing sector by maximizing community acceptance over collective issues.

2. Sustainable Development Concepts: Resource Efficiency in the Housing Sector

Urban responses to climate change have been the driver of the sustainable development movement in cities. Climate change mitigation and adaptation measures are incorporated in planning, construction and management of urban infrastructure (Walsh et al, 2011; Zimmerman and Faris, 2011). Yet, despite using the climate change approach relevant to many cities' needs and demands, the contradictions of sustainable development and urban priorities remain. In the last two decades, the need to dematerialize economies to preserve natural resources, to reduce the environmental impacts and to reduce pressure on ecosystem services led to the bringing of resource efficiency approaches to the forefront of sustainable development debates (Steinberger et al, 2010). These approached understand that environmental pressures, such as greenhouse gas emissions, are closely related to material consumption and its flows (Barrett and Scott, 2012). One of the shifts in how cities response through these policies is moving from increasing energy efficiency of local government assets to reducing a broad array of emissions linked to urban sectors. Rather than relying on producing single isolated plans, cities are putting effort to mainstream through a complex of technological, spatial and financial aspects.

2.1. Integrating Resource Efficiency Measures in Urban Housing

To this end, there are various entry points to examine the existing urban responses to sustainable development through resource efficiency approach. At least several major sectors could be identified, including transportation, energy, waste, industry, commercial, housing, and spatial plan. Housing sector, in particular, plays a crucial role to sustainable cities at the same time it is an integrating element to urbanization, planning and the use of resources through its linkage with the built environment. Further, the concept of housing encompasses the social, cultural, environmental and economic facets of cities. The future of cities depends on how well the quality and the accessibility to sustainable housing are in place.

Yet in many cities, it is unclear to what extent sustainable housing as the solution for the built environment through resource and energy efficiency, environmental, resilience contributes to the overall work of resource efficiency, considering gaps between the physical (e.g. resource and energy use, design) and social economic system of housing policies (e.g. affordability, social justice, cultural and economy). Among many, the search for affordable land at the edge of urban areas to make the construction of affordable public housing financially feasible has the potential of creating a greater cost burden for the local government, as well as a global environmental burden through the emission of greenhouse gases caused by extended vehicle commuting distances (World Bank, 2011). Resource wise, the selection of materials and quality of assembly do not always go hand-in-hand with reducing long-term operations and maintenance cost, and minimizing environmental impacts as housing projects are not motivated by sustainability policy, but by the need to improve economic indicators in the generation of housing stocks (Gordillo and Hernandez, 2014).

In the light of the realities of existing urban housing responses, it is necessary to design policies for sustainable housing in a manner that provide opportunities to achieve social and economic goals through its contribution to reduce resource consumption and emission production. This involves not only developing sustainable housing technologies applicable to various climate regions, economic conditions and residential customs, but also the management innovations for urban governance targeting housing sector. To this end, comprehensive science-based housing policy options are needed to guide planners and policy makers in achieving trade-off between environment and urban growth. These include evidence-based insights on green buildings, sustainable housing, green infrastructure, climate change resilience and urban industrial symbiosis.

From the perspective of resource efficiency, sustainable housing can be defined from design, social, economic and eco-efficient points of view. Notwithstanding certain characteristics of sustainable development, sustainable housing is coherent to the idea of self-reliant development within natural resource constraints and the idea of cost-effective environmental development (Choguill, 2007). Those ideas are in line with a developmental concept which should not degrade environmental quality, nor should it reduce productivity in the long run. It is pertinent to note that housing sector significantly contributes to sustainability due to its large amount consumption of natural and man-made resource in construction, maintenance and continued use by society. Through its design, construction and operation, housing represents a significant point of direct consumption of natural materials, water and energy (World Bank, 2011). As a fixed asset with a long operational lifespan, housing is amenable to produce embodied energy equal as much as 15 years of the operational energy requirement during its construction only (Reardon, 2001). While sources of emissions vary depending on climate, designs and behavior, housing sector remains as the predominant land use in most cities and a major contributor to greenhouse gas emission (Jowsey, 2012).

The housing sector offers substantial opportunities to improve environmental performance and, in the long run, to contribute to the betterment of consumption and production. Recently, a large number of technology and innovations are available for efficiently operating the buildings, including wastewater treatment and use, energy efficiency, solar heating, passive cooling, and creating green spaces in proximity to compact housing. Taking into account the greenhouse gas emissions embodied in housing, incorporating those technologies and innovations into housing developments, particularly public housing and large-scale programs, provides opportunities to minimize local and global environmental programs. However, as housings are highly energy intensive through their life cycle, to shift will require taking into consideration demand-side parameters such as availability, reliability and effective consumption as well as improving energy efficiency and urban density (Rehman et al, 2012).

Sustainable housing policies can be designed to incorporate sustainable materials with potentially large-scale economic impacts. The housing sector is in a unique position to help achieving the triumvirate of sustainable growth; the social goal of reducing the housing deficit, the economic stimulus goal of creating jobs in the construction industry, and the environmental goal of developing healthy homes and communities (World Bank, 2011). Through current observations on existing housing policies, particularly in developing countries, there are still rooms for the betterment of sustainable housing policies and programs to greatly improve urban sustainability. Taking the example of Indonesia, its existing housing policies have yet to fully comply with environmental policies and there is not a comprehensive urban policy in support to the provision of sustainable housing sector.

2.2. Social Acceptance of Resource Efficiency

Social acceptance has been a key part to measuring sustainability and quantifying the social dimension of sustainability (Alcorn). The social sustainability dimension is approached from an angle of social acceptance due to accepted understanding that for a technical approach to be deemed socially sustainable, it should enjoy wider social acceptance (Assefa and Frostell, 2007). Social acceptance is increasingly important factor in the design of effective policy (Steg et al., 2006). Acceptability is also a particularly important issue to manage transitions to sustainability as policies for a transition to sustainable resource use require a significant degree of behavioral change (Geels, 2013). It, thus, depends on the consent of actors at various levels, from multinational to the individual (Bicket and Vanner, 2016). For example, individuals are more likely to accept certain policies if they are well informed of the consequences of issues addressed by the targeted policies and the benefits are well described. A string social norm is associated with higher public acceptability (Schade and Schlag, 2003).

While broadly can be applied to many issues related to technology, the concept of social acceptance is particularly popular in the area of energy and other large-scale infrastructure initiatives (Fournis and Fortin, 2016). The concept of social acceptance has also been frequently applied in the waste management (Seguin, 2005). Contributions to the literature from broader and over encompassing umbrella issue of resource efficiency is less popular compared to specific sector such as energy. Focusing on acceptance and resource efficiency is supposed to offer an opportunity to explore dimension associated with mainstream considerations with social acceptance.

On the operationalization of social acceptance approach, a triangle of social acceptance was introduced by Wustenhagen, Wolsink and Burer (2007) based on the synthesis of three dimensions; socio-political acceptance of technologies and policies by major social actors; community acceptance of local actors and deliberative community themselves; and market acceptance that representing the process of market adoption of an innovation. Szarka (2007) offered a complementary approach of ‘social acceptability’ which link technology to an evolving social contract which involves three levels of collective choice; socioeconomic and technological choice; public policy choice; and governance choice. The addition of the latter takes social acceptance to be a symbolic decision-making framework and a contested and dynamic process (Fournis and Fortin, 2016), informed by collective norms, diverse evaluation processes, political struggles, and the legitimacy of behavior (Szarka, 2007). From governance perspective, social acceptance then is understood as a collective choice of technology-social contract that often conditional and affected by politics. In this framework, conceptualization of acceptance is differentiated through the hierarchisation of distinct levels instead of the plurality of dynamics (Fournis and Fortin, 2016).

This paper follows both lines of thought in order to understand the interplay of complex processes. It focuses on the micro-social level associated with processes such as coordination, social interpretation and the construction of perceptions and meanings by individual in relation to specific situations, activities, and policies. The terms social defined in this paper as encompassing all agents involved. The primary focus of this paper, however, is community acceptance.

3. Conceptualizing the Role of Non-State Actors in the Community-based Planning Process

Community-based planning is considered a fundamental aspect of bringing urban planning closer to its target constituents. Further, the last two decades have seen a global movement promoting democracy, justice and sustainability through active involvement of people, often representing through community participation. The principal implication is that community-based planning has become one of the key requirements to legitimize planning process. The experience in the ground shows that establishing inclusive community-based planning is very challenging. It is often pointed out that disadvantage groups and the poor are struggling to have access to actively participate in the planning processes (Mahjabeen, Shrestha and Dee, 2009).

3.1 Collaborative Planning

From the urban planning's perspective, community participation is considered fundamental to achieve inclusive decision making and sustainable development (Shrestha and McManus, 2008). The idea behind was with community groups actively engaged in planning and implementation processes, plans are likely to be respond well to stakeholders' needs, interests, and expectations (Healey, 1999). Community involvement in planning is also seen as means to bring together information, knowledge and skills from various stakeholders involved to improve the planning outcomes.

The systems of governance of a society or community refer to the processes through which collective affairs are managed (Healey, 1997). Collaborative planning is grounded in the theory of relation-building process creating intellectual and social capital through shared understandings and mutual trust (Healey, 1997). Thus, governance activity is diffused through the multiplicity of social relations we have, and may take many forms. It is a matter of specific geography and history how responsibilities as distributed between formally-recognized government agencies and these other arenas of governance.

Participatory planning approach are often based on the assumption that non-state actors, particularly civil society, are definable, homogenous, relatively organized and actively consensus seeking (Cooke and Kothary, 2001). On the other hand, the societal complexity and conflicts are present in many parts of the world and non-state actors take on very different. At the community level, the differences among community groups are due to various reasons, including socio-economic, culture, political, etc. The situation is exacerbated where the state is the weaker locus of authority (Watson, 2009). Assumption over the characteristics of non-state actors cannot be blamed as the reason why collaborative planning have been less than adequate in addressing urban development issues. In the global South, for example, the inherited planning system and approaches are often not equipped with consideration for inclusiveness, even though the context in which they operate has changed (Watson, 2009).

Baresford (2002) has identified two fundamental contradictions of collaborative planning and public participation: "enhanced political interest, but public dissatisfaction; official priority but very limited achievements and resourcing", implying that public participation initiatives do not always translate into a shift towards a more collaborative planning. In order to make sense of this, he calls for more focus on the social policy of public participation; its ideological, political and socio-economic relations behind.

3.2 Decentralization and Transition

Decentralization in the global South is often seen as the predominant measure of governance structure for delivering to the poor the basic services tasked in the international agenda, such as the Millennium Development Goals (MDGs), as it would be achieved primarily through sub-national governments (Ingram and Hong, 2008). Consequently, in the 1990s, decentralization is considered as a tool to improve public service, economic development, and other social development, particularly when governments are seen less capable in doing so at the rate desired by citizen (e.g. Manor, 1999; Blair, 2000; Ito, 2005). There are many reasons that drive decentralization beside international pressures for governance restructuring, including the failure of centralized planning for economic development (see Freire and Stern, 2001), lack of transparency and exclusive decision making process exercised by the central government (e.g. De Angelis, 2005).

Indonesia was decentralized in 1999, following subtle movements started in early 1990s. The change marked a movement from a centralized and hierarchical government structure to a decentralized system. The decentralization law was enacted in 1999 and was implemented starubf January 2001. Indonesian decentralization was designed to bring a greater role on the local government, bringing a functional and responsibility shift of the central government, designated to lower levels of government through policy reform. The responsibility shift generally revolves around three main principles, i.e. de-concentration, decentralization and co-administration. The sub-national authorities in Indonesia (e.g. provinces, regencies (*Kabupaten*) and municipalities (*Kota*)) were granted autonomous status as local government. The head of regencies and municipalities are no longer directly respond to the provincial government, but to the local assembly.

Decentralization in planning system followed in 2004 after the national assembly passed the new law about national development planning system (Law 25/2004) and the new spatial planning law in 2007 (Law 26/2007). According to the new national development planning system, local governments are not obliged to make their local development plans as the direct extension of the national development plan. Instead, the national plan acts only as guidance and reference. Further, planning is governed at the local level with higher level governments as coordinating partners for regional planning.

Decentralization is not without governance issues. Bottom-up accountability and deficiencies in the existing capacity are often seen as the lacking part of Indonesian decentralization (see Shah and Thompson, 2004; Local Development International, 2013). Decentralization failed to sufficiently integrate elements of decentralization (e.g. political, economy, administration) with other public sector reforms. This lack of coherence was due to weak coordination of key actors where consensus is rarely reached. It is also found that the implementation has been uneven across municipality which largely depends upon the leadership quality of the local elites (see Firman, 2003). Municipalities with better capacity have better records in policymaking and implementation.

Collaborative planning, including local community-based planning, was affected by decentralization as it is closely related to the relationship formed between involved actors and their willingness to collaborate. The resources, objectives and roles that particular actors bring determine the nature of social relations forged within and across networks (Koliba et al, 2011). In a fragmented decentralized system such as Indonesia, actor relations vary across administrative jurisdiction, various levels of governments and between government and nongovernmental sector.

4. The Case Study

The concept of social acceptance towards sustainability and resource efficiency measures through community planning is illustrated with an example of community group that planned, established, and maintained a community based waste management. To facilitate an understanding of the increasing role of communities in the case study, the local sense of social relations and the institutional relationships created by the local administrative structure are explained.

4.1 Data

This case study is drawn from a longitudinal study of low income residential housing. The study was conducted in the city of Surabaya and focused on two housing communities located in the city center (Rusun Urip Sumoharjo and Rusun Grudo). The broader purpose of the study was to analyze the social acceptance of people towards sustainability and resource efficiency measures applied in the low income housing projects. For this paper, the study specifically looks into the role and capacity of community to support people's acceptance through community-based planning.

The initial round of field research gathered secondary data from the local officials regarding the targeted community and changes in community-based planning in the city of Surabaya. In later rounds, the study sought a more in-depth understanding of the social acceptance of the low income housing communities. The study used a combination of qualitative and quantitative methods. Data were collected in a series of intervals begin in 2014 and currently is still ongoing. Research methods included questionnaire surveys, analysis of transcripts based on in-depth interviews and oral histories. The questionnaire surveys to the households were conducted to gather information on household structure, education, employment, consumption and use of resources, housing ownership, access to services, and participation in community-level decision making processes. For each housing complex, 100 samples were collected.

4.2 Social and Economic Characteristics

As of 2018, Surabaya has 78 low-income housing blocks in 14 locations. From the start, development of low-income residential housing in Surabaya was aimed to provide affordable housing and to reduce squatters through relocation.

Rusun Urip Sumoharjo

As one of the oldest low-income housing in Surabaya, Rusun Urip Sumoharjo was built to replace residential houses burned down in a 1982 fire accident. Residents were not allowed to rebuild their houses and instead were temporary relocated while the local government built the multi-store housing which was finalized in 1985. Unlike other low-income housing blocks, Rusun Urip Sumoharjo was not a rental housing. The building undergone a reconstruction in 2003-2005 to replace the structure. Since the budget to rebuild and to maintain the building came from the local government, rental fee exclusive of utilities was imposed to residents starting in 2006.

The majority of the residents living are the owner of houses replaced in 1982. The housing block housed a total of 120 households. Most of them has non-wage source of income. Each unit consists of living-dining room, one bedroom and one bathroom, totaling about 24sqm.

Rusun Grudo

Rusun Grudo was originally built to improve the living condition of slum settlements and to provide housing for low-income local government retirees. It is a rental based housing with subsidy from the local government. Each of the five stories building housed 96 households. The size of housing unit is 24sqm each.

4.3 Planning at the Community Level

In Indonesia, how local residents engage in planning at the community level is defined by the institutional relationships created through the urban political-administrative structure. For the administrative purposes, urban area is subdivided into districts and sub-districts with civil servants as officers. At the community level, there are two units of community group, *Rukun Warga* (RW) and *Rukun Tetangga* (RT) whose leaderships are on voluntary basis and directly elected by community members. In the residential housing complex, unlike in landed housing-based urban settlement, prior to establishing a RT, the community has to set and register a Residents Group in the sub-district office. With each RT consists of 30 to 40 households, each building with 5-6 floors could have two or more RTs. In the political-administrative structure, these community groups institutionally linked community and state. They also hold status as non-state actors alongside civic society organizations. For both Rusun Urip Sumoharjo and Rusun Grudo, RT was formed in each floor with 5-6 RTs in total in each building block.

Synoptic Planning

In 1982 when the first Rusun Urip Sumoharjo was built, residents were not involved in any capacity to develop the housing plan. The local government instead worked with private sector, resulting in many complaints about the quality of the building and housing units throughout 1985-2000. While community planning was enshrined in the planning law starting 1992, the practice was challenging due to a highly restrictive social and political context in which there exists a threat of repercussions for any activism considered political. Any community planning activity was highly controlled and directed by the government. The participatory process available was to improve the living conditions of the housing, including infrastructure and services. It was not an openly participative experience and instead local government adopted a problem-solving approach. Thus, resident participated in a formal, institutionalized planning process with limited power that allow residents to engage in negotiations with public officials.

Decentralization influence the change of process. It gave rise to new social debates on planning where the residents start gaining power to present suggestions and statements to local government to improve the condition of the housing block. The process led to approval of reconstruction. The process leading to the designing and developing the new housing block was more participative than the previous development process. The planners employed by the local government adopted a consultative approach where they offered meetings and participated in public consultation with the residents.

Collective Planning

In Rusun Grudo, residents were not involved in the planning and development of the housing blocks. However, the RT managed to reorganized themselves and establish a local waste recycling and management right after they started inhabiting the housing blocks. Their community-based waste management was considerably more advanced and organized compared to similar activity in Rusun Urip Sumoharjo despite the community group in the latter residential housing complex was established earlier with decades of experience in community organizing for social movement.

Collective local waste management was introduced at the city level in early 2000s following the green city movement and the successful settlement improvement program of affordable housing in the 1980-1990s. Eco city programs were introduced in mid 2000s targeting local communities to develop sub-district level community-based planning for waste management as part of the community green and clean advocacy. Local communities targeted were mostly in the densely-populated urban areas and many of them were low-income, including residential housing complexes.

4.4 Community Acceptance of Resource Efficiency

The level of social acceptance is partly determined by community acceptance, a practical acceptance of new program within the targeted communities. The attitude toward resource efficiency, particularly on issues such as energy and water supply efficiency and waste management, is shaped by deep rooted cultural and ideological identities. It is also influenced by changing forms of information and advocacy. Reward and incentives from other local actors were also influential, including better outlook of general public opinion toward their living areas and neighborhood. For the waste management advocacy, it is the issue of NIMBY in the development of landfill. It is not necessarily close to the communities observed, but as the landfill serves the whole city the debates surrounds it affects the communities at large. Media, in particular, has a string influence on the community acceptance of resource efficiency as it sets emphasis on certain stories and link them with the ongoing supra-local and global movement on similar issues. This structures the public and community debate with perspectives and viewpoints.

We conducted a questionnaire survey on community acceptance of resource efficiency in Rusun Urip Sumoharjo and Rusun Grudo using the indicators listed in table 1 below to gather community perception. Our study found that the overall attitude over resource efficiency is tied to the social-economic factors of sustainable housing, including economic sustainability, accessibility and affordability. The better these factors are, the stronger community acceptance towards resource efficiency. Community satisfaction over their housing quality and quality of life also influences its acceptance towards resource efficiency. If they see exercising resource efficiency affect positively towards their housing quality and quality of life. The positive attitude towards community participation also significantly affect resource efficiency and the strength and coverage of resource efficiency initiatives being implemented in the housing sites.

The table below show the theme of resource efficiency and related community acceptance indicators used to collect the data through the questionnaires. A more detailed analysis using regression is currently being undertaken.

Theme	Type of community acceptance
Economic	Income generation
	Return investment
Accessibility	Accessibility
Affordability	Affordability of rent and utilities
	Quality of electricity
	Quality of water supply
	Overall affordability
Resource efficiency	Efficiency of electricity usage
	Efficiency of water usage
	Efficiency due to housing design
	Waste management
Housing quality	Design adaptability
	Quality of the sanitation
Well-being and neighborhood quality	Quality of the housing
	Quality of the housing amenities
	Quality of the housing environment
	Overall quality of life
Community participation	Community engagement and planning

Table 1: Survey indicators for community acceptance.

5. Conclusion

There are both similarities and differences between community acceptance over resource efficiency within the same urban jurisdiction as shown by Rusun Urip Sumoharjo and Rusun Grudo. On the other hand, the citizen participation possible in both cases was determined more by the leadership in each housing complexes and the socio-economic opportunities generated by different local factors than by the influence of supra-local and global dynamics. The local enabling factors in the community-based planning, however, were influenced by supra-local and urban dynamics as the city introduced new urban development approaches through its planning programs.

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Urban Living Lab: Towards more Legitimate and Inclusive Participation in Urban Planning? Experiences from Bodø Living Lab

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1. Introduction

In recent years, Urban Living Labs have been promoted by both practitioners and scholars around the world as a desirable approach for local governments to engage with different stakeholders and citizens in discussions about urban development. Urban Living Labs are both physical and virtual arenas, allowing the public to contribute to urban planning in various ways. Although carried out differently across different urban scales and contexts, key ideas in the concept of Urban Living Labs are public participation, deliberation and co-creation between different stakeholders.

The UN's sustainability goal on cities and communities has as one of its targets to, by 2030, "enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries". Cities account for three quarters of global carbon emissions, and to reach the goals in the Paris Climate Agreement, drastic steps are needed to be taken in urban planning. This requires the involvement and commitment of the urban population in ways reaching far beyond traditional public hearings and written statements to plans. Moreover, developing innovative solutions that address both climate adaptation and mitigation demand new ways of engaging the private and public sector as well as the citizens at large.

During the last decade, several Urban Living Labs have been set up in different Norwegian cities (Hvitsand and Richards, 2017). Ranging from various initiatives in the capital of Oslo, to medium sized cities as Hamar, Moss and Fredrikstad. Even small towns as Svelvik.
As pointed out by Hvitsand and Richards (2017), these initiatives seem to happen independent from each other, drawing on inspiration from abroad. Moreover, there is not a shared definition or understanding of what an Urban Living Lab is, rather, different adaptations to different urban contexts and challenges.

In this paper, we use Bodø Living Lab as a case to explore how such Urban Living Labs can contribute to secure and improve the legitimacy of urban planning in the face of climate change. We examine where the idea to establishing Bodø Living Lab came from and what the aim was envisioned to be. Further, we focus on how participation from diverse actors with interests in the future development of the city is enabled through the Living Lab and who participate in the Living Lab's activities. At the same time, we are interested in actors not participating in the physical and virtual Lab and the possible alternative voices and perspectives omitted through the processes. In this paper, we combine document studies, including social and traditional media coverage of the Living Lab, participatory observations from activities in the Living lab in Stormen library in Bodø and interviews with involved stakeholders.

The Bodø Living Lab is a project set up by the city, with an aim to look "at the whole society perspective in city development", and by this "to connect public health, education, welfare, environment, culture, governance, business development and technology development together", according to the city municipality's web page. The Lab was formally opened at the beginning of April 2018. The findings presented in this paper, thus, focus on the experiences from the establishing process and the initial phase of the Living Lab's activities. The field work was conducted from April to June 2018, and the analysis is therefore related to public participation and citizen engagement in and through the Bodø Living Lab's establishing phase.

In the next section, we present the theoretical framework and background of the growth in Urban Living Labs, before we give a background to Bodø and the establishment of the Urban Living Lab. We then go on to describing the methods used and the empirical material the analysis draws on. In the following section, we present the findings before discussing these in light of the goal to increase urban planning's legitimacy before ending the paper with some final reflections and recommendation for future development of Urban Living Labs.

2. Theoretical perspectives

While the concept of urban living labs is not clearly defined, there is a consensus that citizen and user involvement is central, and that innovation takes place as a result of bringing together complementary knowledge, skills and resources in real-life experimentation (Bergvall-Kåreborn et al., 2015). According to Mccormick and Hartmann (2017), urban living labs can be seen as both an arena (geographically or institutionally bound space) and as an approach for international collaboration between researchers, private business, citizens and local government.

While there is no unified definition of an urban living lab, the approach is based on the quadruple helix model of partnership “whereby government, industry, the public and academia work together to generate innovative solutions” (Voytenko et al. 2016:47). The focus on innovation in urban living labs is tightly connected to the concept of co-creation. This reasoning is in line with what Lund (2018: 12) describes in her discussion of co-creation in urban governance, as “shifting the focus of participatory processes and mobilisation strategies from power distribution to competencies; a result of moving the focus away from the right to influence towards the ability to identify and solve urban problems.”

Following the aim of this paper, a key concept in the analysis of the Urban Living Lab in Bodø’s city development, is legitimacy. It is a concept with strong normative connotations. The contested and constructed nature of legitimacy makes it challenging to derive ‘objective’ criteria for assessing the legitimacy of planning processes. Parkinson (2003) has argued that legitimacy cannot be fixed on a scale and that it should be approached as an ideal. Moug (2011: 130) has underlined that “Focusing on legitimacy cuts to the heart of power relations offering fresh insight into how context colors what is viewed as legitimate and how particular views and decisions prevail.”

Increased participation from non-governmental actors in formulating and implementing public policies makes authority and accountability unclear and Connelly et al. (2006) have argued that diffusion of authority requires a refocusing from the formal, explicit exercise of power, to a broader definition of policy-making processes to understand how legitimacy is constructed. They underlined that the vital question affecting stakeholders’ perception of legitimacy can no longer conform to the classical formulation of ‘…“do we accept this body as appropriate to make decisions that affect us?” Rather, it becomes “do we accept this process as an appropriate way to make policy – here, now?” – with the corollary “how seriously should we therefore treat its outcomes as a guide to our actions and decisions”’ (Connelly et al., 2006: 270). This underlines the importance of approaching legitimacy and accountability of collaborative governance arrangements broadly and not limiting this to formal institutional arrangements or legal frameworks.

We approach the concept of legitimacy through the distinction between input and output legitimacy (Scharpf, 1999), along the three dimensions of participation, coordination and accountability. Scharpf’s (1999) emphasis on input and output legitimacy have been particularly influential in studies of legitimacy and while input legitimacy rests on procedural logic and the policy process’s inclusiveness, fairness, and participatory qualities, output legitimacy focuses on the problemsolving capacity of the result and, thus, rests on consequential logic (Kronsell and Bäckstrand, 2010). Following Hogl et al. (2012), we identify three dimensions of legitimacy: participation, coordination and accountability. Using these three dimensions, our framework enables an analysis of how an urban living lab may contribute to the construction of legitimacy in urban planning.

Dimension of legitimacy	**Sources of legitimacy**	
	Input legitimacy	**Output legitimacy**
Participation	Who participates? What do they do/participate in/to? What happens with inputs? Access – when?	Awareness (smart and sustainable) Acceptance (living in/at a construction site) Compliance with policies (willingness to follow restrictive climate policies)
Coordination/collaboration	Communication across sectors (private, public, civil society)	Coherence Mobilize resources Shared vision/strategy
Accountability/democratic control	Transparency Open information flows Accessibility to information	Improved local democracy Improved trust between different actors – reciprocity Improved trust to the governance system

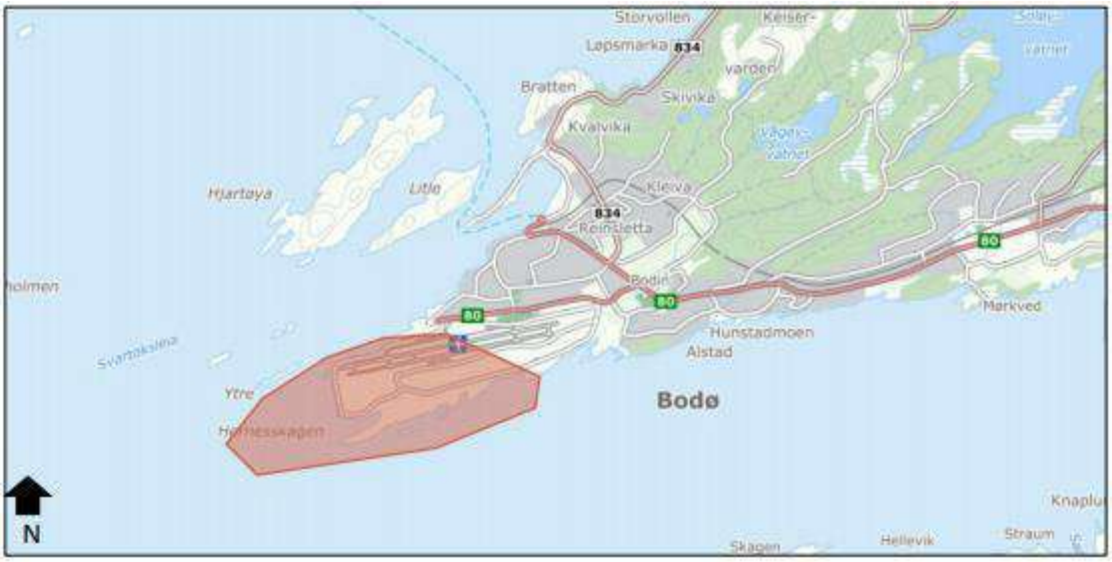
Table 1: Different sources and dimensions of legitimacy

3. **Context and case description**

Bodø is a city in Northern Norway, located on a peninsula facing the Norwegian Sea. The city was founded in 1816 and reached a population of roughly 4700 people hundred years later (Jakhelln, 2004: 16). In 2018 the population was about 50 000, and it is by this the second largest city in the northern part of the country (after Tromsø). As the capital of Nordland County, Bodø has few competitors as the main urban hub in the region, and while the rural areas of the county for the most parts have been seeing a decrease in population in the last years, Bodø is seeing an increase. The population is expected to reach around 60 000 by 2040, according to official estimates.[i]

A key driver for the growth of Bodø in the coming years, is expected to be related to the building of a new airport. In 2012 the Norwegian parliament decided to move the military airport from Bodø to another region further south. In connection with this, the civil airport, which is located right next to the city centre, will be moved 900 meters to the southeast. This will subsequently free areas roughly equal to today's city centre for future development. The municipality wants to use the freed area to build a "New City"[ii]. The area where the city wants to expand is indicated in the map in figure 1.

Figure 1 Area for Bodø's "New City"



Source: Planprogram områdeplan for ny sivil lufthavn i Bodø, Bodø kommune 2017

According to the municipality, the "New City" will be "the smartest city in the world"[iii]. Implicit in this vision, is that the urban development processes in Bodø will be both sustainable and climate friendly. As part of this "smart vision" the municipality has set up an Urban Living Lab called Bodø ByLab. As already noted, the aim of the Lab is to look "at the whole societal perspective in city development", and by this "to connect public health, education, welfare, environment, culture, governance, business development and technology development together", according to the city municipality's web page. The Lab itself is both a physical place located in the main library and a virtual place available online.

4. **Methods**

In this study, we use a single case study approach as described by Yin (1994). This has allowed for an in-depth exploration of the experiences from the initial phase of establishing the Urban Living Lab in the public library in Bodø. We combine qualitative interviews, with document studies and participatory observations from activities in the Urban Living Lab during the first few months after it opened in the beginning of April 2018.

Initially, we planned to use participatory observations from the Urban Living Lab at the library as the main empirical source in this study. We though that this would give us an opportunity to observe the interactions between municipal officials, developers, stakeholders and citizens coming to the Lab. Further, we hoped that that these meetings could provide a starting point for informal conversations with different actors interested in or involved in the development of the city. However, we experienced quickly by being present during the opening hours of the Lab (Tuesday to Thursday from 09.00 to 15.00) in the library, that there were few meetings or encounters between municipality representatives and the public. In total, we were present eight days (from one hour to full days), including the official opening of the Lab on April 5th. Some days, there would be no one from the municipality, while other days there would be no interactions. Organized events by the municipality in the Lab gave us, however, an opportunity to conduct participatory observations. This included a thematical meeting on universal design and public accessibility (May 24th). We developed a research diary from being present at the ULL, including notes from our observations of the physical environment, interactions in the ULL, presentations and discussions with people.

We conducted six semi-structured interviews with actors involved in the Urban Living Lab in Bodø, including public officials from Bodø municipality, both at the administrative and the political level. We also talked to people present at the Lab or at the public library. We developed an open interview guide, with questions focusing on the background and purpose of the Urban Living Lab, as well as experiences so far. This allowed us to explore different perceptions of how the Urban Living Lab enabled participation and/or contributed to legitimacy in urban planning. The interviews were analysed with a focus on the experiences from the establishing phase and expectations for the future.

In the document study we have included both official accounts from Bodø municipality about the Lab, presentation of the Lab on social media and in traditional media coverage. In total, the document study has involved twenty-some documents. The written material has provided us with an insight in to how the municipality justifies/presents the Lab in official documents and how the Lab is communicated to the public/citizens of Bodø through social media, primarily Facebook. The media review has contributed to understand the public debates surrounding the Lab and how urban development/urban planning is put more widely on the public/political agenda.

5. Findings:

Setting up the Lab

In different strategies and plans, Bodø municipality has over the years stated its intention of being an open and inclusive municipality. The intention is not the least clear in the municipal master plan, which points out main challenges and focal points of planning policy for the years to come. In the recently revised social element part of the municipal's master plan (spring 2018), co-creation is identified as the number one priority for the municipality. Co-creation is in the plan roughly defined as a process that will "facilitate new creative solutions, increased well-being, real involvement and meaning for the citizens" (Bodø kommune, 2018b: our translation). In the plan the municipality states that "municipalities that co-create with its citizens are better equipped to handle complex societal challenges." The solutions one choses "need legitimacy, and active participation is a prerequisite for this" (Bodø kommune, 2018b: our translation). One way of achieving this is to develop "new methods for citizen engagement and user involvement" (ibid.)

The urban living lab is emphasised as one method for achieving co-creation in planning documents and interviews. The idea of the setting up an urban living lab came from The Green Party (Guttormsen, 2015). In the political negotiations after the local election in 2015 the urban living lab ended up in the formal agreement between the governing coalition, as "an easily accessible branch of the planning office where citizens may familiarise themselves with and give input to the municipality's planning processes" (Bodø kommune, 2015).

The city council adopted the mandate for the Lab in February 2018. One of the reasons for establishing an urban living lab was to involve citizens in the many development projects in the city. The project mandate stressed the need to create arenas for participation that would promote creativity, engagement and a sense of community. Participation would also ease the implementation of policies (Bodø kommune, 2018a). The project mandate built on other strategies in the municipality highlighting the importance of involvement and co-creation between the local government and the citizens. The Lab was presented as a place to "test co-creation and participation in a real environment". According to the political document the Bodø ByLab concept would be the first of its kind amongst municipalities in Norway, and the Lab would be "breaking ground in its effort to become a more open and inclusive municipality that takes democracy and the role of the citizens seriously" (Bodø kommune, 2018a: our translation). The municipality had also a few years earlier tried to strengthen the local democracy by mapping the status of democracy in the municipality and suggest measures to strengthen participation from the citizens, in a so-called "democracy project" (Bodø kommune, 2014).

Prior to the opening of Bodø ByLab, the Lab was frequently mentioned in local media. In November 2017 the major local newspaper *Avisa Nordland* (AN) published an interview with the organisers (Landstad 2017). In December AN published an interview with the project leader of the Lab and the head of The Green Party in Bodø, who was also the leader of the planning committee in the municipality. Here the ByLab was presented to the readers as one of a kind under the heading “They want to make you and me city planners: – This has never quite been done before” (Gulliksen, 2017).

A month prior to the opening of the Lab the municipality and a research institute who had insight on the workings of other urban living labs around Europe, presented the concept of urban living labs generally and the Bodø ByLab to specially invited participants in a workshop. The participant list included civil servants from the municipality and the county municipality, developers, other stakeholders and researchers. In the workshop the living lab was tightly linked to the concept of *co-creation.* This was again contrasted with that of *participation,* which was defined as the formal and legal right citizens have to be heard in consultation processes, and which applies to all citizens. In the picture presented, the urban living lab, to be successful, should first and foremost be an arena for co-creation and stakeholder involvement.

According to the project description, the Lab would first go through a trial period. The municipality would then use the experiences from the test period when planning a permanent Lab in the new City Hall, which was under construction in 2018 (Bodø kommune, 2018a). Although a pilot, the opening day on 4 April 2018 had all the spectacle of an official opening, with the major cutting the ribbon, announcing the Lab opened. Several hundred people turned out for the opening. The Lab was part of the “Smart City” project in the municipality, and the opening was announced on the Facebook page with the following teaser: “On the opening of ByLab tomorrow at 10 am you will hear from amongst others some of the world’s foremost experts in smart cities, technology, digitalisation and innovation!”[iv]

Picture 2 Model of the city centre in Bodø ByLab

Following up

The Bodø ByLab was in the trial period located in the city’s main public library. The Lab was located on the library’s ground floor. The was no clear distinction between the Lab and the rest of the library. Tables often occupied by students and elderly people in the library, overlapped with the Lab. One of the markers of the Lab was a physical model a few meters wide visualising the city centre. There were also posters with the ByLab logo on them.

It was clear from the beginning that the Lab was a work of progress, and several items were added to the Lab during the first couple of months, including information posters, a projector and couches. Measures to more clearly contrast the Lab from the rest of the library, like carpets and plants, had proved difficult to put in place because it broke with the interior design of the library, according to an informant. The installation of a mail box where people could insert their ideas about urban planning and other issues, was under negotiation between the organisers and the library when we conducted the fieldwork. Bureaucratic slowness was explained as being one of the challenges of making an Urban Living Lab within the framework of a local administration.

The opening hours of the Lab were announced to be Tuesdays to Thursdays from 9 am to 3 pm. The fact that most events happened during daytime on workdays, might have put limits on who could attend, as this would require people to take time off from work to present themselves at the Lab at the public library. The opening hours also seemed to be a little off-target if the goal is to reach those who usually doesn't speak their voice. As several informants from the municipality told us, one of the groups that is hardest to reach in ordinary planning processes, are families with small children. As one informant from the municipality put it: "At public meetings there is a lot of grey hair. The category we want to reach the most are families with children. They are a little bit invisible in the big picture, but very engaged when it comes to their own neighbourhood." It would seem difficult to attract this group given the opening hours on daytime. As a project run by the municipality, it is of course challenges associated with adjusting the opening hours. This would necessarily demand that civil servants spent their evenings or weekends working, a measure that is likely to meet some obstacles in the well-organised working environment of Norwegian public sector.

As important as the opening hours is of course the content of the Lab itself. As the Bodø ByLab project was organised directly below the Municipal Chief Executive, with a goal to involve and give ownership to the Lab to different parts of the municipality, different departments of the municipality were given responsibility to host their own thematic days. One of the ideas of the Lab was that by putting municipal officials together in an open setting – in the public space like the library – this would spur creativity and interactions between officials and the public, but also across established bureaucratic barriers. During the first few months the Lab was therefore hosted by civil servants with their laptops, working with issues concerning planning, building, welfare, public health, children and adolescents and digitalisation, amongst others.

Some of these days consisted of presentations or demonstrations (of welfare technology, the municipality's new website, etc.), others were more loosely organised, with one or more civil servants making themselves available to the interested citizen. The Lab was also being used for different types of meetings, as it was conveniently located in the city centre. For instance, the standing committee of planning, industry and environment put its monthly committee meetings in the Lab to open it up to the public. There was also a Children's City Lab on a Saturday.

Picture 3 Meeting of the standing committee on planning, industry and environment in Bodø ByLab

During the time we were observing the Lab, the turnout from the public was low, with some exceptions. This impression was confirmed by the Lab hosts we talked to. They didn't seem too surprised by this, however. They had several thoughts on how to attract more people, including better marketing of the Lab, expanding the opening hours and making it clearer who the civil servants actually were, so they didn't blend in with the rest of the library visitors.

One of the more successful events, in terms of interest from the public, was when the local building authorities hosted the Lab. According to the reports, a total of 14 building applications were discussed that day. This shows an apparent need for small developers to meet with the authorities, something that the Lab offered an arena for. In this case the participants had their own private interest in turning up. It was more challenging to get people interested in regulation plans – which was the topic of one of the days the local planning authorities hosted the Lab. According to one informant, those stakeholders who had an interest in regulation processes, had already given their opinion in the consultation process. Another day the topic was development of the "New City" that will double the size of the central parts of Bodø. This is a long-term development project with at least a fifty-year perspective. This also proved to be a challenging topic to sell to the public, with few people appearing at the Lab.

Despite that there clearly were some challenges in the establishing stage, everyone we spoke to in the municipality were eager to keep the laboratory going. They all agreed that the Lab was a useful initiative to get people interested in local affairs. A common theme among the urban planners we spoke to was that the municipality needed to do *something else* than what it was already doing to reach and involve the citizens. It was stressed that a lot of people were likely to have an interest in urban development, but it was a challenge to get them to participate.

Picture 4 The municipality lends it ear to the citizens: "You are the expert. We listen."

From our observations and interviews, strengthening the communication about what Bodø

ByLab is, seemed to be a key issue. According to one informant, the marketing of the Lab should strive to be less "municipal" – meaning it should less resemble what usually comes from official channels. The main marketing and information channel of the Lab was its official Facebook page. The Lab also had its own website – the "virtual" part of the Lab – as well as an account on Instagram. These channels however lacked much in content and seemed to generate little attention in the first couple of months. The Facebook page contained for most parts information about coming events at the Lab and pictures of prior events. There was little response on the Facebook page from people outside the municipality, indicating that this first and foremost functioned as an information channel. Like the Facebook page, the Bodø ByLab website also demanded that the visitor created an online user to comment or "like" different posts on the site. There were some instances of input from the people outside the municipality on the website. One of these welcomed the Bodø ByLab initiative and asked for more information on the website about different development projects, before he could give input and participate.

6. Discussion:

In this paper we ask if an urban living lab is a viable method for making urban planning processes more legitimate. We have presented the Bodø ByLab as a case of an urban living lab in its initial stage, focusing on how this lab was initiated and justified, how it was marketed, what happened in the lab the first few months and who participated.

First it should be noted that Bodø ByLab was more than a laboratory for urban planning. Although that was where the idea of the Lab started – that is should be a branch of the local planning authority's office, – in the first months it was a potpourri of different municipal initiatives. One way of interpreting this is to say that urban development was broadly defined by the municipality. As one of our informants told us: urban development is about much more than making regulation plans. This way of thinking was clear with the inclusion of for instance the health and welfare sectors, and this may be an effort from the municipality to create awareness both inside its own organisation and among the citizens that urban development concerns many more than those who are usually involved in consultation processes and so on. One more pragmatic way to look at this, is that to fill three days a week with content, a broad understanding of urban development was necessary.

The Lab was marketed as an arena for testing ground-breaking new methods for citizen participation in urban development. In one way, this marketing strategy is understandable, given the need to “break through the noise” in the information age, and to get the necessary attention before opening. It seemed to have worked as a lead up to the opening day, when hundreds of guests appeared. The contrast to what took place in the Lab after opening day, is on the other hand striking. It was difficult to see the ground-breaking elements and turnout from the public was disappointingly low. This is one of the risks of making high promises.

From the viewpoint of urban planning, rather than being an alternative to traditional planning processes or offering something completely new, the Lab can be seen a supplement. The thought was that by being present at the Lab, civil servants from the planning authorities would engage in conversations and receive input from the citizens in matters concerning urban development – together they would “co-create” the new city. For this to work, some adjustments seem necessary. The planners in the municipality knew a great deal about what the challenges were, and this knowledge could be used in the design of the Lab. For instance, if one of the challenges in urban planning processes is connecting to families, the Lab could be used to target this challenge more precisely. This requires a close collaboration between the organisers and the planning professionals.

Looking beyond the “ground-breaking” rhetoric and the start-up problems, Bodø ByLab may be a way to open public policy processes, or “demystify the municipality” as one of our informants called it. Moreover, using Facebook as the main channel of information sharing could be problematic in a legitimacy perspective, as it excludes some groups who are not "logged in".

One challenge that was mentioned several times by the organisers, was the strong “municipal grip” on the Lab. This concerned both practicalities of setting up the Lab within a bureaucratic system, but more important for our discussion of legitimacy, is the possible exclusion of other actors that this might lead to, whether this is developers, private actors or organisations. Even though several factors might explain the low turnout in the first period, like the lack of knowledge about the Lab among the public, there is a risk that the Lab was perceived as just another channel for information from the municipality. This is in some sense true; part of the content of the Lab was in large degree information from the municipality and had little to do with engaging or interacting with citizens.

7. Concluding remarks:

Bodø ByLab was established against the backdrop of large development plans in the city of Bodø, and a realisation amongst decision makers that this called for a greater deal of involvement from the public. There was, in other words, a need to secure the legitimacy of the development processes. As we have shown in this paper, some challenges stood in the way of making the Lab an immediate success in the establishment phase. This included practical as well as more content specific obstacles. Based on our findings, we would argue for making some adjustments, and have the following suggestions:

- The organisers should ask themselves who they want to involve in the specific events and target these groups more directly. What kind of input the municipality wants from the public could also be specified.
- If the Lab is to be a successful method for more legitimate urban planning, a close collaboration between the planning professionals and the organisers of the Lab seems necessary.

- As several of our informants pointed out, people are more likely to get involved in matters concerning them, so perhaps more locally specific events could be a way to attract people.
- A more clearly defined Lab, with more visual elements, maps and so on, might be a good way to create engagement and interest concerning urban development amongst the public.
- A way for people to interact with the municipality, give input and so on without the need to talk to official representatives, might lower the threshold to participate in the Lab.
- The marketing of the Lab, including the communications platforms, could be opened to a bigger public. To create more attention about the Lab, a collaboration with local news media might be effective. This proved to be a good strategy in another small city not far from Bodø, who wanted attention about urban development.

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Gaming simulation as policy planning tool in a racially diverse neighborhood: a case study of Lardproaw district, Bangkok

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The researcher implemented Gaming Simulation as a method to assess the awareness toward climate change and the perception regarding the collaboration for local policy development from different local racial groups which include Thais, South East Asians, Europeans, etc. Ultimately, we recommend the progressive approach for elevated local community-based planning.

1. Background

Local community policy planning has never been an easy issue, most of the time the policy was generalized for the whole country or at best for the provincial level. Unfortunately, they will be the first actor that are going to face the adverse effects of climate change, in the decade to come the local ability to tackle with emerging issues of resiliency, immigration, diversity and inclusiveness will be extremely crucial. Presently, the district of Lardproaw is facing the impacts of ASEAN Economic Community (AEC) that was initiated in the year 2015 to promote the movement of people in 10 South East Asian countries. Unfortunately, in his research Huyakorn also learned that “In Thailand, the majority of Thai people still refer the low-skilled migrant worker as an “alien resident” instead of immigrant and as such, they have been regarded as so-called alien residents. It has been extremely difficult for them to find a place in the community”. (Huyakorn et al., 2018). And due to that, there have been growing tensions among the local residents and the newcomers in several neighborhoods. Consequently, as Thai local planning authorities neither familiar with the context of climate change nor the immigrant integration, we direly need a novel tool to creatively deal with this unaccustomed local phenomenon.

Interestingly, this research utilized the Gaming Simulation (GS) as a primary tool, due to its efficacy in both complex learning and risk communication tool, in the view of different scholars, GS allows participants to develop a global perspective, to connect learning with real-world situations and to get close to the realities of a complex world (Duke, 1974; Faria & Dickinson, 1994; Haapasalo & Hyvonen, 2001; Hoberman & Mailick, 1992; Lainema & Hilmola, 2005).

In term of risk communication tool, Promsaka and his team have found that “the gaming simulation offers representatives of stakeholders the opportunity to meet each other, discuss and exchange their different information and opinions on a specific issue, which enable a fruitful communication avoiding a risky judgment on wrong terms” (Promsaka et al., 2014).

More importantly, Huyakorn found out that in GS is truly useful for the neighborhood that has the complex relationship among diverse group of resident “It seems to have an extremely elevated potential for urban planning and design context wherewith. Regardless, in this new era of diversity, several nations will require collective policy planning in the local community level. Neighborhood planning is the best arena that urban policymaker and immigrant integration initiator should start implementing this tool” (Huyakorn & Rizzi, 2017).

The Arrival City Game was introduced to research participants, aiming at the local stakeholders that include natives and immigrants, while the participants have to accommodate the complicated issue about immigration, particularly the fact that in the GS the local and newcomer have to compete for jobs, house and other utilities. According to the role in the game, their action would affect not only the district but also the citywide and nationwide area, i.e. the investor could decide to invest in an old type of factory plant, the government can invest in costlier but more sustainable public transport. Hoping that we can comprehend how the racial difference affect their understanding and wherewith a solution for better collaboration and contribution toward local planning policy from different groups of stakeholder.

Accordingly, the research objectives are 1) to assess the local community awareness toward climate change, 2) to assess the local community perception about the collaborative local policy planning that have impact on the citywide area and 3) to propose appropriate policy recommendations for the local community-based planning efforts.

2. Research methodology

In order to assess the local community awareness toward climate change we observed their actions and decision during the game. And we let them do the pretest and posttest questionnaire. Firstly, we let them list the causes of climate change, the impact of climate change and then we let them assess from 1. Strongly disagree, 2. Disagree, 3. Neutral, 4. Agree and 5. Strongly agree about these 5 statements,

1. Giving the chance I will join the participatory planning event
2. Climate change is a problem for everyone
3. Climate change impacts effect my life
4. I am willing to contribute to climate change reduction and mitigation
5. Urban planning relates to climate change issues.

As per the local community perception about the collaborative local policy planning that have impact on the citywide area we observed the participant during the game activity and we also did a focus group interview activity to collect the data. The essential discussion topics were about the GS activity, participatory planning issue in Thailand and in the neighborhood.

The neighborhood we implemented the game in was within Lardproaw district. Due to lower average rent compare to other district that is connected with decent public transport, it becomes easier and easier to see the foreign faces in the area. While the national statistic institution is still too rigid and slow to collect the data about immigrant residents we have learned that beside the low-skilled migrant that you can easily find in other neighborhood, there are a huge number of immigrant residents who have moved in to the area. Some of them even live in Lardproaw for more than 25 years.

The date of the game activity was on the 20th Mar 2018, the planning activity was on the 30th May 2018 and also the follow up interview on the 13th July 2018. The main languages of the activities are English and Thai. There were 50 locals and 50 migrants who took part in our research. We tried to have as diverse as possible group of samples for the research through snowball method. Our research samples include people of 15 countries, who identify their ethnicity as: Thai, Chinese, Japanese, British, American, German, Russian, Taiwanese, Indian, Mexican, Australian, Burmese, Lao, and Cambodian. The largest ethnic groups among the immigrants are Burmese. Interviewees' duration of stay in the neighborhood varies from a few weeks, months, a couple of years, to several decades. The longest consecutive durations of stay in the neighborhood are 25, 20,16 and 15 years.

There are 60 women and 40 men. Most samples are between 31-45 years of age. The second largest age group is 46-60 years old. We have also people aged 18-30 and over 60. The youngest four samples are 18, 21 and 25 years old, while the eldest three are 65, 67 and 70. The group contains the person who live by themselves, couples, single-parents, couples with children, a multigenerational family, and people who live in a form of shared housing (e.g. shared house with relative). The largest groups of interviewees live alone, have a partner and children, or are single parents with children.

Furthermore, in terms of the socio-economic status (SES) of the samples, referring to income and education levels and type of occupation, there are extremely diverse but the majority is in a lower-middle or middle SES and at least high-school degree. Nevertheless, these attributes are not the main consideration for this research as we focus more on the racial difference context. we randomly assigned them to 5 groups of 20 people (10 immigrants, 10 native resident) then in each group they formed a team of 5 people (must include both immigrant and native) to play for 4 roles of the game. The game session took up to 2 hours for each group.

3. Arrival city game

Arrival city game implement this mechanism for the simulated situation; 1. The immigrants are motivated by the job and quality of living, and then they migrate to the city (Arrival city), resulting in 2. The lack of urban resources/ utilities such as healthcare, police, electric power, then the player need to 3. Use land use management as a main tool to try to plan the land use policy, develop the infrastructure and control the vulnerability and lastly, 4. There will be a chance for every player to take part in mayoral election. (Refer to figure 1)

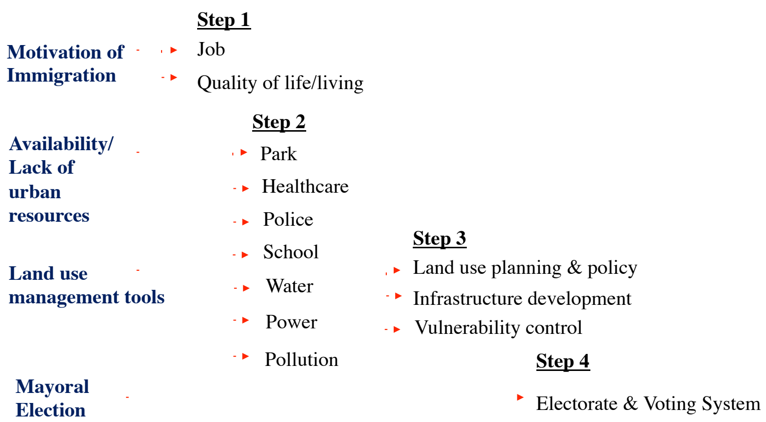


Figure 1: Processing mechanism

The game is a square-shape board with the circular-shape town center in the middle, the land lots are owned by both the public sector (in this case government) and private sector (investor). All the players will take part in managing the land; for their income, for their house, and for their livelihood. Accordingly, as illustrated in figure 2, all the players from the 4 different roles of immigrant, resident, investor, and government have to contribute to the development of the city (Arrival City). The government is the main decision maker of the city policy and land management, the investor is the job contributor in the city as well as developer of the land, lastly, the resident and immigrant are compelled to compete for the jobs and the accommodations.

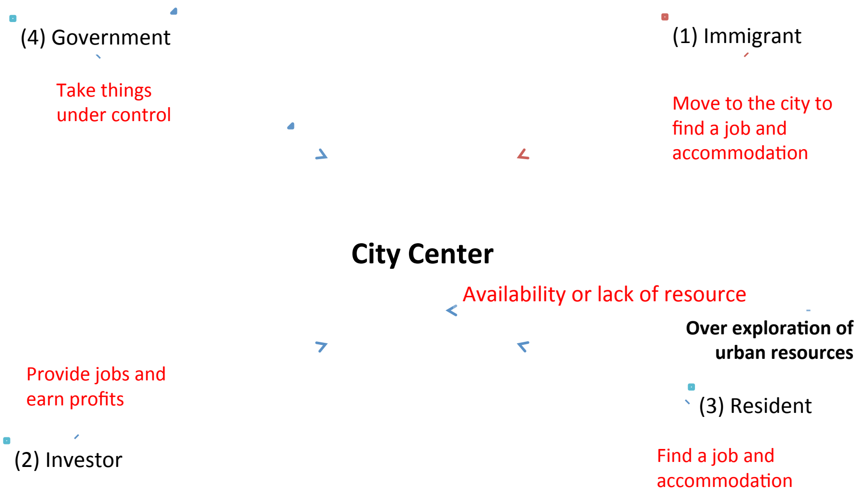


Figure 2: The simulated model.

After all the players complete their action according to their roles, all four teams are obliged to participate in city planning, which they must try to find solutions for Arrival City. Each turn becomes increasingly challenging as bigger waves of immigrants continue to come into the city that could cause additional problems and disruption to Arrival City.

The figure below is the example of the option cards. As the players are not experts in the field of planning, in the game we provide option cards for them to help them make decisions. For example, the government team can choose to provide incentives to the investor, adjust the property tax, or evict the illegal settlement. Not only that, the role of government is quite complex and they have to examine about a number of issues compare to others, the government role has access to the Excel sheets that provide detailed information of the situation of Arrival City and simulated index and graph such as the consumption, crime index, city vulnerabilities, etc.

Figure 3: Example of option cards for the player.

Throughout the game, it will become harder and harder for the player if they just work alone without considering the impact of their actions, they need to learn to work with each other, and eventually realize that they can also live and work with immigrants, wherewith they understand the role of immigrant in an urban system. They will also learn about the reality of urban planning impact on the climate change issue. Especially, the mode of transportation, the type of infrastructure and land use management. (See figure 4)

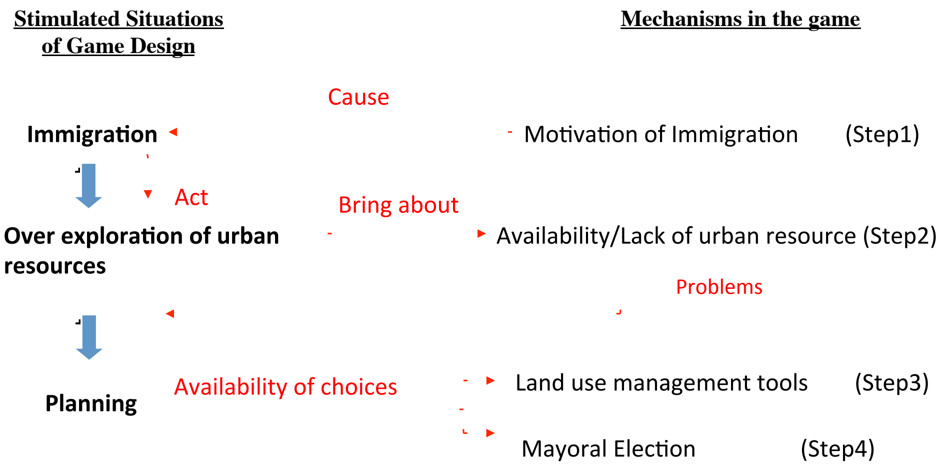


Figure 4: Game mechanism

4. The result of gaming simulation activities

The results indicated that the majority of the research participants aware of the climate change problem, however, they prioritize their current livelihood, income security and housing first. Noticeably, the group from developed countries chose their actions more consciously if it concerns the issue of climate change. While, the natives are more familiar with the local planning processes, the immigrants seem to be more enthusiastic and eager to participate in the activity.

Importantly, as there was a huge gap between the immigrant and native resident samples' perception, we are convinced that it is necessary to show three different figures, which elaborate three sets of sample group as follow, figure 5 shows all 100 samples, figure 6 represents the pre and posttest results of immigrant group perception toward diversity and figure 7 shows pre and posttest results of native resident perception toward diversity.

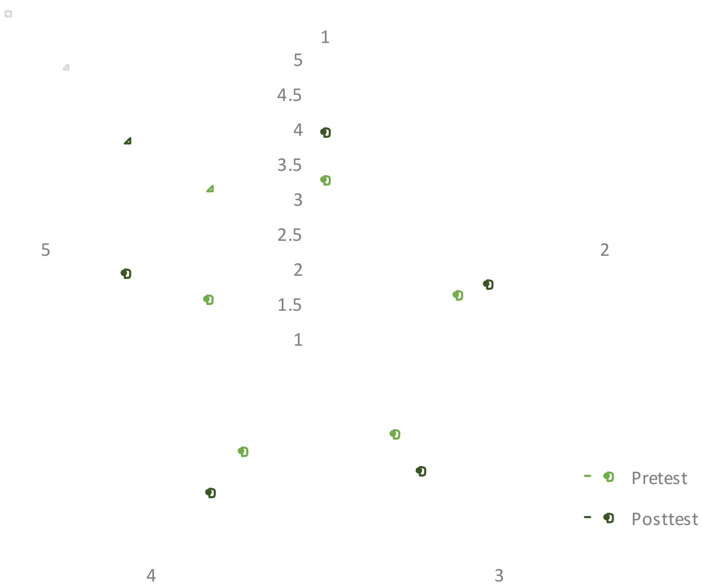


Figure 5: Pre and post test results of resident climate change awareness (N=100)

Overall, all the 5 categories are in neutral level (3.3, 3.0, 2.7, 3.0, 2.8 respectively) which "Climate change impacts effect my life" and "Urban planning relates to climate change issues." were among the lowest. After the game, there were apparent changes in all categories (4.0, 3.5, 3.4, 3.8, 4.0 respectively). They all agreed that "Giving the chance I will join the participatory planning event", "Climate change is a problem for everyone", "I am willing to contribute to climate change reduction and mitigation" and "Urban planning relates to climate change issues", while they still remained neutral about climate change impacts effect my life. (see figure 5)

As figure 6 shows, the Thai resident seems to have lower awareness about climate change situation as the pretest reflexed that they disagree that climate change impacts effect my life (2.3) and urban planning relates to climate change issues (2.2) while "Giving the chance I will join the participatory planning event", "Climate change is a problem for everyone" and "I am willing to contribute to climate change reduction and mitigation" are in neutral. (2.9, 2.5, and 2.5). After they played the game they agreed with statement 1,4 and 5 (3.7, 3.6 and, 4.0), statement 2 and 3 still remained in neutral level (both 3.1).

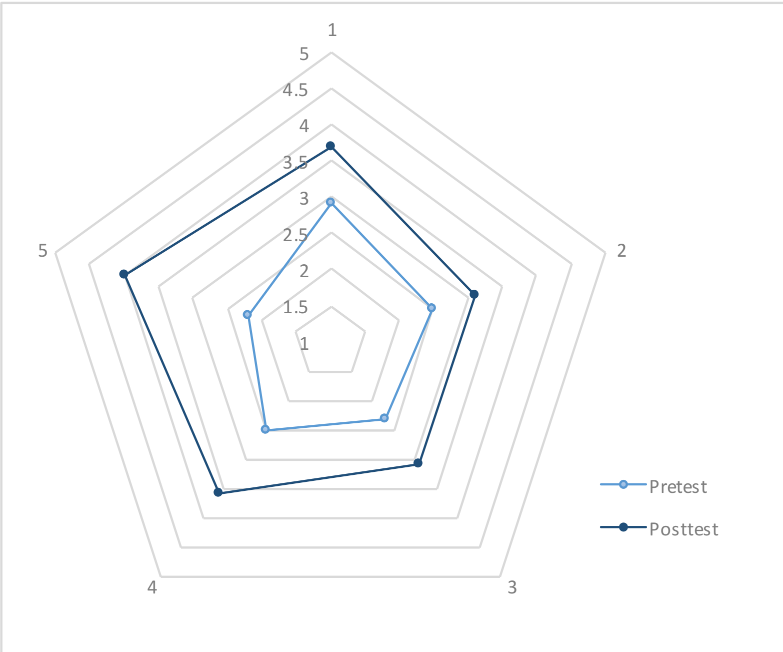


Figure 6: Pre and post test results of native resident climate change awareness (N=50)

Howbeit, for the immigrant residents they seem to have more elevated awareness about climate change as they wanted to participated in the planning process (3.6), they also think that climate change is a problem for everyone and they are willing to contribute to climate change reduction and mitigation both (3.5). However, the statement regarding "Climate change impacts effect my life" (3.1) and "Urban planning relates to climate change issues" (3.3) were in neutral. Eventually they came to agree with all statement as there were improvements in each category (4.2, 3.8, 3.6, 3.9, 4.0 respectively).

In term of causes and impacts of climate change, before the game they could just list around 2-3 causes and impacts of climate change. But after the game they could list around 6-7 answers. This was forasmuch the opportunity during the game which they can learn about the phenomenon as well as the interaction and exchange of ideas, case studies during the game and essentially in the planning activity.

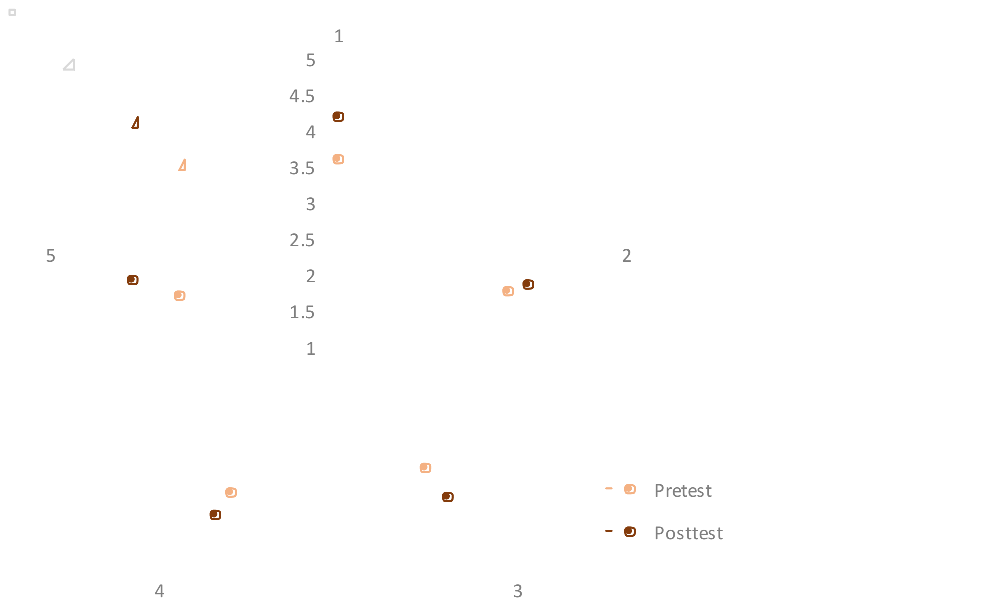
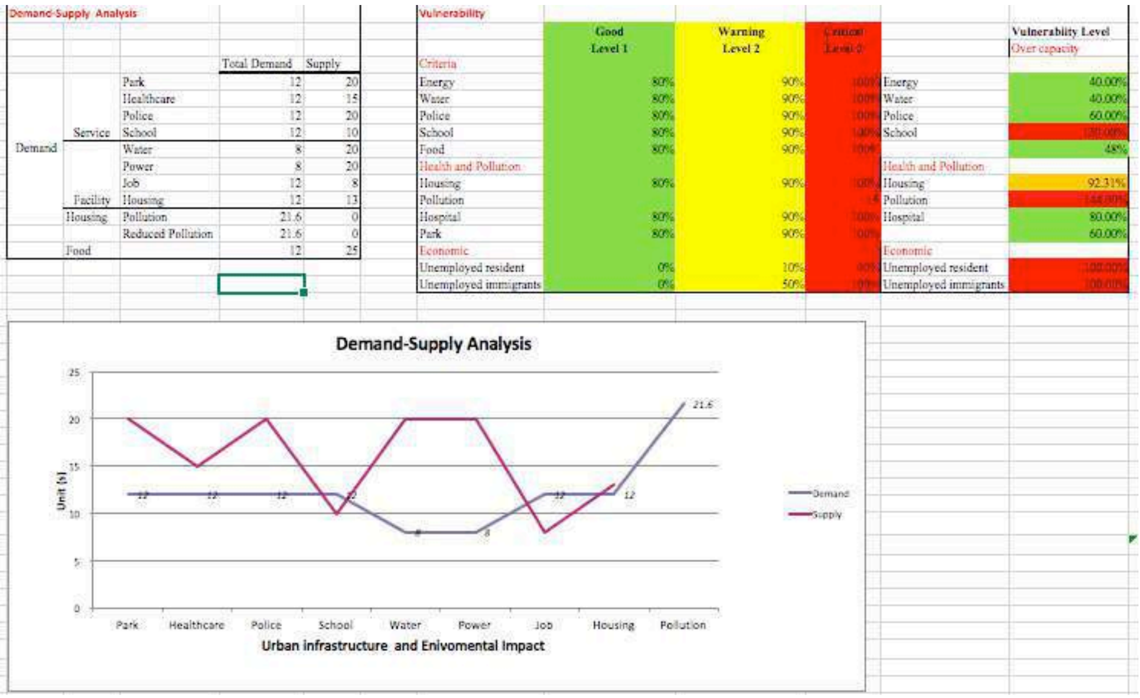


Figure 7: Pre and post test results of immigrant climate change awareness (N=50)


Demand-Supply Analysis

			Total Demand	Supply
Demand	Service	Park	12	20
		Healthcare	12	15
		Police	12	20
		School	12	10
	Facility	Water	8	20
		Power	8	20
		Job	12	8
		Housing	12	13
	Housing	Pollution	21.6	0
		Reduced Pollution	21.6	0
	Food		12	25

Vulnerability

Criteria	Good Level 1	Warning Level 2	[illegible]		Vulnerability Level Over capacity
Energy	80%	90%	100%	Energy	40.00%
Water	80%	90%	100%	Water	40.00%
Police	80%	90%	100%	Police	60.00%
School	80%	90%	[illegible]	School	[illegible]
Food	80%	90%	100%		48%
Health and Pollution				Health and Pollution	
Housing	80%	90%	100%	Housing	92.31%
Pollution			[illegible]	Pollution	[illegible]
Hospital	80%	90%	100%	Hospital	80.00%
Park	80%	90%	100%		60.00%
Economic				Economic	
Unemployed resident	0%	10%	[illegible]	Unemployed resident	[illegible]
Unemployed immigrants	0%	50%	[illegible]	Unemployed immigrants	[illegible]

Figure 8: In-game excel sheet

Principally, in all of the 5 groups that we played the game with, in general they had similar result during the game. In the first phase they only focused in making profit and competed with other teams in order to try to win the game. The Arrival city could function for some time but eventually there will be an abruption such as over demand, high rate of crime, unemployment rate, pollution problem and disaster situation as you can see from this example (figure 8). Consequently, when they all had to face with the crisis, they started to realized that while they prioritized the short-term need and individual benefit they can make do for a certain period of time. But ultimately, the world (in this case Arrival city) will face with several problems, some of those relate to climate change. Then all the 5 groups showed a change in mindset and the way they played the game, all of the team in each group acted as they need to work and rely on each other. The government teams communicated more before making decision. The resident and migrant teams tried to work together, while the investor teams contributed more to the city.

If we take a look deeper within the team member and group composition, Japanese, British, American, German, Russian, Taiwanese and Australian participants concerned more about green infrastructure, public transport and alternative energy resources. The German, American and Australian are in particular more willing to collaborate with other players, while Chinese, Russian, Cambodian are the three groups that seem to be less cooperative. And it was not a surprise that Thai are the most sensitive to immigrant role but some of the British, American and German also voiced their concerns toward low-skilled migrant worker.

Seeing the positive result of gaming simulation activity, we asked all the participant to come again to do the neighborhood planning policy development by themselves with the help from our team and local experts. Not only that they demonstrated better understanding, more expression and connection between ideas and several climate change related issue. They could come up with a considerable number of policy recommendations for their neighborhood to tackle with climate change issue. The notable policies are as follow,

1. The urgent need in the neighborhood master plan development in all the local area.
2. Improvement on the infrastructure that connect between mode of public transportation as well as origin and destination. Because it is not walkable enough people still need to use other paratransit mode (motorbike taxi) to connect between nodes of public transport.
3. Several small and medium size park are needed.
4. More incentive and compensation to motivate people to do positive behavior.
5. Alternative public space that focus on socio-cultural activity such as museum, art gallery and library.
6. Higher parking fee, and policy that discourage people to use car, i.e. CBD entering fee, zoning pass, odd and even driving plate permit.
7. Standardized and improvement to local school and kinder garden so that parent can just send their children to the local school.
8. Better management of the water resource, in particular the improvement to waste water treatment, sewage as well as the revitalization of canal and river.

The following are some of the interesting interview answers that we need to quote. The Thai participant want to work more with other and contribute more to urban planning and climate change reduction but they still criticized the current urban planning system in Thailand "We must plan in advance, government must be proactive and we need to start to consider about the immigrant resident if we still want to support AEC. Well I still feel that urban planning may not contribute that much due to the limitation in our planning law and regulation" (R4, M, 32, Native resident) "we love to work together more if we are allowed and supported, bringing new ideas is a beautiful matter, in particular the cases from developed country, but I do not think our government will allow the foreigner to take part in Thai urban planning" (R13, F, 29, Native resident), While the immigrant participant showed that they want to work more with other and contributed somehow to planning. "In my home country participation is a must and it is easy to join but I never join the activity in Thailand, I am not sure that we can." (R67, F, 45, German). "Well as I may not be so fluent in speaking Thai, in order for a successful planning event, we need a medium to share and help bridging people as well as communicate in the language that everyone understand" (51, F, 33, Mexican) and "local planning is the basic of everything in Japan, people can make change through this opportunity for participation" (R87, M, 50, Japanese).

5. Discussion and recommendations

Correspondingly, from the result we can supplement our finding to the past research that utilized GS as the tool for the planning to implement in the neighborhood which is experiencing the dynamic of population movement. "The game shows a very good potential as an education tool for immigrant integration and neighborhood co-existing diversity. Players also learn about land use planning and its relation with the immigrant phenomenon. It has proved to be a very attractive tool for urban planners, to use as a tool to teach people about land use management planning" (Huyakorn et al., 2018). But not only that, judging from this research experiment results, the Arrival city game is also an excellent planning tool in the context of participation and climate change problem.

We have unearthed the essential pronouncement that GS is exceptionally appropriate to be the tool in the arena of immigrant integration as it could stimulate progressive dialogue between the local and the migrant populations that result in a rewarding partnership afterward.

In essence, the key attributes of GS are the simulated events, action and reaction as well as the ability to bypass time. And these lead to the in-game experience that the player can learn about the consequent of action. We believe that this is extremely important when you want to campaign for climate change.

Taking the research finding in mind, hopefully with further improvement the GS can become the novel toolkit for other neighborhoods in AEC region respectively. More investigation on the actions and roles that were taken during the Arrival city game should be triangulated with other factor such as the participant attribute, period of stay and the impact of participant background, in order for us to understand better this complex situation. Importantly, with this new local reality of diversify neighborhood and ongoing changes of population, we can rely on the GS to be the tool that help the local planner communicate more progressively with both the resident and the immigrant population. Wherewith, it is proved again to be an effective participatory planning tool for extensive group of stakeholders.

Endnotes

1. Regarding Thai urban planning regulation, it still limited to land use planning but it does not include several aspects such as public transportation, local grid, compensation and advance incentive scheme, etc.
2. Thai urban planning participation processes have been mainly focus on public hearing to just present the result of land use plan.

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Embedding energy user's behaviour into multi-criteria analysis: providing scenarios to policy-makers to design effective renovation strategies of the housing stock

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Abstract

Nowadays, policy-makers are facing the challenge to design and implement effective housing renovation strategies both for the public and the private housing stock, able to support not only the technical and physical renovation, but also a change of paradigm in energy consumption. Indeed, energy transition takes place on a local level and needs to involve individuals. The importance of tackling behaviour change to improve energy efficiency, especially in case of building retrofit, is increasingly recognised, as well as the urgency to combine the renovation of the housing stock with informative and feedback strategies, in order to reduce the gap between expected and actual energy consumption. The paper presents a methodology based on multi-criteria assessment of different strategies, aiming at providing support to policy-makers for their decisions concerning the reduction of energy consumption in buildings. The methodology has been designed to explicitly incorporate the impact of user's behaviour into the planning strategies and renovation measures to be assessed. Through the development of a multi-criteria analysis based on the Analytic Hierarchy Process (AHP), this study demonstrates that, to increase the sustainability of cities and communities, a holistic approach is required, and considerations on citizens' behaviour need to be embedded into energy renovation policies to address energy reduction targets.

Keywords: energy behaviour; renovation strategies; housing stock.

1. Introduction

Nowadays, urban environment is considered to be a key player in addressing climate change. The inclusion of energy considerations into the planning process has grown the awareness that spatial and urban planning can be the strategic framework where both mitigation and adaptation measures are positioned in the broader perspective of sustainable development.
The EU building sector is the largest single energy consumer in Europe. While the efficiency of new buildings has steadily improved over time, most of European existing building stock has yet to be affected by energy performance requirements. In fact, in most EU countries, half of the residential stock was built before 1970, prior to the first thermal regulations. Buildings in EU are responsible for approximately 40% of energy consumption and 36% of CO_2 emissions. Currently, about 35% of the buildings are over 50 years old and almost 75% of the building stock is energy inefficient, while only 0.4-1.2% of the building stock is renovated each year, depending on the country. Therefore, the increase of the renovation extent of existing buildings has the potential to lead to significant energy savings and the residential

sector is the one which offers the greatest potential. Improving the energy efficiency of buildings can also generate other economic, social and environmental benefits. Better performing buildings provide higher levels of comfort, wellbeing and health for their occupants. It also has a major impact on the affordability of housing and on energy poverty, a growing phenomenon since 2008, with 12.8% of the population reporting inadequately heated homes across EU, which rises to 20.0% by considering the ten Central and Eastern European member states (EU10), and 16.6% for the eight EU countries that border the Mediterranean Sea (Bouzarovski, 2014). The European Commission has recognised the importance of buildings performance in the effort to mitigate climate change, and has set regulations to help promoting the use of smart technology in buildings, to streamline existing rules and accelerate buildings renovation. While the Energy Performance of Buildings Directive (EPBD) has set minimum energy performance requirements for all buildings that undergo major renovation (European Commission, 2010), Article 5 of the Energy Efficiency Directive (EED) has set a binding renovation target for public buildings and imposed related obligations, stressing that public authorities, especially governments, shall undertake an exemplary role in the energy retrofit of public buildings (European Commission, 2012). The revision of the EPBD, just entered into force on the beginning of July 2018, aims at accelerating the cost-effective renovation of existing buildings and promoting smart-ready systems and digital solutions in the built environment, therefore providing consumers with more accurate information about their consumption patterns (European Commission, 2018). However, researches have started questioning the effectiveness of retrofitting policies, since they are mainly based on theoretical assumptions (Galvin, 2014) and do not accommodate user energy practices (Gram-Hanssen et al., 2018). In order to achieve real energy reduction, policy instruments need to include considerations on the actual use of buildings rather the theoretical consumption (Visscher et al., 2016).

In this context, the paper presents a methodology based on multi-criteria assessment of different strategies by applying the Analytic Hierarchy Process (AHP), aiming at providing support to policy-makers for their decisions concerning the reduction of energy consumption in buildings. The methodology has been designed to explicitly incorporate the impact of user's behaviour into the assessment of planning strategies and renovation measures. In Section 2 , previous research is presented. Section 3 explains the adopted methodology, the main steps of the AHP, and the selected measures, criteria and scenarios. The alternatives that are more dependent from behaviour are identified, and the way to tackle this uncertainty in the pairwise comparisons is presented. The findings are discussed in Section 4, where the possible steps to unlock the energy saving potential of buildings are presented. In Section 5, conclusions and limitations are shown, and policy implications are drawn.

2. State of the art

On the one hand, the design of energy efficient buildings does not necessarily result in low energy consumption (Stevenson, Leaman, 2010; Guerra-Santin, Itard, 2010; Gupta, Chandiwala, 2010). Whenever the buildings are designed to be energy efficient, it is up to occupants decide how to use them (Gupta, Chandiwala, 2010; Janda, 2011; Feng et al., 2016; Santangelo et al., 2018), introducing a consistent uncertainty on the level of energy savings, very often resulting in a gap between expected and actual energy consumption.

Despite the central role of users to lower energy consumption has been increasingly recognised, more recently in regulatory frameworks and earlier in research field, evidence from research has showed that so far households have not been sufficiently motivated or

supported in undertaking changes, and they are still not enough aware of the impact of their lifestyles and decisions on energy consumption.
On the other hand, public administrations have still to find ways to face the lack of public resources and increase the renovation rate of their building stock. They have so far failed in leading the renovation process on public buildings, while the property fragmentation represents a limit to the implementation of renovation strategies in the private housing sector.
Some past studies show multi-criteria analysis as a powerful tool to identify priorities for energy efficiency measures. A study conducted in Dortmund analysing energy efficiency measures in public buildings (März et al., 2011) has shown as Multi-Criteria Analysis (MCA) can simplify complex situations when it comes to allow decision-makers to include a full range of social, environmental, technical and economic criteria to their decision on measures to be implemented to unlock the energy saving potential of buildings. The results highlight which energy efficiency measures should be implemented to achieve the greatest benefit for the city, resulting in a ranking list of measures and recommended solutions. A similar research has been performed in Italy by considering the Sustainable Energy Action Plan of the city of Melzo (Dall'O' et al, 2013). Results have demonstrated how considering only the economic approach to make decisions on the renovation of buildings leads to results that do not take into consideration the most important objective of the cities – to increase the sustainability of the whole community. However, in both studies, the considered renovation strategies have not explicitly incorporated initiatives addressing user's behaviour among the recommended solutions to be implemented to effectively reduce energy consumption in the housing sector, both prior and after renovation. Without considering energy behaviour has a key factor for the success of strategies addressing buildings renovation, the expected energy savings have been demonstrated to be misleading, and the impact of such measures overestimated.
Policy instruments at different levels (i.e. EU, national, regional and local) are struggling to encourage decision-makers to include information to occupants as a prerequisite to implement effective energy renovation strategies of the housing stock. Measures to promote efficient behaviour can be divided in two groups, psychological strategies and structural strategies (Steg, 2008). While the former (e.g. education, information) are aimed at influencing directly the user, the latter (e.g. new appliances, infrastructures, services) are aimed at changing the context in which decisions are made, to increase the energy saving attractiveness. Policy instruments are responsible to translate these strategies into practices. Four main categories of policy instruments can be identified: information, economic, administrative and physical (Linden et al., 2006). Focusing on information, the importance of tailored information and feedback has been recognised (European Environment Agency, 2013). Feedback plays a significant role in raising energy awareness and changing occupant attitudes towards energy consumption. Among the different types of feedback, this research focus on direct feedback (e.g. smart meters), available on demand and indirect feedback (e.g. informative energy bills, energy awareness campaigns and collaborative learning). Faruqui et al. found that direct feedback provided by in-home displays can encourage occupants to make more efficient use of energy. Energy savings from occupant behaviour range between 3% and 13%, with an average of 7% (Faruqui, 2010). The range of savings achieved through indirect feedback tends to be lower than the one reported in direct feedback studies (5%–15%). Nevertheless, they are important to make users aware of the impact of their daily practices, and are achievable at relatively low cost. Moreover, it has been studied that the combination of different informational feedback may lead to an increase of energy savings up to 20% (European Environment Agency, 2013).

3. Methodology

3.1 The Analytic Hierarchy Process (AHP)

The main issue policy-makers are struggling with is to understand which measures offer the greatest benefit within the framework of interacting environmental, economic and social factors. In fact, when it comes to increase the sustainability of cities, an economically oriented cost-benefit analysis alone is not adequate to take into consideration the multiplicity of determinants towards an energy efficient building stock.

To support decision-makers to design effective energy efficiency renovation policies, a methodology based on the application of the Analytic Hierarchy Process (AHP) is presented. AHP is a theory of measurement through pairwise comparisons and relies on the judgements of experts to derive priority scales. The comparisons are made using a scale of absolute judgements that represents, how much more, one element dominates another with respect to a given attribute. Through these scales, is possible to measure intangibles in relative terms. The judgements may be inconsistent, therefore consistency should be checked and kept within certain values (Saaty, 1990; Saaty, 2008). To generate priorities to support decisions, four main steps have to be followed: i) to define the problem, and to set the goal; ii) to structure the decision hierarchy from the top (the overall objective), through the intermediate level (criteria), to the lowest level represented by the alternatives (measures); iii) to build pairwise comparison matrices and undertake a consistency test; iv) to estimate the relative weighs of the components of each level. AHP scale considered is as follows: 1 for equal importance; 3 for moderate importance; 5 for strong importance; 7 for very strong importance; 9 for extreme importance; pair values are used for priorities in-between the odd ones.

The methodology described in the following paragraphs aims to demonstrate that the measures tackling user's behaviour are the most urgent to be implemented and therefore they should be on the top of the priority list when it comes to design effective renovation strategies of the housing stock. Thus, energy behaviour of occupants needs to be embedded in renovation policies, in order to reduce the gap between expected and actual energy consumption, to raise awareness on the individual impact on the energy consumption and to build sustainable communities. A sensitivity analysis is performed to design different scenarios based on the allocation of priorities among different criteria. The scenarios are intended as multiple ways to achieve the above-mentioned goal.

3.2 Definition of measures, criteria, scenarios and their hierarchy

The overall objective considered as the goal of the AHP application, is to lower energy consumption in housing sector by selecting the measures that more than others can lead to an effective implementation of the energy renovation strategies.

Among the numerous criteria and indicators that are normally used in environmental assessment of buildings, four criteria have been taken into consideration for the aim of this study. The *environmental criterion* is the one aiming at maximising the energy and CO_2 reduction, no matter the economic, social and practicable feasibility of implementing the renovation alternatives. The *economic criterion* aims at maximising the revenues and/ or minimising the loss, thus takes into consideration the cost-effectiveness of measures. The *social criterion* is the one recognising the importance of social and cultural values, and support inclusion of these values in the selection of energy renovation measures. The last criterion considered is the *practicability* of such energy efficiency measures, evaluating how easy and free from operational barriers is the applicability of the foreseen measures.

As results of literature and case studies review, taking as a reference the renovation practices of Italian residential building stock (Semprini et al., 2015; Santangelo et al., 2018), 7 packages of measures – M(1) to M(7) – have been identified as potential alternatives to improve the energy performance of the housing stock (Table 1).

MEASURES	DEPENDENCY FROM BEHAVIOUR
M(1) - Indirect feedback	High
M(2) - Direct feedback/ smart meters	High
M(3) - Replacement of the heating system	Medium
M(4) - Replacement of home appliances/ lights	Medium
M(5) - Replacement of windows	Medium
M(6) - Insulation of building envelope	Low/ None
M(7) - Renewable energy systems	Low/ None

Table 1: List of measures and level of dependency from behaviour

These measures have been clustered according to their levels of dependency from the occupant behaviour. M(1) and M(2) are the two alternatives strongly dependent on occupant behaviour, since they are designed to address directly the behaviour change and the households awareness of their impact on energy consumption. M(3), M(4) and M(5) are dependent to a certain degree on occupant behaviour. In fact, whether the heating system, the home appliances and the windows are efficient or not, it will still be the occupant who decides how to use them, introducing a level of uncertainty of such measures to increase the energy efficiency of housing buildings. On the contrary, M(6) and M(7) have been clustered as non-dependent on behaviour, since they represent the alternatives that more than others are able to reach the target of energy efficiency they are designed for, with limited influence of occupant's behaviour.
The structure of the hierarchy framework described above is drawn in Figure 1. The first level represents the goal of the analysis. The second level is composed by multiple criteria. The last level is made by the alternative choices or measures.

Figure 1: Hierarchy framework

4. Results and discussion

The results report the application of AHP according to the hierarchy of goal, criteria and measures described above. The second sub-section describes the scenarios selected and how the criteria are combined among them to define the five scenarios.

4.1 AHP pairwise comparisons

The consistency test is one of the essential features of the AHP method which aims to eliminate the possible inconsistency revealed in the criteria weights through the computation of consistency level of each matrix. The consistency ratio (CR) is used to determine and justify the inconsistency in the pairwise comparison (Saaty, 1990). The acceptable CR values is assumed 0.10 for matrix larger than 4x4. All the CR values of the matrixes considered are below this limit, therefore the weight results can be assumed as valid and consistent.

The results from the environmental criterion decision matrix are presented, prioritised and ranked in Table 2. In order to highlight the medium-dependency level of M(3), M(4) and M(5) from behaviour, the preference of such measures pairwise compared to M(1) and M(2) have been lowered (i.e. two points decreased in the scale of preference). This assumption has been made to incorporate the somehow dependency on behaviour of such measures. Selecting M(3), M(4) and M(5) without taking into consideration that they are influenced from user's behaviour can lead to overestimate the environmental benefit of such measures.

Tables 3-5 present the results from pairwise comparisons taking into consideration respectively the economic, social and practicable criteria. Each table shows the priority of selected measures according to the results of the decision matrix, and the ranking of the alternatives when each criterion is considered alone, in absolute terms.

ENVIRONMENTAL CRITERION									
DECISION MATRIX	M(1)	M(2)	M(3)	M(4)	M(5)	M(6)	M(7)	**PRIORITY**	**RANKING**
M(1)	1	0.33	0.33	0.33	0.33	0.14	0.11	2.6%	7
M(2)	3.00	1	0.33	0.33	0.33	0.14	0.11	3.6%	6
M(3)	3.00	3.00	1	3.00	0.33	0.20	0.14	7.6%	4
M(4)	3.00	3.00	0.33	1	0.33	0.20	0.20	5.8%	5
M(5)	3.00	3.00	3.00	3.00	1	0.20	0.14	10.5%	3
M(6)	7.00	7.00	5.00	5.00	5.00	1	0.33	26.5%	2
M(7)	9.00	9.00	7.00	5.00	7.00	3.00	1	43.4%	1

Table 2: Pairwise comparison for environmental criterion. Consistency Ratio CR = 0.09

ECONOMIC CRITERION									
DECISION MATRIX	M(1)	M(2)	M(3)	M(4)	M(5)	M(6)	M(7)	**PRIORITY**	**RANKING**
M(1)	1	3.00	5.00	3.00	7.00	9.00	7.00	40.5%	1
M(2)	0.33	1	1.00	3.00	5.00	7.00	7.00	21.7%	2
M(3)	0.20	1.00	1	1.00	1.00	5.00	5.00	12.3%	4
M(4)	0.33	0.33	1.00	1	3.00	5.00	5.00	12.9%	3
M(5)	0.14	0.20	1.00	0.33	1	3.00	3.00	6.9%	5
M(6)	0.11	0.14	0.20	0.20	0.33	1	1.00	2.8%	7
M(7)	0.14	0.14	0.20	0.20	0.33	1.00	1	3.0%	6

Table 3: Pairwise comparison for economic criterion. Consistency Ratio CR = 0.05

SOCIAL CRITERION									
DECISION MATRIX	M(1)	M(2)	M(3)	M(4)	M(5)	M(6)	M(7)	**PRIORITY**	**RANKING**
M(1)	1	3.00	5.00	5.00	5.00	7.00	5.00	41.5%	1
M(2)	0.33	1	3.00	3.00	3.00	5.00	3.00	29.4%	2
M(3)	0.20	0.33	1	1.00	1.00	1.00	1.00	6.0%	3
M(4)	0.20	0.33	1.00	1	3.00	3.00	1.00	6.0%	3
M(5)	0.20	0.33	1.00	0.33	1	1.00	1.00	6.0%	3
M(6)	0.14	0.20	1.00	0.33	1.00	1	0.33	5.5%	6
M(7)	0.20	0.33	1.00	1.00	1.00	3.00	1	5.5%	6

Table 4: Pairwise comparison for social criterion. Consistency Ratio CR = 0.03

PRACTICABLE CRITERION									
DECISION MATRIX	M(1)	M(2)	M(3)	M(4)	M(5)	M(6)	M(7)	**PRIORITY**	**RANKING**
M(1)	1	3.00	5.00	3.00	5.00	9.00	7.00	38.9%	1
M(2)	0.33	1	3.00	1.00	5.00	5.00	5.00	20.0%	2
M(3)	0.20	0.33	1	0.33	1.00	5.00	3.00	8.8%	4
M(4)	0.33	1.00	3.00	1	3.00	5.00	5.00	18.0%	3
M(5)	0.20	0.20	1.00	0.33	1	3.00	3.00	7.4%	5
M(6)	0.11	0.20	0.20	0.20	0.33	1	3.00	3.9%	6
M(7)	0.14	0.20	0.33	0.20	0.33	0.33	1	3.1%	7

Table 5: Pairwise comparison for social criterion. Consistency Ratio CR = 0.06

Figure 2 shows the priority trend of each criterion. "M(1) – Indirect feedback" and "M(2) - Direct feedback/ smart meters" are the top alternatives considering three out of four criteria, while implementing "M(7) - Renewable energy systems" has the highest priority when the environmental criterion is considered. Beside these three solutions, "M(4) - Replacement of home appliances/ lights" is the measure that shows the most significant changes among the criteria considered.

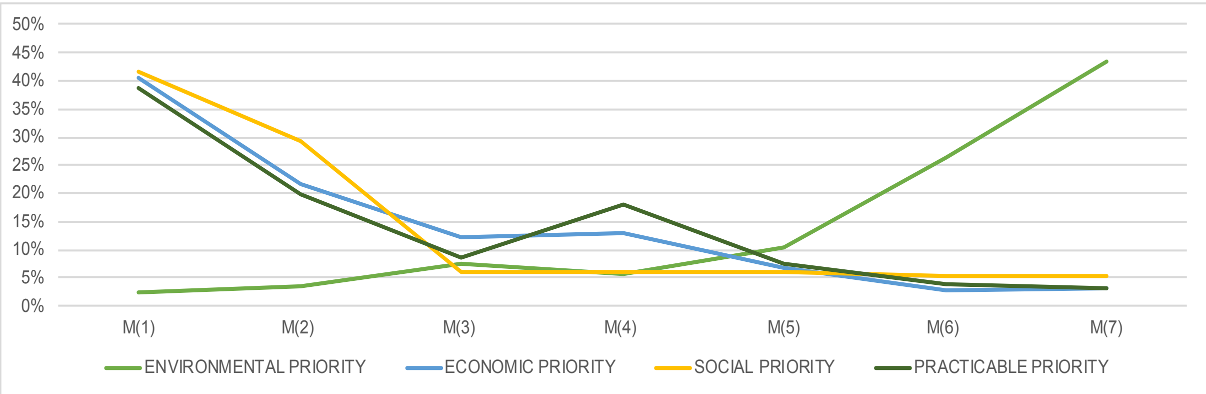

Figure 2: Criteria priority

4.2 Sensitivity analysis

In order to include all the main alternative decisions that policy-makers might face to reach the overall objective of lowering energy consumption in housing sector, a sensitivity analysis has been performed to define 5 possible scenarios that includes different combination of the selected criteria. The weights assigned for each scenario are presented in Table 6. The neutral scenario foresees a decision made by equally evaluate the four criteria. The rest of the scenarios are designed to make one criterion prevail, with a double weight with respect to the other three criteria.

The results of the sensitivity analysis are presented in Table 7. The rows represent the seven measures, while the five main columns show both the priority and the ranking of each scenario. Recommendations on which measures should be selected first are drawn by taking into consideration the results of each ranking list. The traffic light colours from green to red show the priority of recommended solutions.

The evidence of how behaviour is embedded into the measures with the highest scores is presented in Figure 3.

	ENVIRONMENTAL CRITERION	ECONOMIC CRITERION	SOCIAL CRITERION	PRACTICABLE CRITERION
NEUTRAL SCENARIO	25%	25%	25%	25%
ENVIRONMENTAL SCENARIO	40%	20%	20%	20%
ECONOMIC SCENARIO	20%	40%	20%	20%
SOCIAL SCENARIO	20%	20%	40%	20%
PRACTICABLE SCENARIO	20%	20%	20%	40%

Table 6: Weights assumption for sensitivity analysis

RECOMMENDED SOLUTIONS	NEUTRAL SCENARIO		ENVIRONMENTAL SCENARIO		ECONOMIC SCENARIO		SOCIAL SCENARIO		PRACTICABLE SCENARIO	
	Priority	Ranking	Priority	Ranking	Priority	Ranking	Priority	Ranking	Priority	Ranking
M(1)	30.9%	1	25.2%	1	32.8%	1	33.0%	1	32.5%	1
M(2)	18.7%	2	15.7%	3	19.3%	2	20.8%	2	18.9%	2
M(3)	8.7%	5	8.5%	6	9.4%	5	8.1%	6	8.7%	5
M(4)	10.7%	4	9.7%	5	11.1%	4	9.7%	4	12.1%	3
M(5)	7.7%	6	8.3%	7	7.5%	6	7.4%	7	7.6%	7
M(6)	9.7%	7	13.0%	4	8.3%	7	8.8%	5	8.5%	6
M(7)	13.8%	3	19.7%	2	11.6%	3	12.1%	3	11.6%	4

Table 7: Results from sensitivity analysis and ranking of recommended solutions

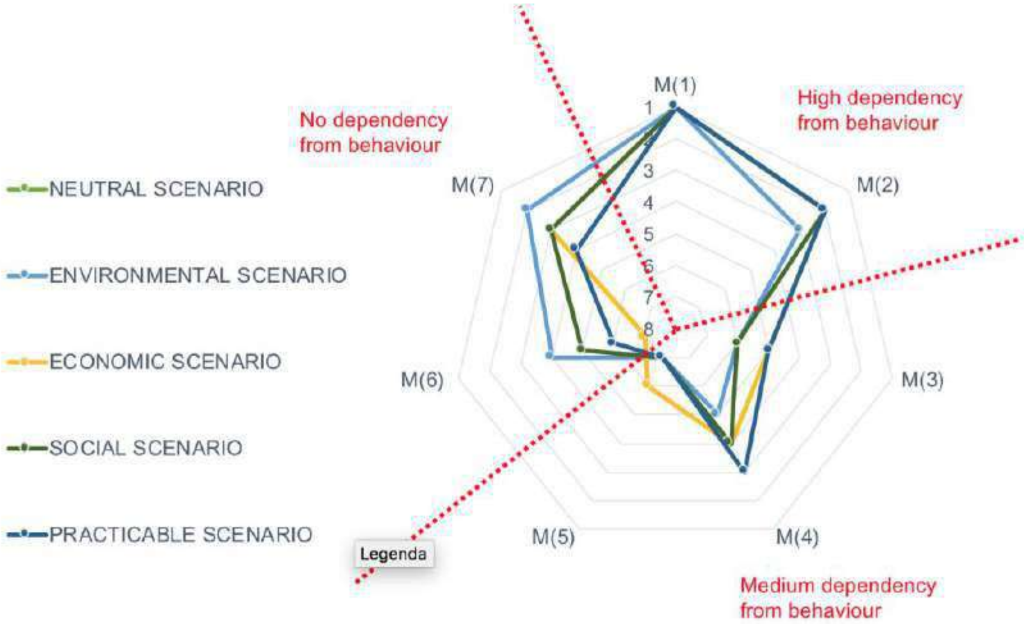

Figure 3: Scenario analysis and evidence of energy behaviour relevance

5. Conclusions, limitations and policy recommendations

This research has contributed to highlight the central role of household behaviour and daily practices to lower energy consumption when it comes to renovation of existing housing buildings. A methodology based on multi-criteria assessment of different strategies by applying the Analytic Hierarchy Process (AHP) has been presented. The methodology allowed to combine quantitative and qualitative attributes and to translate qualitative

preferences into ratio scaled data. The AHP application goal has been defined as selecting the measures that more than others can lead to an effective implementation of the energy renovation strategies and can increase energy efficiency of existing housing stock. Four criteria and seven measures have been identified, respectively as intermediate level and lower level of the hierarchy framework. Results show that "M(1) - Indirect feedback" and "M(2) - Direct feedback/ smart meters", the two measures that more than the other considered rely on user's behaviour, have resulted to be the top alternatives by three out of four criteria. Afterwards, a sensitivity analysis has been performed to define five possible scenarios that includes different combination of the selected criteria. The aim has been to include all the main alternative decisions that policy-makers might face to reach the reduction of energy consumption by renovating the housing stock. The analysis has confirmed the urgency and convenience to implement the first two measures prior to the other alternatives.
The research embeds also some limitations. First of all, the decisions on the scores of pairwise comparisons have been made directly by the authors. Although they come from the evidence of long-lasting collaborations with public authorities (e.g. municipalities and regional authorities), to enhance the robustness of the results, it might be suggested to design a participatory process to directly involve experts in decisions, or to deliver a survey to gather stakeholders' feedback on the priorities. Secondly, to the extent of the study, informational feedback – both direct and indirect – has been considered to lead to behaviour change due to rational behaviour. However, this approach has been criticised for relying on assumptions of consumers as guided by economically rationally decisions, while in practice is not the case. Although the limits of this kind of strategy, informing the users still represent an important element in the implementation of structural strategies intended to increase the energy efficiency of buildings.
Two main policy recommendations can be drawn. On the one hand, as more data on household energy consumption and indoor comfort levels become available, there are more possibilities of providing tailored feedback to occupants. However, there is a limited evidence of post-occupancy evaluation studies in existing literature. Thus, the measures proposed in this research with a high dependency on behaviour are intended as complementary to the others, and first to implement to raise awareness and drive behaviour towards more energy sustainable practices, but they certainly cannot reach the goal if implemented alone. Information, awareness campaigns, feedback and other informative policy instruments should be integrated by other measures addressing the physical renovation. On the other hand, public authorities are seeking for services rather than products to increase the renovation rate of the housing stock. Better integrated complementary approaches to both the technical and social energy transitions are required.

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Detecting the Attractive Spots of Hiking Tourism Based on Geo-tagged Photos: The Case of the Northern Outskirts of Guangzhou, China

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Abstract

Hiking in the outskirts of mega cities as a kind of environmentally friendly and sustainable urban tourism is becoming more and more popular in China. The trend of urban residents participating in hiking in China appears to be relatively late comparing with that in Europe. Therefore, the facilities and management for hiking tourism still need to be improved in China. Hiking activities can help citizens keep physically and mentally healthy because it provides the opportunity to experience the tranquility, solitude and pristine beauty of nature, which are recreational qualities that contrast with the stress of urban life. So, going hiking frequently is a green lifestyle. Since hiking activities are often carried out in outdoor areas with no regular path, it is difficult to use traditional methods to research these activities, especially when the research focus on large-scale area.

The social networking sites for hikers have emerged in China in recent years, which provide opportunities to share geo-tagged photos when going hiking. These photos serve as a new source of data for studying hiking activities. Considering that people take photos to record attractions, geo-tagged photos reflect people's memorable events associated with locations. Therefore, these photos provide insights into hikers' preferences and their interactions with the surroundings. Based on these photos, a novel approach is presented to identify the spots which attract the hikers through density analysis and to get the tags representing features of the spots through image recognition.

In this paper, we made a case study of the hiking activities in the northern outskirts of Guangzhou, China. This area is approximately 1797 square kilometers, having rich ecological resources and attracting numbers of hikers. First of all, the shared geo-tagged photos of the area from March 2010 to March 2017 were obtained. After screening, 13157 photos shared by the hikers were gained. Then, the hot spots attracting hikers were identified through density analysis in GIS. After image recognition, tags representing contents of the photos taken within 50m around the attractive spots were found out. Then top two representative tags were selected for each attractive spot. These tags including "Mountain, "Vegetation", "Water", "Rock", "Building" and "Person", introduce the types of the attractive spots and the contents of the most photos taken by hikers when they stay. Finally, the pattern of distribution of different types of attractive spots were studied and summarized. The information of the attractive spots and the tags can serve as an important reference for planning, governance and management of hiking tourism.

Keywords: geo-tagged photos; hiking tourism; attractive spots; representative tags; Guangzhou, China

1. Introduction

The tourism sector which is already one of the fastest growing industries in the world is currently undergoing extensive change (Sørensen & Sundbo, 2014). Among various ways of tourism, hiking is becoming more and more popular in China. The rapid development of outdoor activities and Internet have promoted the popularity of hiking tourism. Hiking in the suburbs of large cities is a typical type of eco-tourism. Citizens from large cities participate in hiking in the outskirts of the cities in order to get exercise, rest and recreation. In this process, they also achieve the purpose of understanding, enjoying and protecting nature. Many developed countries have developed mature systems and commendable facilities for hiking tourism. However, hiking tourism in China appears to be relatively late, and it is still spontaneous. Therefore, the facilities and management for hiking tourism need to be improved in China (Jin, et al , 2012).

The characteristics of tourists' behavior are very important aspects in tourism research (Beeco, et al, 2013). Understanding the tourists' needs and activities is crucial for tourism planning and management (Taczanowska, et al, 2014; East, et al, 2017). However, hiking is often carried out in rural and natural environments so that traditional survey methods are difficult to apply due to the area is lack of monitoring and some hikers lack map reading skills or have difficulties in orientation.

With the development of technology, GPS is integrated into portable equipment, providing new opportunities for tracking travel activities (Nielsen, et al, 2010). With the gradual development of the social networking platform, many hikers share where they are and what they see in the process of hiking by sharing geo-tagged photos on the social networking sites. A large number of geo-tagged photos on the Internet provide a new and valuable source of information for the study of tourists' behavior (Orsi & Geneletti, 2013). The study of the preference and behavior of tourists based on geo-tagged photos has become an important topic in the field of tourism research and management. By analyzing geo-tagged images, we can get information about the places that attract hikers (Arase, et al, 2010). These spots often have charming landscape or interesting things. They are also places that are prone to crowding (East D, et al, 2017). The planning and management of these places need to take into account in terms of both viewing function and security protection.

This study attempts to collect the geo-tagged photos shared on the social networking sites and obtain the attractive spots of hiking tourism through density analysis in the GIS. After using image recognition technology to identify the contents of photos around the attractive spots, the tags which represent the contents interested by the hikers can be gained. The information of the attractive spots and the tags can provide a basis for planning and management of the attractive spots of hiking tourism.

2. Related Research Review

In academia, the study of outdoor tourism activities has a long history. In densely populated areas, providing quality outdoor recreation areas is a particularly important topic. The design methods that explore the balance of the needs of tourists and the services have attracted plenty of attention (Bell, 2008). Traditional studies often use written diaries or telephone interviews to obtain information. These methods have problems including the inability to obtain accurate information of travel time and destination location (Murakami & Wagner, 1999). In addition, some studies have conducted interviews with on-site visitors in order to know about the routes of the tourists and explore the spatial behavior of tourists (Taczanowska, et al, 2006). Some studies also explore monitoring options for tourist numbers in natural areas (Cessford & Muhar, 2004).

However, hiking tourism tends to occur in rural areas. If the hikers have difficulties in orientation, it is probably difficult for them to recall the hiking route and the location of attractive spots after hiking activities. So, traditional methods are not applicable in such cases. In contrast, data with geographic coordinate information shows advantages.

Some scholars tried to extract travel information from geo-tagged photos in order to understand the behavior of tourists (Li, et al, 2013), and to obtain the location of the spaces that attract tourists to stay (Papadopoulos, et al, 2011; Henderson, et al, 2010; Li & Ding, 2015). What's more, some studies used geo-tagged photos to speculate the tourist routes (Arase, et al, 2010; Kurashima, et al, 2013; Orsi & Geneletti, 2013). Furthermore, some scholars used geo-tagged photos to identify the behaviors and needs of tourists and to build

a travel route recommendation system (Okuyama & Yanai, 2013). For managers, the information contented in geo-tagged photos is used as a basis for planning tourism routes and arranging tourism facilities (Yoshikawa, et al, 2010).
In addition, some scholars have tried to use GPS data of the track in tourism research. For example, some studies used these data to research tourists' behavior (Orellana, et al, 2012; Meijles, et al, 2014; Donaire, et al, 2015). Base on the characteristics of tourists' behavior, some scholars generated a tourist route selection model (Bierlaire & Frejinger, 2008) or constructed a new tourism route design method (Li, et al, 2016).
It can be seen that research methods for outdoor hiking tourism are constantly evolving. At present, tourism research based on geo-tagged photographs pays more attention to urban built-up areas and less attention to the outskirts of the cities. These researches based on GPS data of the track pay attention to the feature of the behavior of tourists and the generation of routes, and basically have not advantages in identifying the features of spots that attract tourists. This study focuses on the case of the northern outskirts of Guangzhou in China and make comprehensive use of geographical information and visual information carried by geo-tagged photos to obtain the attractive spots that hikers prefer to stay and to identifies the features of the spots.

3. Research Foundation

3.1 Research Object

Hiking is a walking exercise which always occurs in the suburbs of cities or rural area. In many countries, as leisure time increases, the proportion of people participating in hiking tourism increases (Cole & Buckley, 2004). In China, hiking activities are mainly in short-distance, and their destinations are always in the wild area or rural area (Jin, et al, 2012). Areas that are easily accessible around large cities or densely populated areas often become main destinations for short-distance travel (Bell, 2008).
The Zengcheng District and Conghua District in the northern part of Guangzhou have various ecological and rural resources, attracting a large number of hikers. The “Master Plan of Guangzhou (2011-2020)” introduces that the Liangkou Town, Lvtian Town and Wenquan Town in Conghua District, Paitan Town, Xiaolou Town, and Zhengguo Town in Zengcheng District have advantages in ecotourism. The elevation of this area ranges from 30 meters to 1170 meters and the slope range from 0 degrees to 50 degrees. Thanks to the great change of topography, the ecological resources in this area are abundant. At the same time, this area is in the northern part of Guangzhou and it is relatively convenient to get to. Therefore, this area has been popular for hiking.
This study chose this area as a case, using the geo-tagged photos on the social networking sites to identify the spots that attract hikers to stay and found tags representing the feature of the spots.

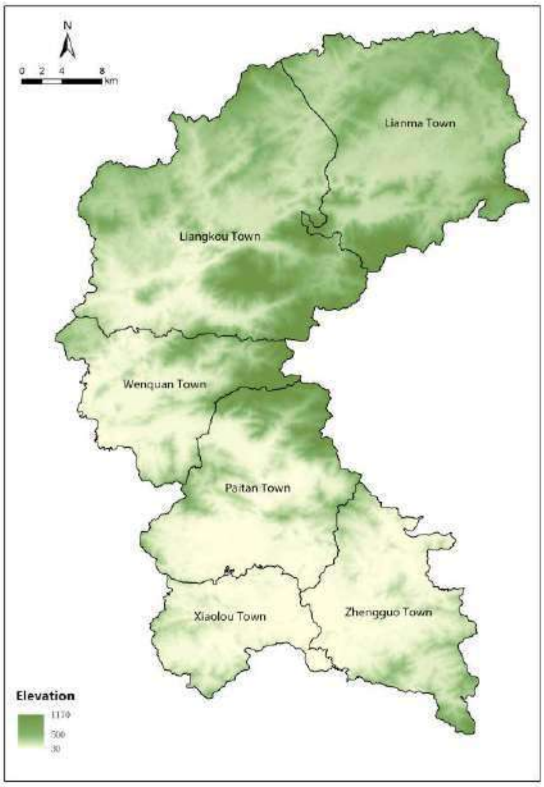


Figure 1: Topographic map of study area

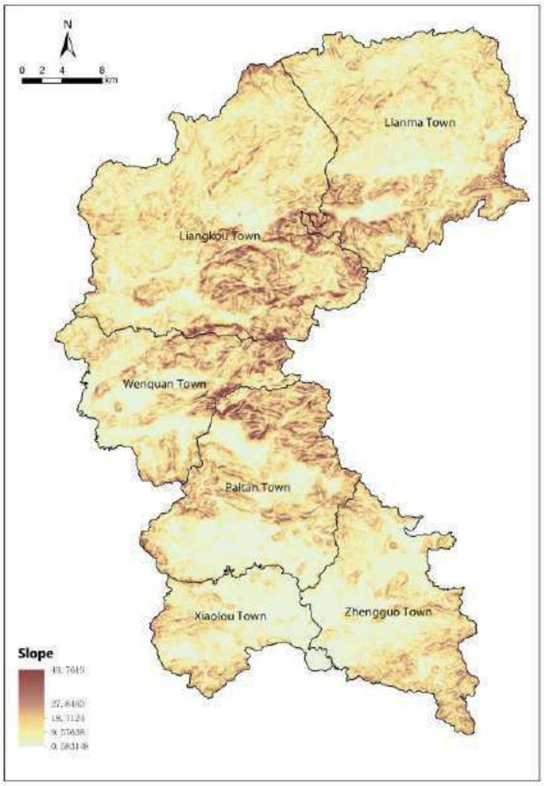


Figure 2: Slope map of study area

3.2 Research Methods

With the development of outdoor travel activities and the popularization of GPS technology, social networking sites for sharing geo-tagged photos have appeared on the Internet. These social networking sites provide an opportunity to share photos with geographical coordinates whenever and wherever users are doing outdoor activities. These sites provide hikers with the opportunity to share GPS tracks and geo-tagged images online. They have been gaining plenty of users in China.

After searching with “Conghua” and “Zengcheng” as keywords, this study used the software called LocoySpider to gain geo-tagged images and corresponding GPS tracks on one popular social networking site for hikers. A total of 19664 geo-tagged photos and 4116 corresponding GPS tracks were collected. After importing the original data into GIS for visualization, the data outside the study area, the abnormal or non-hiking travel data were filtered. Finally, 13157 corresponding geo-tagged photos and 2564 corresponding tracks were obtained.

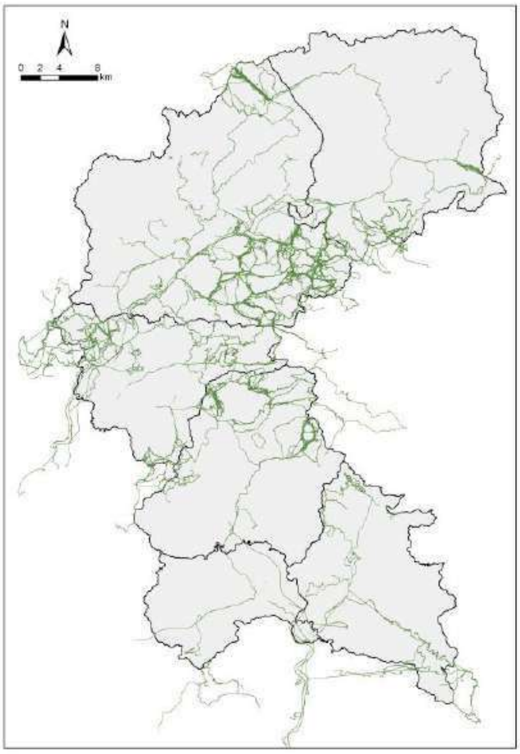
After importing these geo-tagged photos in GIS, we used density analysis to identify places that attract people to stay and take photos. Based on the result of the density analysis, we selected the 100 attractive spots with high density value. Then what people interested in when they stay in these spots was explored. The content of the geo-tagged photos taken within 50m around the attractive spots were studied. Based on the open sources database on the Internet for image recognition, the content of these photos was recognized after running a machine learning model. Then the top two representative tags were selected for each attractive spot. These tags are able to tell us the types of the attractive spots and contents of the majority of photos taken by hikers when they linger at the spot. What’s more, the distribution rules of different types of spots were also summarized.

Figure 3: The GPS track and geo-tagged photos on one social networking site (The blue marks on the map represent the location of the shared photos)

4. Detecting the Attractive Spots of Hiking Tourism

4.1 Identifying the Attractive Spots

A small number of the tracks coincide with the existing county roads, while most of the routes chosen by the hikers are just limited to walking. The hikers prefer the unhardened paths in the wild which are always not recorded on the traditional maps. Many hikers find their ways by tracking the GPS data shared by other hikers before. Thus, some routes have become popular among the hikers through the spread of the Internet. The hiking tracks are unevenly distributed across the study area. They are more intensive in the central area. The dense area is in the southeast of Liangkou Town, followed by the north of Liangkou Town, the south of Lvtian Town, the northwest of Wenquan Town and the north of Paitan Town. Correspondingly, the 13157 geo-tagged photos were mainly distributed in the middle of the study area, which match to the dense areas of GPS tracks. It can be seen that the networking sites can provide a great deal of precise information on the behavior of hikers.



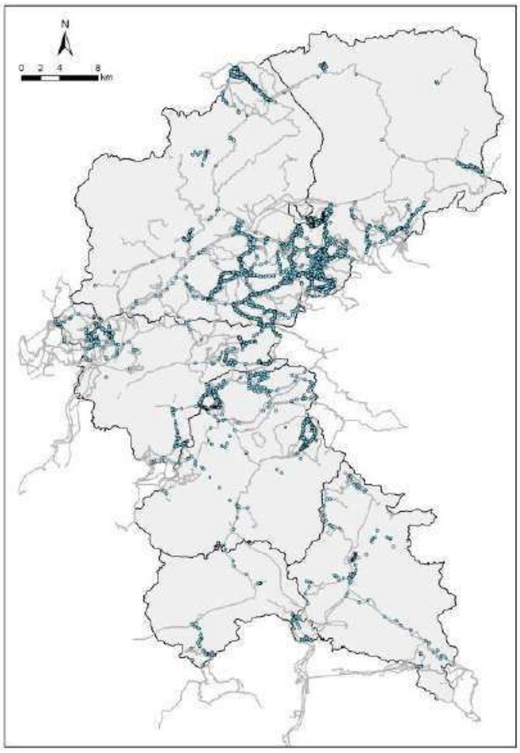
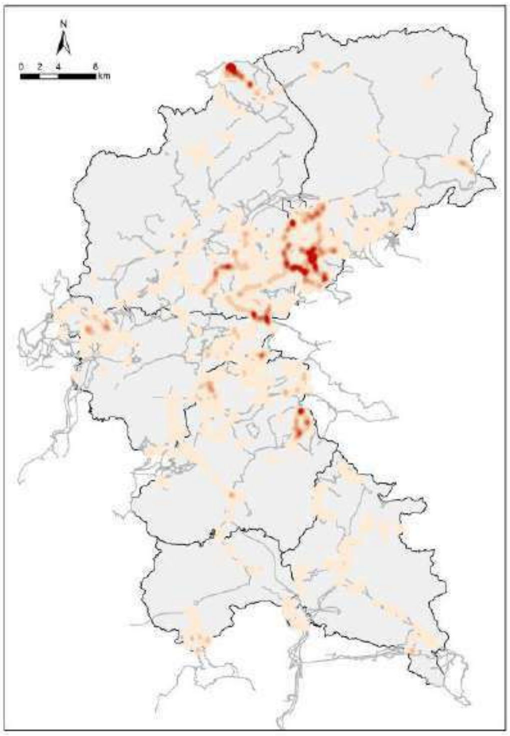


Figure 4: The distribution of GPS tracks *Figure 5: The distribution of geo-tagged photos*

If a place attracts many hikers to take photos, these places are supposed to have high-quality landscapes or special events to attract hikers to stay (Arase, et al, 2010; Henderson, et al, 2010). Based on the density analysis in GIS, 100 attractive spots with high-density value were selected. These spots are mainly concentrated in the central-eastern part of the study area, and a small number are located in the northern part of the area. They are concentrated in the area where the topography changes greatly.



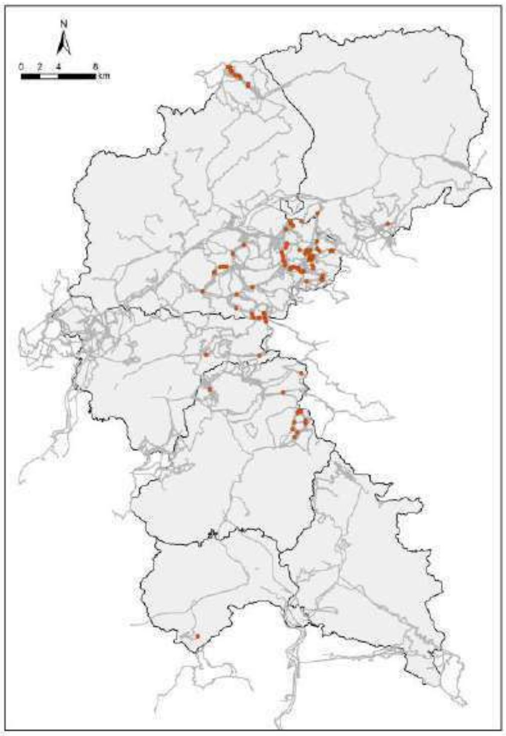


Figure 6: The density of the geo-tagged photos *Figure 7: The 100 attractive spots selected*

4.2 Tags Generation of Attractive Spots

A total of 4403 geo-tagged photos taken within 50m around the attractive spots were selected in this study. Based on the open database called ADE20K[i] for image recognition on the Internet, the contents of these photos were recognized after running a machine learning model.

The most frequently occurring contents include “Mountain”, “Vegetation”, “Water”, “Rock” “Building” and “Person”. For each photo, the proportions of “Mountain”, “Vegetation”, “Water”, “Rock”, “Building” and “Person” were counted.

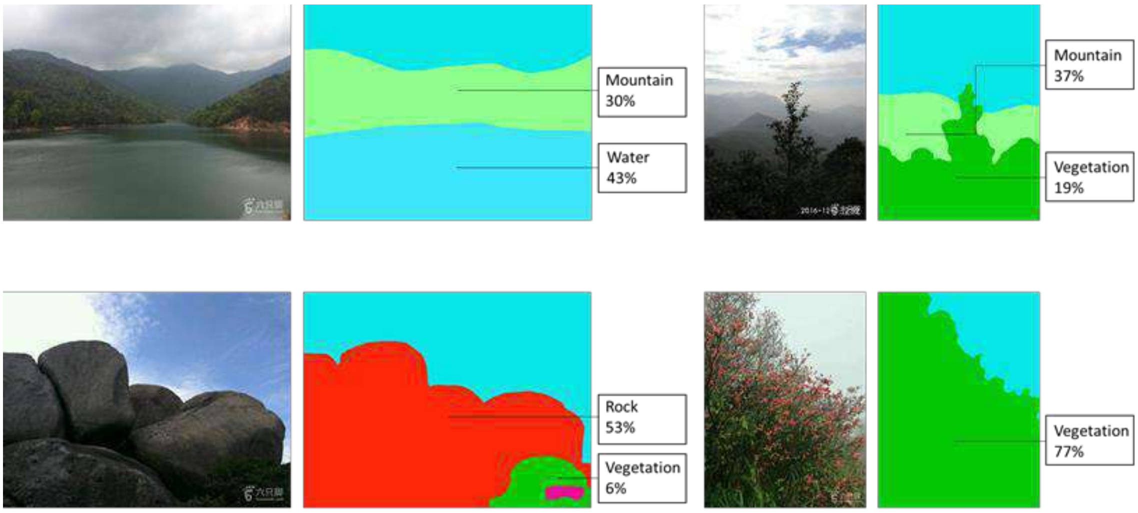


Figure 8: Some examples of photo identification!

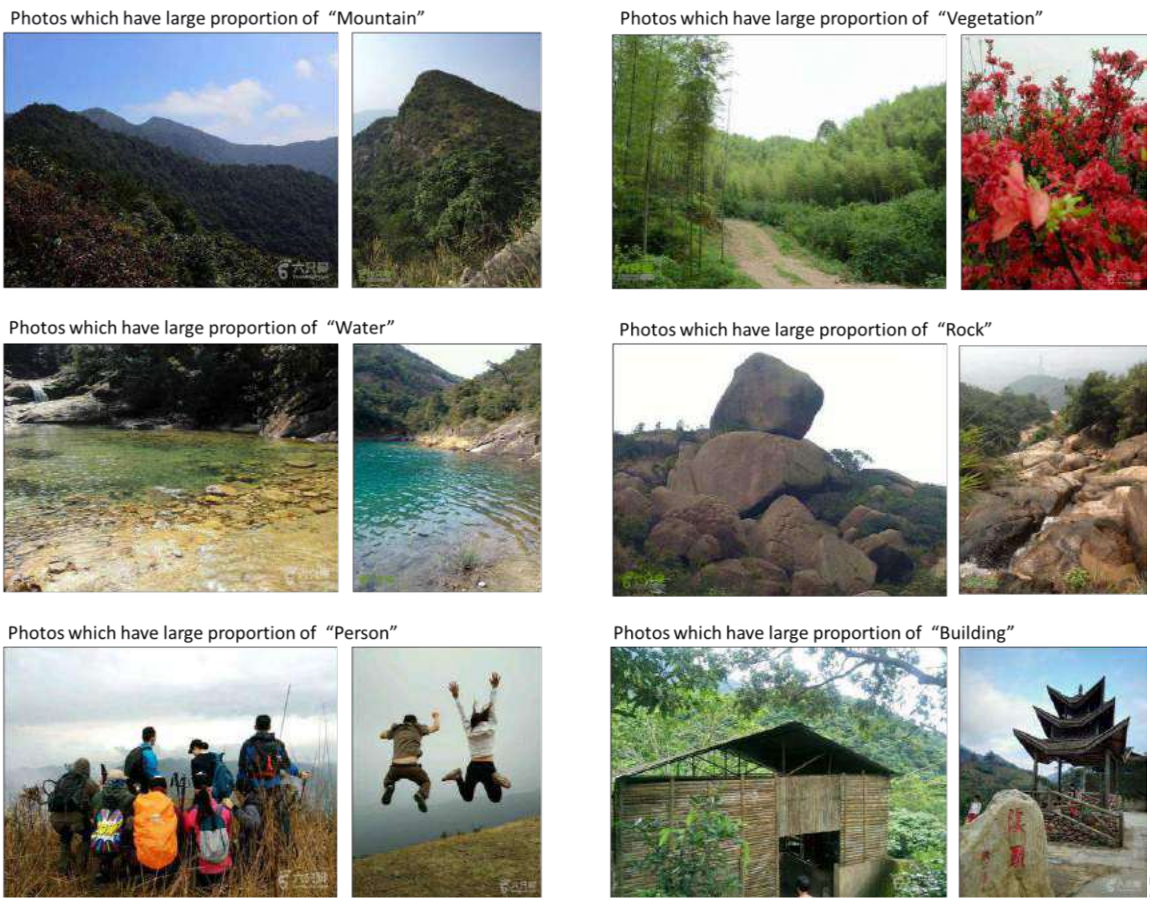


Figure 9: Photos with different main content

For every photos, we calculated the relative proportion of each type of content in all photos to achieve standardization. Since one spot usually has more than one attractive content, we selected two representative tags including a primary tag and a secondary tag for each attractive spot. The primary tag represents the first dominant content of the photos and the secondary tag represents the second dominant content. These tags can tell us the types of the attractive spots and contents of the majority of photos taken by hikers.

4.3 Distribution of Different Types of Attractive Spots

Different types of attractive spots have significant differences in attractive contents and location distribution. For example, the attractive spots with the tags of "Mountain" are generally places for enjoying the distant mountains with a good view; the attractive spots tagged by "Vegetation" often have beautiful plants; the attractions of spots tagged by “Water”, “Stone” and “Building” generally have close view of landscape; the attractive spots with the "Person" tags are places where hikers usually stay for a longer period of time and take portrait photos and they are usually the starting places or the resting stations of the routes.

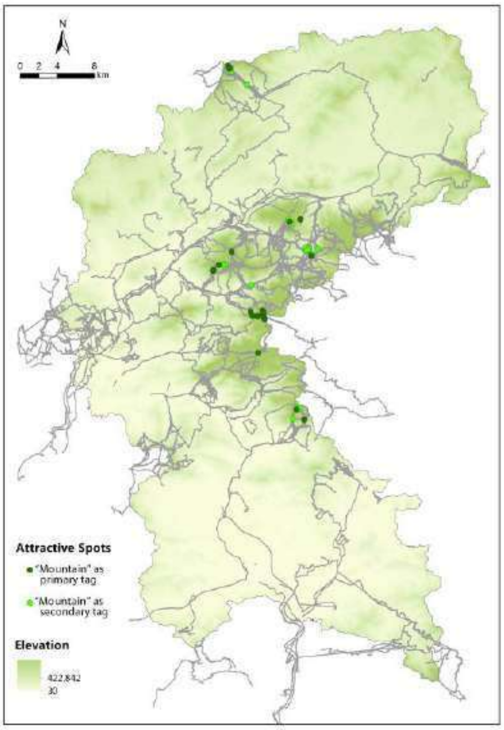


Figure 10: The spots tagged by “Mountain”

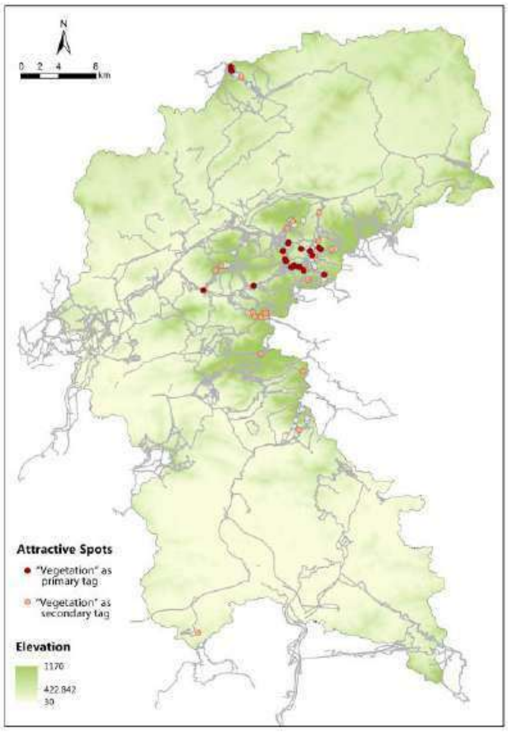


Figure 11: The spots tagged by “Vegetation”!

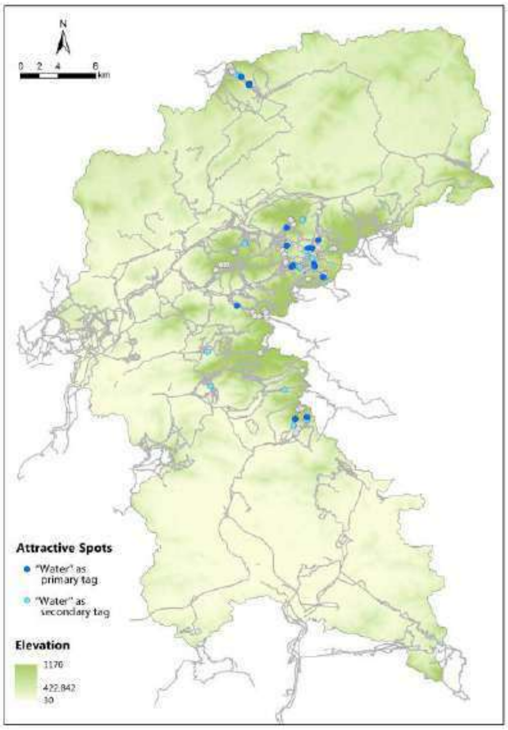


Figure 12: The spots tagged by “Water”

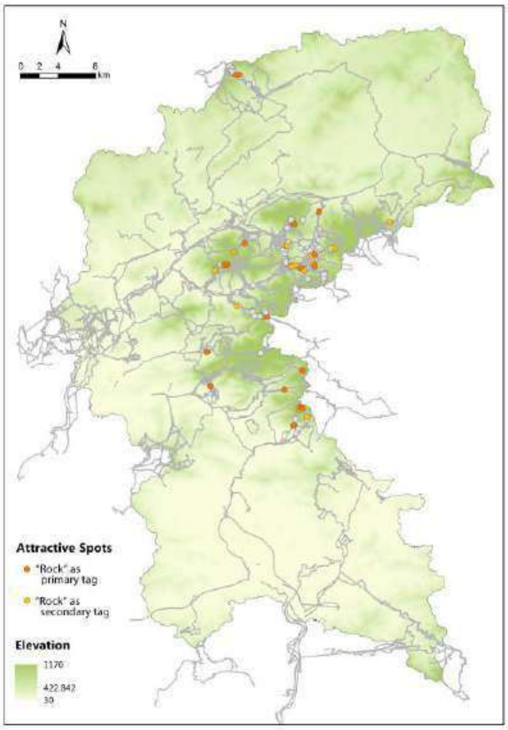


Figure 13: The spots tagged by “Rock”

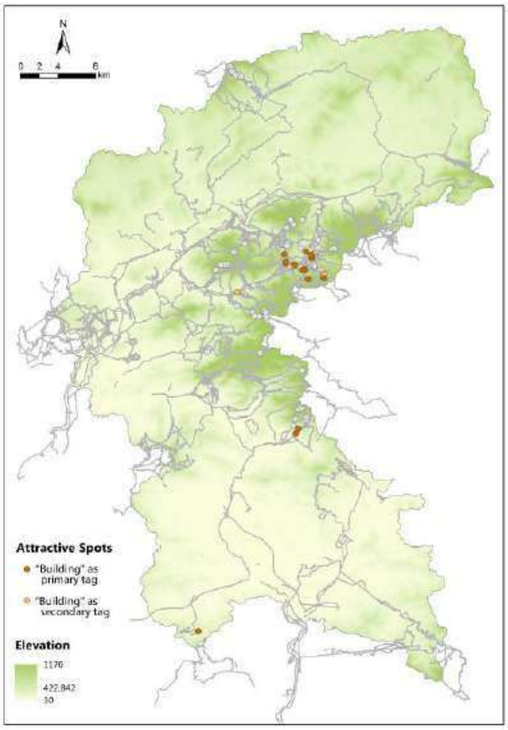


Figure 14: The spots tagged by “Building”

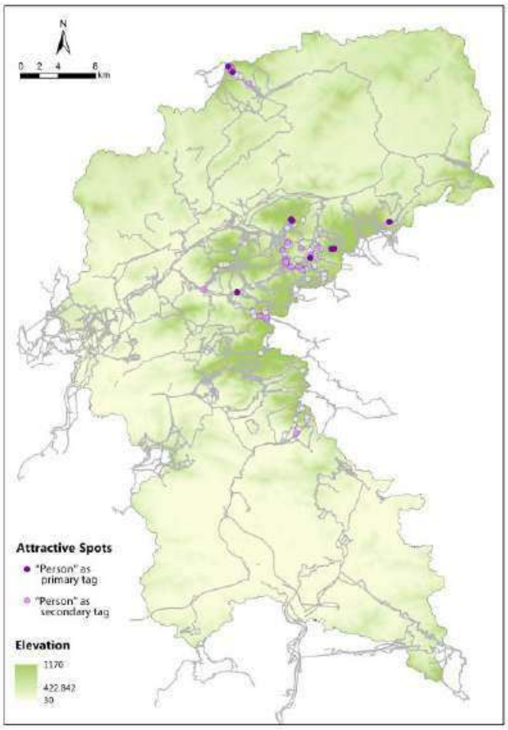


Figure 15: The spots tagged by “Person”

The elevation and slope information of each attractive spot were obtained to analyze the distribution characteristics. It is seen that the attractive spots tagged by “Mountain” are the highest in elevation and slope comparing with other categories. And they mostly occurred on the top of the mountains or on the slopes. The spots tagged by “Vegetation” are widely distributed in various elevation and slope. They are always in mountainous area which is dense with vegetation. The spots with tags of "Water" have wide distribution of elevation but most of them have gentle slope, indicating that the places with charming water view are distributed at different elevations, but the water banks are slow in slope. The spots with tags of "Stone" have low elevation distribution similar to the spots tagged by "Building", but the slopes of these spots are higher. The attractive spots with the " Person " tags where hikers take portrait photos as souvenirs are most widely distributed in elevation and slope. There is not specific relationship between these spots and their topography. They are mainly choices for resting places.

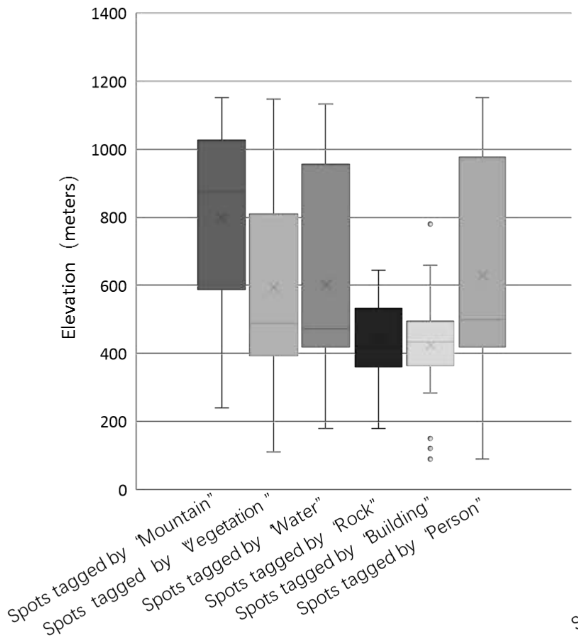


Figure 17: Distribution of elevations of the spots

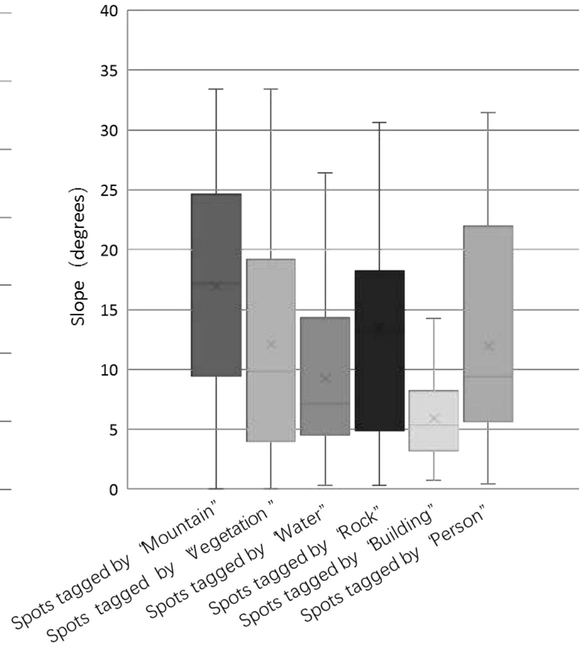


Figure 18: Distribution of slopes of the spots

5. Conclusion and Discussion

Hiking in the outskirts of mega cities as a kind of environmentally friendly and sustainable urban tourism has significant benefits. For a long time, Internet has been the major information media for hiking tourism, continuously expanding the market scale (Huang, 2005). This study used geo-tagged photos on social networking sites to detect the attractive spots of hiking tourism. It provides new ideas and directions for the study of hiking tourism. The attractive spots obtained using this method can provide basis for the planning and management of hiking tourism. For example, these spots can be places to provide travel services after being fully equipped with service facilities. Besides, these places are where the hikers prefer to stay, so they easily tend to be crowded. The security protection facilities and the measures to prevent congestion should also be considered. The improvement of the landscape quality of the spots based on their tags is also very important. For example, the spots tagged by "Mountain" are generally places to enjoy the distant mountains, so they should be ensured to have good visions. While the attractions of spots tagged by "Water", "Stone" and "Building" always have close views, the promotion of the original landscape and the addition of new landscape structures can be taken into consideration.

The method used in this study has great potential in the planning and management of hiking tourism, but there are still some limitations: 1) The chosen social networking site is mainly targeted to groups loving hiking and reflects the information of many hikers, but it cannot fully cover all the information of hikers. 2) If the satellite signals are not good enough in some jungle districts, the geo-tagged information may be biased (Taczanowska, et al, 2008).

With the development of social networking sites and GPS technology, the information of geo-tagged photos shared on the Internet will become more abundant, comprehensive and accurate. In actual planning and management, the attractive spots of hiking tourism obtained by this method can provide effective early guidance. However, in the process of deepening planning and management, this method needs to be combined with on-site investigation because on-site investigation can verify the results obtained using this method and provide corrections.

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[i] Database source: http://groups.csail.mit.edu/vision/datasets/ADE20K/

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A study of Japanese neighborhood communities expected to work during climate change-related natural disasters – from the religious diversity perspective

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Abstract

In Japan, neighborhood organizations are expected to work during large-scale natural disasters, and municipalities have begun encouraging their activities. Some of their activities are related to shrines or temples. Therefore, the way in which the neighborhood organizations are used as a tool to create social capital by municipalities is an issue from the perspective of religious diversity. Moreover, the relation between neighborhood organizations and municipalities warrants examination. In this study, the issue is investigated and the results are reported.

1. Introduction

1.1 Background and objectives

In addition to climate change, the number of natural disasters has been increasing and it has become difficult to predict where they will occur next. After Higashi-nihon Daishinsai (the Great East Japan Earthquake), the Japanese government began promoting mutual aid with neighbors. Numerous studies have highlighted the importance of social capital when huge disasters occur (Iwagaki, Tsujiuchi and Ogihara, 2017) (Yoshizawa, 2017).

Traditionally, Japanese neighbors establish neighborhood organizations that are based on specific areas. Each neighborhood organization has its own separate area, which does not coincide with the area of another neighborhood organization. Therefore, there are differences in their operations, role sharing within the organization, and relationships with municipalities

Recently, many reports and books have described neighborhood organizations' issues, including a decline in the percentage of households that are organization members and, a shortage of members, who work for the organizations. Therefore, depending on the area, the municipalities have begun encouraging neighborhood organizations. Historically, Japanese neighborhood organizations fulfill functions such as providing mutual aids, accomplishing cooperative work with municipality, representing their area, and conveying the opinions of the community, this is one form of community participation in Japan.

This study focuses on how the municipalities use the neighborhood organizations as a tool for creating social capital. The treatment of these organizations by the municipalities reveals the position on religious matters.

1.2 Previous research

There is considerable research on neighborhood communities and neighborhood organizations in the field of Sociology, and etc. These studies have examined and analyzed as a neighborhood organization as a local organization having historical or traditional meanings (Ajisaka and Komatsu, 2008). They have also analyzed the relations between municipalities and neighborhood organizations. Kamiya (2014) analyzed neighborhood organizations as a tool for encouraging social capital. Neighborhood organizations have also been studied as representatives of community (Nakada, Yamazaki and Kogiso,2017) (Nakada, 2000) (Nawada, 2009). However, few studies have examined neighborhood organizations from the perspective of religious diversity (Susaki, 2016) (Susaki, 2017), and no study has analyzed the relationship between municipalities and neighborhood communities from the religious diversity perspective.

1.3 Research method

In this study, neighborhood organizations of two municipalities the Shinagawa ward, Tokyo, and Kyoto City were compared and analyzed. Both Kyoto City and Shinagawa ward have regulations that encourage local communities and neighborhood organizations, respectively. However, since their aims and contents substantially differ, these two municipalities and their neighborhood communities were compared.

For comparison purposes, documents published by these municipalities were collected from websites or other sources. In addition, phone interviews were conducted with the persons concerned with this matter at both municipalities. Initially, the plan was to distribute questionnaire surveys to neighborhood organizations in both municipalities; however it could not be realized because of the Act on the Protection of Personal Information.

2. General situation of neighborhood organizations

2.1 Neighborhood organizations in Japan

According to The Cabinet Office (2007), 93.6% of Japanese areas have a neighborhood organizations; moreover, the area size of 72.3% of these neighborhood organizations smaller than that of an elementary school. The average number of households that are members of neighborhood organizations is 600 and the membership percentage is 89.2%.

The listed responsibilities of neighborhood organizations include delivering information of their events, distributing their newsletters, and establishing communication among their members; 90.8% of the neighborhood organizations fulfill these responsibilities. In addition , among these organizations, 78.5% inform the community about topics from the municipalities, 71.2% organizing festivals and Bon dancing; notably these are the top three responsibilities of the organizations. The following fourth and fifth responsibilities are managements of street lamps, fulfilled by 66.3% of neighborhood organizations, and reporting requests of members to the municipalities, performed by 64.2% of neighborhood organizations.

There are many areas with other active residents' organizations or associations, such as women's association, children's association, and voluntary local fire brigades.

A major characteristic of Japanese neighborhood organizations is that they historically provide mutual aid. In Japan, there is no period in which mutual aid and corporation with municipalities has not been needed. Mutual aid and corporation with municipalities is the basic responsibility of Japanese neighborhood organizations; this primarily separates them from local communities in European countries.

Even though, neighborhood organizations are responsible for mutual aid and corporation with municipalities, there are no legal ground for fulfilling them. This is the second characteristic of Japanese neighborhood organizations (Nawada, 2009).

2.2 Neighborhood organization in the Shinagawa ward

The Shinagawa ward, Tokyo, has 201 neighborhood organizations. The entire Shinagawa ward area is covered with neighborhood organizations without any over laps. Neighborhood organizations are divided into five groups, depending on their geographical area (Shinagawa, 2016b).

The population of the Shinagawa ward is 392,213, with 379,478 Japanese and 12,735 foreign residents (Shinagawa, 2016c). The average number of households in one neighborhood organization is 595 (Shinagawa, 2016a). Neighborhood organizations in which the number of households is less than 500 is 48.5%; more than half of the neighborhood organizations are constituted by more than 500 households.

The histories of neighborhood organizations vary depending on the geographic location and other factors. The oldest neighborhood organization was established in 1903; 16 (14.3%) neighborhood organizations were formed before World War II. Most of the organizations were established from 1946 to 1989 (after World War II).

The most popular activity of neighborhood organizations is the conducting the "disaster emergency drill." This activity is performed by 95.8% of the neighborhood organizations. The second most popular activity is "a fund-raising campaign for Red Cross," which is carried out by 95.7% of the organizations; organizing "festivals" is the third most popular activity completed by 90.2% of the organizations. Considering the activity list of each neighborhood organization, "festivals" imply not only festivals of shrines but also events such as Hanami (watching cherry blossom and eating and drinking near the trees). The fourth and fifth activities are providing mutual aid for "ceremonial occasion," performed by 87.1% of the organizations, and "cleaning up their neighborhood," undertaken by 86.5%.

According to the recognition of neighborhood organizations, the top two important activities are "disaster emergency drill" and "festivals," as chose by 67.3% and 64.3% of neighborhood organizations, respectively (Shinagawa, 2016a).

As mentioned above, "festivals" are of two types . One is related to shrines or temples and the other has no relation to shrines or temples (Shinagawa, 2016b); it is an event for the community. Festivals related to shrines or temples have religious meanings and there are some members who do not support and participate in them because of their faith (e.g. if they are Christians). According to Susaki (2017), they have less trouble in avoiding participation in these activities

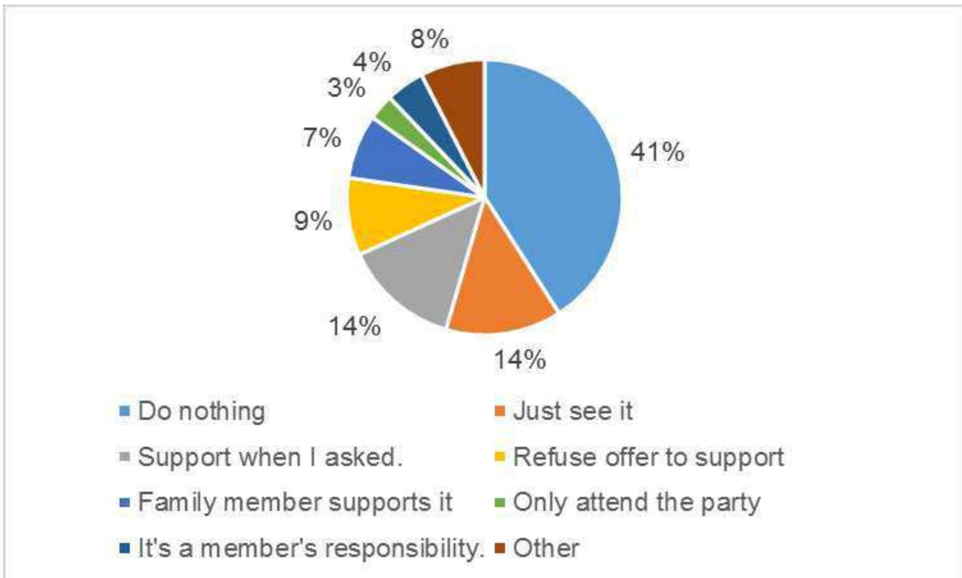

Figure 1:How do you deal with festivals of shrines or temples ?

Reproduced from Susaki (2017)

Figure 1 presents the results of a questionnaire survey administered to the Christian members of neighborhood organizations in all 23 wards of Tokyo (Susaki, 2017).

Some neighborhood organizations have their website on which they announce their activities (Figure 2) or they use the website of the Shinagawa ward municipality, on which there are information pages for all neighborhood organizations.

Figure 2: An information of festival of shrine

Reproduced from Shinagawa (2018)

2.3 Neighborhood organizations in Kyoto City

The inner areas of Kyoto City have a history that date back to 794 (beginning of Heian era) generations of emperors lived there until 1869. In those areas, the masses established very closely connected neighborhood organizations in the 14th century, which laid the foundation for the current neighborhood organizations. In other area of Kyoto City, organizations historically based on communities of shrines are common and some have strong connections (Ajisaka and Komatsu, 2008).

Local communities in Kyoto City have specific feature called “Gakku,” which is based on “Cho-gumi,” a neighborhood organization from the Muromachi era (in 14th century), and “Bangumi-Shogakko (Numbered elementaly school)” from 1870 (the beginning of Meiji era).

Although the “Gakku (or “Moto-Gakku”)” is different from the current elementary school district, they are kernels of local community in Kyoto City. Overall, Kyoto City has 222 “Gakku” and each “Gakku” has neighborhood organizations; in some cases, other local organizations are also included in “Gakku” (Kyoto, 2016).

Kyoto City has 11 wards and each ward office has the most information about “Gakku,” however, the Kyoto City website does not clearly indicate whether one “Gakku” covers two wards or not.

The total population of Kyoto City is 1,412,293, which includes more than 40,000 foreigners (Kyoto, 2018).

Figure 3: Jizo-Bon

(Sakurai, 2015)

The percentage of members in neighborhood organizations is approximately 69.8%. Furthermore, 42.5% and 75.4% of neighborhood organizations have less than 50 and less than 100 households, respectively. Each neighborhood organization performs two types of activities. One is their own activity and the other are activities associated with the Gakku. A total of 76.9% of neighborhood organizations consider “Jizo-Bon” as their own activity while 72.6% and 46.5% of organizations list “providing mutual aid for ceremonial occasion” and “having dinner or undertaking a friendly “ as their own activity, respectively (Kyoto, 2012).

“Jizo-Bon” is organized in two ways; one, as an event for children and the other as a religious event. For the latter, a Buddhism monk is invited to recite sutras and perform several rituals to pray for Jizo; on the other hand, the event for children is similar to a children’s festival (Maeda, 2015). There are members who do not participate in this type of event because of their faith. Susaki (2016) observed that it is difficult to avoid participating in these events.

Figure 3 depicts a Buddhism monk sitting in front of an altar that is enshrined with Jizo; the monk is reciting a sutra. Children participate in this Buddhism ceremony and worship Jizo. This event is organized in the last week of August in most parts of Kyoto City by neighborhood organization.

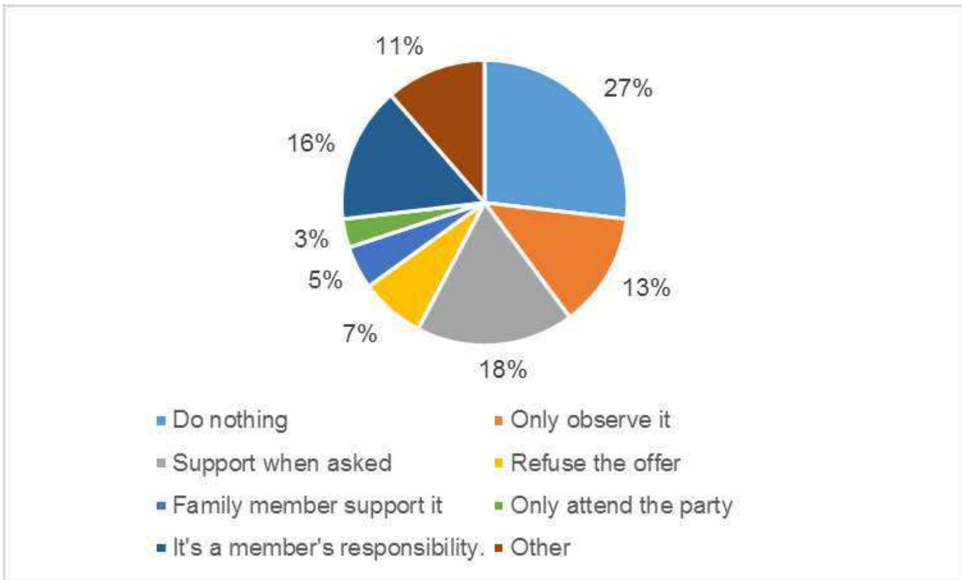

Figure 4: How do you deal with festivals of shrines or temples ?

Reproduced from Susaki (2016)

Figure 4 presents the results of a questionnaire survey administered to the Christian members of neighborhood organizations in Kyoto City (Susaki, 2016).

The most popular "Gakku" associated activity is "A field day or sports events" and it is performed by 71.4% of the "Gakkus," the second most popular activity is the "disaster evacuation drill," which is conducted by and 68.7% of the "Gakkus" (Kyoto, 2012).

2.4 Comparison on neighborhood organization activities in the Shinagawa ward and Kyoto City

In the Shinagawa ward, neighborhood organizations are more recent than those of Kyoto City; no neighborhood organization in this ward has a history that dates back the beginning of Meiji era. Furthermore, some neighborhood organizations in this area conduct festivals of shrines as their events. However, most members of the neighborhood organizations in the ward are not so earnest and members who do not participate can prevent others from participation (Susaki, 2016).

In Kyoto City, neighborhood organizations have long history and, more importantly, they have inherited traditional events. In addition, some of the traditional events have religious meanings, and therefore there are members who participate in such kind of events, although reluctantly (Susaki, 2016). In Kyoto City, a single neighborhood organization has a small member of households., compared with that in the Shinagawa ward. Moreover, the organizations in this city have a specific feature called "Gakku," which is lack in the Shinagawa ward.

3. Relationship between neighborhood organization and municipality

3.1 Shinagawa ward municipality

In 2016, the Shinagawa ward municipality implemented a regulation that encourages neighborhood organizations. The regulation establishes legal position of neighborhood organizations. According to the first interview with the responsible person in the office of the Shinagawa ward in 2016, they are aware that festivals, which have religious meanings, are in the activity list of some neighborhood organizations and that some members of the neighborhood organization want to prevent such kind of activities because of their faith.

According to the second interview with the officer, the regulation was implemented as a result of committee meetings. The aim of the meetings was not to create regulations, but to find a way to promote cooperation between the neighborhood community and the Shinagawa ward municipality. Following the implementation of the regulation, residents of the Shinagawa ward can become a member of their living area's neighborhood organization by simply posting a card without a stamp. One of the effects of the regulation, which the municipality officers had heard from leaders of neighborhood organizations, is that the explanation of neighborhood organization becomes easier than before, when they invite new residents to the organization, because the organizations now have a legal position.

Figure 5: Neighborhood organizations are clearly assigned on the map

Reproduced from Shinagawa (2017)

In addition to the implementation of the regulation, the municipalities has increased the amount of supported money provided to neighborhood communities that fulfill tasks assigned by the municipality. This makes it easier to run the neighborhood organizations. Before the implementation of the regulation, the Shinagawa ward municipality set a committee and conducted meetings. The records of the meetings are available for public viewing on the Shinagawa ward website (Shinagawa, 2014). There were many discussions in these meeting and on typical agenda was changing the boundaries of neighborhood organizations because of the situation of roads that have considerable traffic.

In the Shinagawa ward, the relation between the municipality and neighborhood organization is very clear and visible, it can be easily understood by everyone.

3.2 Kyoto City municipality

The aims implementing regulations include the establishment of a local community in case of disasters, since, in Japan, the number of children is decreasing and the number of elderly people is increasing; moreover, the number of residents who do not become members of neighbourhood organizations was increasing (Kyoto, 2016).

In Kyoto City, the relationship between the municipality and neighbourhood organizations is completely different from that of the Shinagawa ward. The regulation encourages local community activities; however, the neighbourhood organizations are the only actor. Moreover, the Kyoto City municipality and neighbourhood organizations do not have direct contact.

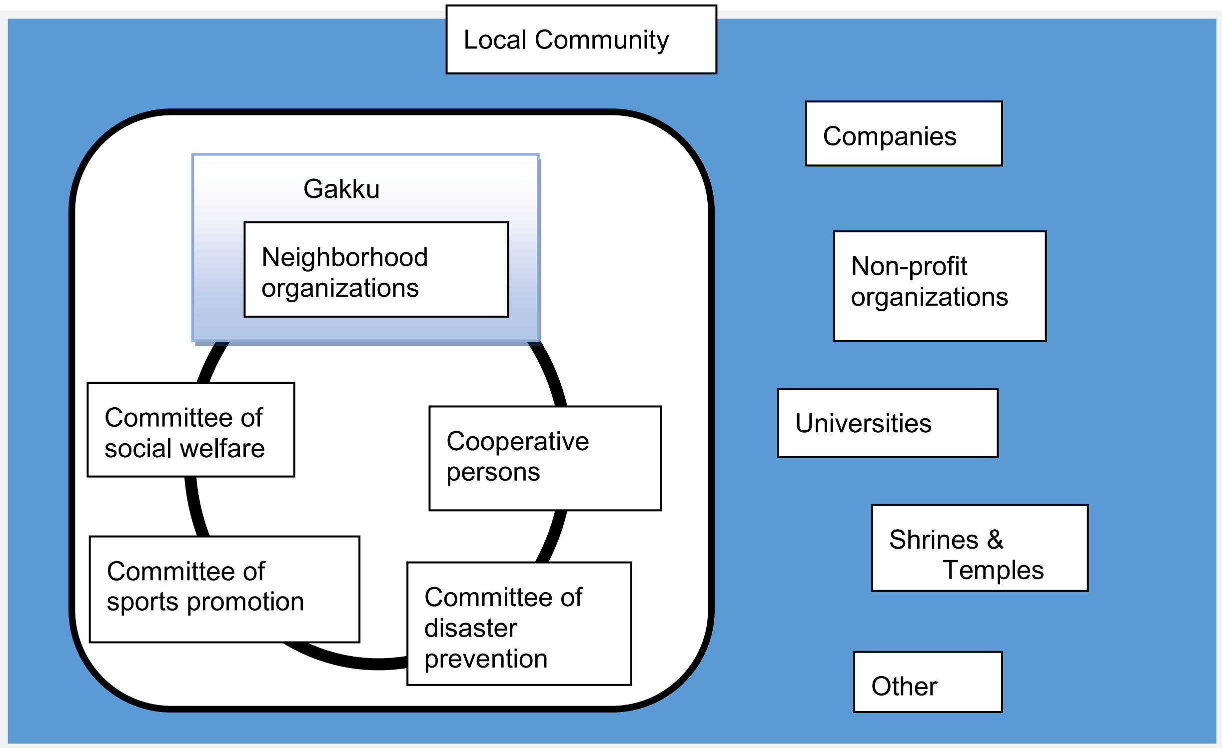

Figure 6: An image of local community

Created and translated in English by referring to Kyoto (2016).

According to the regulation, the Kyoto City municipality developed a plan to encourage local communities, which comprise neighbourhood organizations, other area based organizations, and cooperative persons from Kyoto City municipality, who are part time officers. The regulation assigns a legal position to cooperative persons from the Kyoto City municipality; their responsibilities include delivering municipal documents, collecting information required by the municipality, and communicating the requirements of residents, who are in the assigned area, to the municipality. Cooperative persons are assigned depending on the population of each area and all persons have their assigned area. They are assigned by the Mayor of Kyoto City and they attend the meeting assigned by “Gakku” to communicate with each other. The Kyoto City municipality connects with its residents via these persons.

In the Kyoto City plan (Kyoto, 2016), local communities are organized by neighbourhood organizations, other organizations supported by residents in the area, companies, universities, non-profit organizations (NPO), other organizations supported by non-area based residents, temples, shrines. Figure 6 presents the organization of local communities.

After trying for several years, the Kyoto City municipality is aware that it is difficult to reconstruct organizations in each area; the current position of Kyoto City is to maintain the current structure in each area. Furthermore, the Kyoto City municipality attaches importance to residents’ autonomy, which has a long history; the municipality is proud of this autonomy and considers the strength of the city.

The plan precisely explains how a neighbourhood organization should be constructed. According to the interview responses, new neighbourhood organizations are sometimes constructed in newly developed residential areas or areas with newly built condominiums. However, whether it is better to establish a new neighbourhood organization is another matter. If residents do not establish neighbourhood organizations, there are no neighbourhood organizations in that area. From the beginning, coordinators, who are officers of the Kyoto City municipality, have participated in the discussion on how to do it.

When neighbourhood organization wants to restructure and needs supports, these coordinators provide the necessary support in the process.

According to the plan, the local community includes temples and shrines, which is an important point from perspective of religious diversity. The interview responses related to this point suggested that many neighbourhood organizations have strong connections with shrines or temples and some of them list the activities of shrines or temples as their main activity. Therefore, argument from the perspective of religious freedom, the regulation and plans state that the local organizations are independent of the Kyoto City municipality and that they are organized solely based on the agreement of the participating residents; this seems tricky, but it is legal.

In Kyoto City, local communities, including neighbourhood organizations, are invisible and difficult to understand to individuals from other cities; apparently, it is not easy finding out how to become a member of a neighbourhood organization.

3.3 Comparison between the municipalities of Shinagawa ward and Kyoto City

The Shinagawa ward municipality directly supports neighbourhood organizations; the relationship is clear and visible for everyone. All neighbourhood organizations are introduced on the municipality’s website and the area where a neighbourhood organization is located is clearly indicated, as shown in Figure 5. Moreover, the activities of each neighbourhood organizations are announced both on the website and in the guides of each neighbourhood organization. The restrictions on members to participate in festivals with religious meaning are weak; they can select their place of residence after checking the activity lists of each organization.

The Kyoto City municipality supports many kind of organizations in the local community and each has its own history and background. These organizations are independent and the municipality cannot reconstruct them. The boundaries of the Gakku or neighbourhood organization are sometimes ambiguous, and therefore the Kyoto City municipality is unable to create maps, such as Figure 5.

There are many neighbourhood organizations, that have a strong relationship with shrines and temples. A member of such neighbourhood organizations is expected to support the festivals of shrines.

Unlike the Shinagawa ward, the activities of each neighbourhood organization are not open; moreover, a person who wants to live somewhere in Kyoto City cannot chose his or her best area to live from a religious perspective.

4. Conclusion

The use of neighborhood organizations as a ways to encourage social capital in the Shinagawa ward and Kyoto City differs significantly. The Shinagawa ward municipality uses neighborhood organization as a core of social capital, while the Kyoto City municipality uses these organizations as one actor of social capital.

The Shinagawa ward municipality has begun cooperating with neighborhood organization. The Kyoto City municipality, on the other hand, first planned to cooperate with neighborhood organizations or Gakku, but the neighborhood organizations or Gakku in this area are too independent to be modified. Therefore, the Kyoto City municipality recognizes the value of self-governance of Gakku or neighborhood organizations; moreover, it does not have direct access to these organizations.

From the perspective of religious diversity, everybody can know about the activities of the neighborhood organization and can select the most suited place for residing in the Shinagawa ward. It is presumed that the percentage of neighborhood organizations that have a relation with shrines or temples is higher in Kyoto City than in the Shinagawa ward. Furthermore, obtaining information of neighborhood communities is more difficult in Kyoto City than in the Shinagawa ward. Therefore, it is difficult to find a suitable place to keep their faith .

Which way of encouraging social capital is more effective is another matter.

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Citizen participation for increased sustainability and quality of life in cities in Nordland County

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1. Background

About half of the world's population lives in cities today and by 2050 the figure is expected to rise to 70 percent. Seventy per cent of all greenhouse gas emissions and 60 per cent of all energy consumption takes place in cities. Cities also produce 70 per cent of all waste. Cities are thus both the problem and the solution to many of the major environmental and societal challenges, and this fact is reflected in the UN's sustainability development goals (SDG).

Urbanization and centralization are ongoing social processes in Nordland county in Northern Norway, affecting the population and their quality of life. The ten largest cities in Nordland county account for 68 percent of the region's population. They also provide 72 percent of the employment in the region. However, population growth in the county has been modest compared to the national average. Emigration to the capital (and other cities), aging population, and unemployment are continuous challenges for the region. To address these challenges, Nordland County's regional plan for city and regional development aims to develop compact, sustainable and innovative cities. A key element is to strengthen attractivity of the city as a place to visit and to live in.

1.1 Description of study site: Svolvær

The municipality of Vågan, located in the Lofoten archipelago in Nordland county, has a population of about 10 000 people. Its administrative center is the city of Svolvær, the largest city in the Lofoten region with a population of about 5000 people. Key business sectors are tourism, fisheries and aquaculture, fish processing- and mechanical industry in addition to typical urban sectors like finance, insurance and other services (SSB, 2018). About one fourth of the jobs in the municipality are in the public sector (Hjelseth et al., 2016:21). Traditionally being a center for the renowned Lofoten winter fishing, the relative importance of the fisheries sector measured in number of jobs has been reduced in the later years, while the importance of the tourism sector has been growing rapidly. After a dip during the early 2000s, the population has been growing since 2008, caused by net positive immigration (Hjelseth et al., 2016:18).

The growth in the tourism and service sectors have contributed to increased optimism and helped create an urban atmosphere in Svolvær. This, on top of the spectacular nature in the region, attracts not only tourists but also people that wish to establish a new life in Vågan and enjoy the mix of urban and natural qualities. The growth in population, and particularly in tourism has also led to local debates on the sustainability of the development with new challenges like increased housing prices and pressure on land use. During the peak tourism season the local population face challenges with inadequate waste management, pressure on natural resources and overcrowding.

Despite the growth in tourism, Vågan, as is the case for many municipalities in rural Norway, has experienced a steady outflux of Norwegian citizens towards the larger cities. This is particularly the case for young people. Vågan also scores lower than the Norwegian average on indicators for health and quality of life, a common trait for most of Northern-Norway (Vågan municipality, 2017:11). To counter this tendency, Vågan established a project aiming to produce new knowledge on how children and young people can live “the good life” in Vågan. Despite some positive effects, significant results have not been achieved partly because of lack of sufficient dialogue and mobilization of young people in the project (Vågan municipality, 2017:11).

The municipality is currently in a process of revising its community plan for the period 2018-2030, and wish to base this plan on holistic and updated knowledge, including through new and innovative methods for citizen involvement. The key question to be answered are related to how to secure a sustainable development for the citizens. This relates to what type of growth the municipality should promote through its policies, including what type of tourism is sustainable in the long run. Another question is related to cultural heritage and traditional fisheries: what is the significance of this heritage both in terms of local culture and attractiveness as a tourism destination, and how can this sector be protected and developed. Through citizen dialogue, the municipality wants to learn more about key positive and negative aspects of the recent development and the key premises for quality of life in Vågan.

2. Method for citizen participation: Needs based workshops

A sustainable urban development requires the active involvement of citizens and critical reflection on the paths of societal development. Participation of citizens in policy design also increases quality of life. This is because participation in itself is meaningful, builds trust, and not least, because it stimulates policy and planning that facilitates high quality of life. Citizen participation processes are, however, challenging in practice. Although the purpose of citizen participation is to facilitate dialogue between stakeholders with different interests and planning authorities, it has proven difficult for many citizens to understand and participate actively in complex and long-term planning processes. Many politicians and planners have challenges in creating commitment and involvement in more comprehensive decision-making processes. Furthermore, it is demanding to translate inputs that have come through these processes into policy decisions.

In this project, we will adopt Manfred Max-Neef's Human scale development (HSD) approach to involve citizens in identifying paths (and policy recommendations) that satisfy both human wellbeing/quality of life and environmental sustainability. Max-Neef differentiated between needs and satisfiers (Max-Neef 1991). Human needs are essential for wellbeing and are universal across cultures and historical periods. The means to satisfy these needs (satisfiers) vary between cultures, traditions and historical periods. He organized human needs as a matrix with two categories: existential and axiological needs. There are nine axiological needs: (1) subsistence, (2) protection, (3) affection, (4) understanding, (5) participation, (6) leisure, (7) creation, (8) identity, and (9) freedom and four existential needs: (1) having (2) being (3) doing and (4) relating (Max-Neef 1991). 'The key idea here is that humans do not have primary needs for the products of the economy. The economy is only a means to an end. The end is the satisfaction of primary human needs. Food and shelter are ways of satisfying the need for subsistence. Insurance systems are ways to meet the need for protection. Religion is a way to meet the need for identity' (Costanza, Cumberland et al. 2014, p.158).

A community can come together and identify satisfiers that are relevant for their particular context and time. Max-Neef and colleagues designed workshops to assist this process and to identify key institutions, (individual and community) characteristics and actions that satisfy fundamental human needs and increase quality of life. A matrix that contains the nine axiological and four existential needs (see table below) is used in this process.

	Being (individual or collective qualities)	Having (resources, tools institutions, norms)	Doing (personal or collective actions)	Interacting (settings and environments)
Survival				
Protection				
Affection				
Understanding				
Participation				
Idleness				
Creation				
Identity				
Freedom				

Table 1 Matrix of needs and satisfiers (template). Source: Max-Neef (1991)

The workshops are organized in two steps by a group of 12-20 individuals representing their community. In the first step, the group is divided into two. One of the groups identifies hindrances for actualizing fundamental human needs and achieving a good quality life. The matrix they fill in this process is called a negative matrix. The other group identifies the ideal situation for actualizing fundamental human needs, the ideal scenario. The matrix the group produces in this process is called the positive matrix. In the second stage, the two groups come together to discuss how the community can move from the negative to the positive matrix. In this process, they identify the role individuals and communities play in moving towards the ideal situation. They also identify policy measures at the regional and national level that contribute in this process.

The workshops are flexible and effective at identifying challenges and solutions relevant to policy design. They illuminate processes and mechanisms that promote or hinder people's quality of life and the sustainability of the natural environment. Needs based workshops have been used in some regions, cities and communities in Europe, the United States and South America to identify community- and policy relevant measures that contribute both to human wellbeing and environmental sustainability.

3. Results

(Forthcoming)

Following the description given above, we will organize workshops with participation from selected segments of the population to explore the interlinkages between personal, local and global factors that determine current hindrances and opportunities for sustainability and wellbeing in Nordland county. The outcome of the structured workshops are proposals for community/group, local and regional level-policy initiatives and a greater understanding of their interlinkages and trade-offs. The workshops will be implemented in early September and preliminary results from these workshops will be included in the updated paper we will submit 20th September. The results will also be presented at the ISOCARP congress in Bodø, 01- 05 October 2018.

4. Concluding remarks

(Forthcoming)

5. References

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Multi-dimension urban planning in renewal of the old city ------ a case study of urban renewal project in QuYang, Shangahi ,China

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ABSTRACT:

Community changes with the development of market economy. The differentiation and diversification trend of residents' needs has become more and more obvious. In the context of China's New Normal, inventory planning requires communities which has been built to improve quality and efficiency. However, the configuration standards we used now are unable to adapt to the needs of both. Under the conditions of traditional community management systems and mechanisms, the ability to integrate community resources is poor. This kind of management tends to cause uneven distribution of resources and waste. Social management and social service network is an important way to solve such problems.

This study is based on the foundation of the old city renovation plan. We build a data platform for third parties, which including: government management platform, property management platform and convenience service platform. We use these data platforms to improve community management and living services. We can improve management systems and mechanisms in communities. We can integrate community management resources and establish a new mode of community "networked" management services. The community's grassroots social management is strengthened by the platform. Social conflicts are resolved. Social harmony is promoted. We use the method of minimal adjustment and multi-dimensional planning to achieve the purpose of the transformation of the old city. After such transformation, the community has improved the functions of community management and services.

The research workflow includes the following steps:

(1) Preliminary demand survey;

(2) Data analysis;

(3) Integration of resources and planning adjustments to form a feasibility plan;

(4) To build a web platform, and setting up a client client and offline services;

(5) Obtaining big data through operation management, according to which data can be adjusted for programs and services, and at the same time form a report.

We conduct surveys on the needs of public services and facilities through established mature communities, establish basic databases, and use the Internet and mobile Internet technologies to build community public service interactive platforms based on this. We provide real-time information on the supply and demand of community public services, and master basic public services in a timely manner. We master the actual needs of basic public services and facilities (ICMP system) timely. Based on these more real and detailed demand information, the demand and structure of community public service and facility resource allocation are forecasted, and relevant planning indicators and planning and design requirements are provided for users, suppliers, decision makers and investors. The basis for reducing the gap between supply and demand provides more efficient and high-quality service (facilities) configuration for community planning and design, community construction, management, and development.

The Framework Research on Sustainable Conservation of Urban Building Heritage: Collaborative Visioning for the Future Based on the Complexity Theory

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1. Introduction

As an important resource for stimulating economic growth, building heritages conservation and sustainable development has received increasing attention. However, the contradiction between urban development and resource protection is still a common problem[1]. Especially, the sustainability of building heritages in the cold regions of China are continually confronted with severe challenges such as the extreme environments anthropogenic effects, as well as the challenges in the process of globalization nowadays. The core is how to effectively coordinate and optimize the relationship between the conservation of heritages and the rapid improvement of economy and tourism. The identification of the priority areas and strategies is the key to realizing the optimization choice of the conservation behavior and achieving the sustainable development of heritages surrounding-environments in the development of urban system. Many experts have proposed attentions to conservation behavior and use empirical analysis methods to study the behavior characteristics that influence the sustainable-conservation of building heritages and their spatial environment, to seek a sustainable planning framework or to support for policy management[2].

Nowadays, with the rise of the scientific paradigm shift and model theory, and the development of the spatial data, the use of the complex model of urban-system and their evolution analysis become one of the important researches of urban theory. Some experts have proposed the new science of heritages drawing strengths from complexity theory. The starting point is the conference organized and chaired by the two authors in Singapore on "Heritages Science as a Complex System" [3]. In the research they proposed the concept that in keeping with the spirit of the entire collection, to use the language of complexity as a lingua franca and observe heritages through the lens of complexity to study emergent properties in human-heritages-landscape systems[4,5]. Some researches aim to address the question of how this acquirable knowledge can be linked to action (policy- and decision-making) by public and private institutions (local communities, government agencies, international organization, corporations) in the framework of a new science for the systematic study of the principle and use of heritages through observation and experimentation.

Though some advances have been made, most focus on individual building, and certain achievements have been made in the protection policies, laws and regulations, as well as individual building protection technology and methods[6,7]. Existing planning strategies mostly biased towards individual buildings maintenance and renovation suggestion rather than from a comprehensive conservation to consider the factors differences between different heritages and their surrounding-environments. In addition, less attention is paid to dynamic changes in the conservation, behavior.

Buildings heritages in cities is influenced by their immediate local environment factors such as local microclimate condition: temperatures, wind speed, air pollution levels, noise, access to daylight, etc. which can result in significant impacts in the sustainability of buildings heritages conservation. The heritages sites, their environment and function optimization are required to maintain a building heritage at acceptable local conditions. As well as the two-way of information transfer between the multi-stakeholder in the relevant cultural heritages sites and the urban planner also results the dynamic interaction the performance of conservation approach. Therefore, combining the Heritages Impact Factor Theory (SHIFT) and behavior-oriented framework are the vital connection between quantification simulation and decision-making, aiming to provide a down- top approach[8].

In this paper we typically referred these as Sustainable Heritages Impact Factors, these are largely anthropogenic, resulting from local agglomerations of density of buildings and population, behavior, activities, and occupant's knowledge and values of a region. We aim to investigate and identify how heritages data can be distilled into knowledge, so as to support political decision-making with scientific methods and evidence to reinforce the identities and values of all stakeholders.

Paper investigates the relative influences of three geospatial parameters by agents: local environment, policy index, and composition of building types (based on their function, values and social preference) in 13 districts of Shenyang Province of China. Based on the dynamic simulation with the multi-agent system, each agent expresses its own characters with the activity and protective behavior. According to the results of ABM proposed in different stages with the model how to choose and how to coordinate the behavior of each agent in a system prospective were proposed, and the protective behavior strategies were also proposed. With the qualitative as well as quantitative results drawn from the analysis, this paper proposes specific suggestions on how to improve the sustainability of buildings heritages sites in the urban context.

2. Method of Model Formulating

The theory of complex adaptability system is the components of functional system, where single agents in the environment and playing individual roles in their interactions and coordination [9]. In the context of the system the Multi-agent simulation method is a technique for bottom-up modeling, providing an alternative perspective to those that can be attained by using optimization approaches. In agent-based simulations, system behavior emerges from the behaviors of interacting agents. Its advantages have been widely recognized by the experts, but the application of heritages conservation and simulation research has just started[10].

Sustainable conservation of building heritages and their surrounding environment in urban system is a challenge, which needs an integrated research platform, and a common language. The decision-making of protection behavior in tourism destinations is a systematic decision-making process that links the executives of various behaviors.

2.1 ABM Model Behavior

As proved by exist research ABM is expected to contribute significantly to the study of behavior-environment interactions, and to provide a valuable tool for exploring the effectiveness of policy measures in city complex environments [11].This characteristic of ABM makes it a practical approach for simulation of policy and meanwhile, revealing the effectiveness of conservation policy.

The purpose of this research is to develop an agent-based analysis model for sustainability conservation of buildings heritages. This new environment is named CBAM from the initial letters of Conservation Behavior Analysis Model of building heritage. The new analysis environment aims at revealing the possibility of reflecting implementation effects of this conservation policy by local city of northwest of China.

An agent is an autonomous and potentially self-directed entity that is characterized by a set of attributes. Agents are situated in a system in which they interact with each other and their environment. The behavior of an agent is usually driven by its goals. The Multi-Agent-Based Modeling (ABM) method starts from analyzing the behavior of the individual agent, and modifying the behavioral characteristics of multiple agents through the system's rules, and the model will ultimately optimizes the system by conducting different behavior selection[12]. It has been widely used in simulation studies of socio-economic-environmental systems such as land use, urban development, and group behavior analysis[13].

We attempt to conduct simulation of conservation behavior strategies of building heritages through ABM in order to reveal the possibility of ABM on analyzing the implementation effects of promoting policy. The policy includes allowances for hierarchical and classification coordination system of conservation behaviors is established by ABM as shown in Tab-1.

Table 1: Conservation promoting policy in famous historical and cultural town or village.

OBJECT CATEGORY	POLICY description	
Building Heritage	Characteristics	The traditional pattern and the historical style and features are preserved in the buildings
	1. protection principles, protection contents and protection scope;	
	2. protection measures, development intensity and construction control requirements;	
	3. requirements for protection of traditional pattern, historical style and features;	
	4. core protection scope and construction control belt of the famous historical and cultural block, town or village; and	
	5. a phased program for implementing the protection planning.	
Agent Apply	Agents category	Environmentalist, Researcher, Residents, government agencies, Tourist
	Behaviors Index	Intent, Current satisfaction, General behavior preference value, Conversion behavior preference value, Behavioral preference index
Surrounding environment	Characteristics	1The cultural relics preserved there are particularly rich;2 The historical buildings there are clustered;3 The traditional pattern and the historical style and features are preserved there.
	1. descriptions on history and development, local characteristics and historical and cultural value;	
	2. status quo of traditional patterns and historical styles and features;	
	3. Define protection scope;	
	3. requirements for protection of traditional pattern, historical style and features	
	4. core protection scope and construction control belt of the famous historical and cultural block, town or village;	
	Agents category	Environmentalist, Researcher, Residents, government agencies, Tourist
	Behaviors Index	Intent, Current satisfaction, General behavior preference value, Conversion behavior preference value, Behavioral preference index

2.2 Description of CBAM

In our research the decision-making of building heritages conservation is a systematic process of decision-making that links the performance of various behaviors. The foundation of multi-agent simulation is that each agent has the abilities of both behavior learning and adjustments, such as the historical buildings and their surrounding environments, tourists, enterprises, residents, local governments, are all in the large city system which have multi-hierarchy and dynamic interactions. Based on the interaction between various agents and the environment, the environment is link to the building heritages sustainable conservation behavior of multiple individuals in a complex urban system (Fig. 1).
In CBAM each building heritages and their surrounding environment will be further defined by a series of special attributes. Agent will make decision on new conservation strategies based

on the conditions of environmental historical culture and socio-economic as well as the local policies. Before conservation strategies are readjust, government agencies will firstly evaluate the utility and condition of current building heritages location. This process will produce a satisfaction evaluation of current building heritages condition location and hereby, decides the readjusted desire.

Therefore, this paper investigates the relative influences of three g eospatial parameters by agents: local environment, policy index, and composition of building types (based on their function, values and social preference) in 13 districts of Shenyang Province of China. Based on the dynamic simulation with the multi-agent system, each agent expresses its own characters with the activity and protective behavior, taking protection behavior preference as the interaction points. By analyzing the behavioral characteristics and interactions, this paper aim to build a multi-objective behavioral decision-making framework and to analyze the differences in conservation behavioral preferences of different agents from the micro-level and their impacts on building heritages and surrounding environmental systems. Then this paper explores the behavior characteristics of the overall behavioral decision-making of the conservation system, and compare with three different scenarios to optimize the selection of sustainable conservation behaviors for building heritages. The results are supposed to reveal the scientific and dynamic differences in decision-making for sustainable conservation of building heritages.

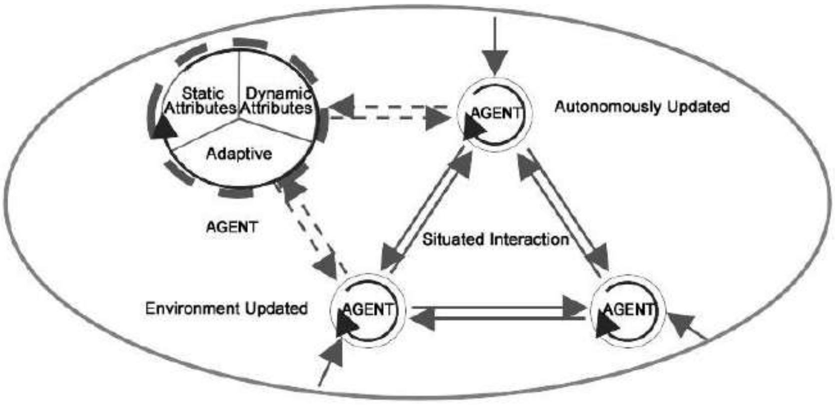

Figure 1: Cconceptual illustration of four interactions in ABM

In this work ,instead of using real persons as individual agents, five types person including Tourist Environmental practitioner government agencies, tourism practitioner Residents are defined as different behavior agents. Physical condition of building heritage and social-economic condition of their surrounding area are defined as agents in CBSM and behavior agents can make decisions after comprising with the attributes of conservation evaluation-indicators for single or groups of building heritages.

In CBAM, the rules of behavioral constraint are determined by three levels: the target level (behavior requirements), the criterion level (behavior preference), and the measure level (decision and measure).CBAM-ABM ranks the importance factors that influence decision making and builds the behavior decision-making matrix to select conservation behavior. Multi-agent simulation is an optimization for static analysis process, emphasizing the adaptability and micro-dynamic changes of the behavioral system from a macro-perspective with considers the interaction of the objects and agents[14].

The CBAM system consists of three layers, input variables, behaviors evaluation and output variables (Fig.2). The first layer is “Input variables” including the behavioral characteristics of the agents that directly influence the evaluation of behavioral performance, including surrounding environmental factors, natural environmental conditions, historical culture, and socio-economic conditions；The second layer is behavior evaluation which mainly indicates the behavioral preferences and influence intensity of different agents under certain conditions including tourists, urban planner, government authorities, community residents under certain conditions. The output variable layer reflects the optimization and adjustment of the system behavior after multi-agent simulation, which is the result of behavior decision.

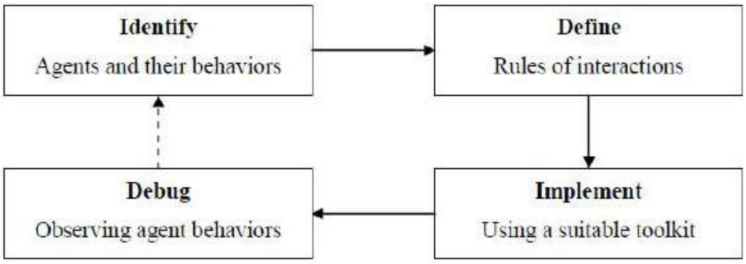

Figure 2: Four steps for the implementation of CSAM- ABMS model

3. Study Area and Data Description

3.1 Testing and Validation in Shenyang province

Shenyang, as capital city of Qing Dynasty, has many cultural relics and historical sites. Shengjing palace, known as "Forbidden City outside the Forbidden City", is a symbol of Shenyang's famous city. Although Shenyang has been rated as a "historic city" in recent years, owing 10 historical and cultural blocks, 46 national first level protection buildings and 4 traditional folk villages, there are still a large number of quasi historical buildings which have been seriously damaged in the rapid construction of the city. Since 2011, Shenyang has strengthened the investigation and appraisal of historical architectural heritage and Archival Protection and archival work, and 113 new historical buildings have been added to the historical buildings. However, these historical architectural heritages are widespread in poor use because of the unclear number of Shenyang quasi historical buildings, the lack of the main body of the implementation and the improper protection measures. In order to accurately analyze the protection and utilization of Shenyang's historic building heritage and its surrounding environment, this paper takes Wu Jia Village in Shenbei as the specific investigation and research area(Fig.3).

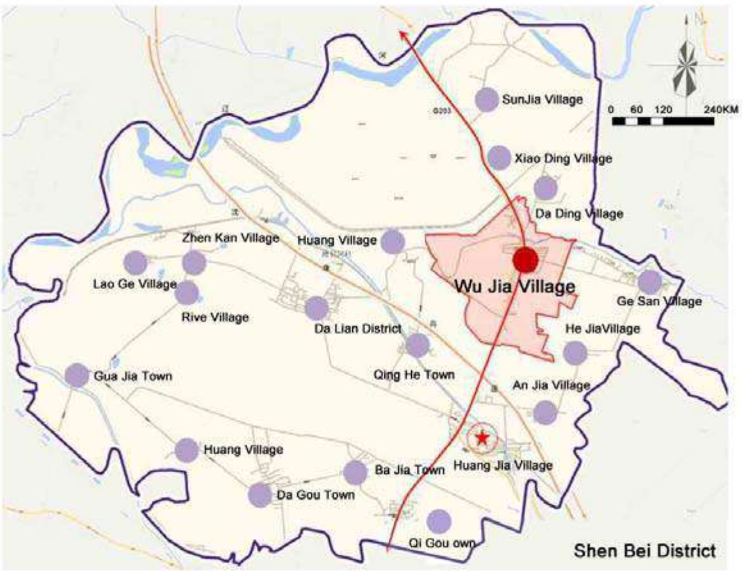

Figure 3: Study Area

Located in the north of Shenyang, Shenbei Wu village is a gathering place of historic architectural heritage and traditional villages. The research area ranges from 123 degrees 16'to 48' in the east longitude, from 41 degrees 54'to 42 degrees north 11', with a total area of 70.2 hectares. Shenbei Wu village is located in the cold area. The annual average temperature is 7.8-9.0 ℃. The average temperature in winter is -12 ℃, and the lowest temperature in winter is -35 ℃. The cold climate is likely to threaten the frost damage to historic buildings, and many existing historical protection buildings have no modern facilities such as heater or air condition, resulting in a decline in the utilization rate of historical protection buildings. Without the utilization and maintenance of human beings, historical protected buildings are hard to maintain properly.

3.2 Description of executive system of conservation behavior

The behavior execution system is divided into five types of agent: tourist, environmental practitioner, government agencies, tourism practitioner, residents. There are different characteristics in behavioral preferences for each agent due to the differences in conservation motivation and desires. Based on the evaluation of the significant priority of various behavioral preferences, and the feedback（influence） of environmental condition, economic, and social factors of the system sort the importance of conservation strategies and improve system behavior accordingly (Fig. 4).

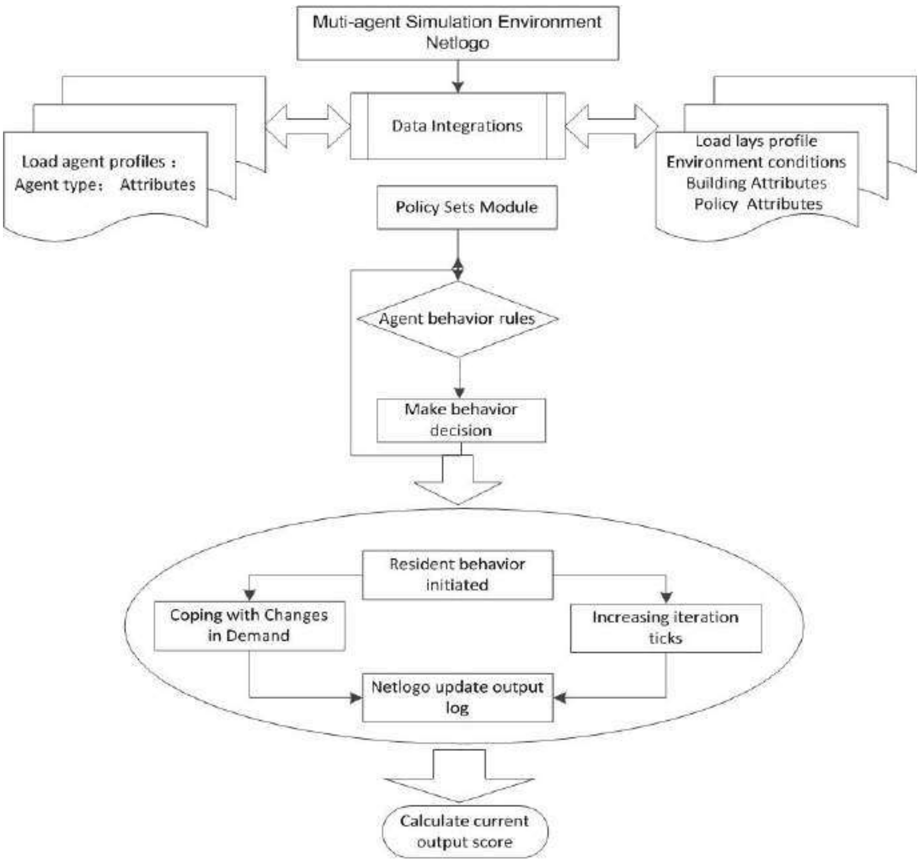

Figure 4: State Diagram for Conservation Behavior Analysis Model of building heritage

3.3 Description of behavioral preferences

CBAM has a series of spatial attributes, which will be inputted in the beginning of simulation, and agents can conduct satisfaction evaluation based on the spatial attributes of their locations. The mechanical models for evaluation on agent can be satisfied with current environment condition of building heritage according to questionnaires as description below. For collecting data, we estimated the necessary coefficients using the questionnaire carried out in Shenyang province,in which 382 persons were selected to be the inquisition object, collecting 330 valid questionnaires, with 86.4% efficiency. In which 190 questionnaires were selected form community residents and 56 are from I Tourists, researchers, government agencies administrators, urban- conservation practitioners. The content of the questionnaire involves the demographic characteristics, the conservation willingness of different career groups, and the satisfaction about the current conditions of building heritages and surrounding environments, and the intention of tourism development. Then we process and analyze the valid questionnaire by applying SPSS, according to the rulers of calculating scores. According to the analysis of sample data, the intention, satisfaction and behavior preference have strong correlation with conservation behavior of different agents which can be used as evaluation indicators of behavior preference. Since the values of behavior preference of each agent are impacted by the difference of sample weight, structure and individual decision, this paper builds the intensity of behavior preference model.

The behavior preference value is calculated as below:

$$S_i = \frac{\sum_{j=1}^{n} i_j \times x_{i,j} + \alpha}{N}$$

$$S_{threshold} = 3, \quad (1-5)$$

$$S_{threshold} = \begin{cases} S_i > S_{threshold}, & \text{(Satisfied by current condition)} \\ S_i \le S_{threshold}, & \text{(Unsatisfied by current condition)} \end{cases}$$

As shown by the equations, variable S_i stands for the satisfaction preference of the respondents i' s current building heritage condition . a_j is a vector of behavior preference coefficients value to variable j, which obeys the order in Tab-1. In addition, i indicates the willingness to protect and the satisfaction of current building heritage condition, which obeys the order from the survey sample data of each agent, the willingness degree of each factor was divided into 0-1(1 indicates the strongest, 0 indicates the weakest).

In order to avoid the influence of the sample size, we select 5 expert evaluation teams which are consisting of geography, urban planning, and tourism economics to score the relevant behavioral preferences of each agent group. The average of the expert scores is taken as the weight of the different sample indicators. Finally, the weights of the questionnaires and experts are averaged to obtain the weight values of each sample. The results are showing in table 2 as below：

Table 2: Preference with the object of conservator behavior in research site

Agent behavior Index	Tourist	Environmental practitioner	government agencies	Tourism practitioner	Residents	Experts
	N-Sample 56	N-Sample 31	N-Sample 15	N-Sample 38	N-Sample 190	N-Sample 30
Willingness (0-1)	0.42	0.89	0.73	0.87	0.69	0.76
index weight	0.20	0.28	0.26	0.31	0.22	0.31
Current satisfaction (0-5)	4.02	3.17	4.10	2.50	3.21	3.56
index weight	0.34	0.28	0.46	0.35	0.32	0.41

General behavior preference (0-1)	0.25	0.59	0.65	0.47	0.28	0.55
index weight	0.32	0.27	0.46	0.25	0.33	0.23
Conservation behavior preference (0-1)	0.22	0.90	0.65	0.58	0.62	0.85
index weight	0.18	0.22	0.20	0.30	0.16	0.21

3.4 Description of weight setting for the index of behavior impact

Wu Jia Village is a typical Manchu area, with a history of more than 400 years. Most of the original residents were Manchu officials, belonging to the Huangqi. At that time, many officials' mansions were built, as well as some relative public buildings, including the government buildings, banks, post offices and leisure places in Manchuria. There are 5 buildings on the historical architectural heritage list in Wu's village. In addition, there are more than 20 buildings to meet the conditions of the historical architectural heritage according to the author's local investigation. These buildings are generally divided into three categories. The first type contains the well-preserved and in-used buildings, which still maintains its original building function, including 1 government office buildings, 2 Yanghang, 2 small post offices, 2 school buildings and 5 private residences. The second contains poor-preserved but still in-used buildings, including 8 private mansions, which have been reformed as commercial buildings like restaurants, cafes and shops. The third contains abandoned buildings, including 1 reclaimed Yanghang, 1 broken small post offices and 6 damaged private houses.

The behavioral preferences of different agents and the difference in satisfaction with the current conditions of building heritage and their surroundings are the rules for conducting impact evaluation of conservation behaviors. In the evaluation, the strength is calculated according to the interaction of input variables and behavioral preferences. Based on the principle of combination of qualitative and quantitative, we build the behavior intensity model by the method of analytic hierarchy process.

3.5 Utility of CSAM in Netlogo Urban Space

At present, the government departments have not put forward the protection and Reform Opinions on the quasi historical architectural heritage, except 5 history buildings in protection list. In the investigation, aborigines have deep memories and feelings about these buildings, and propose that the traditional architectural patterns and cultural atmosphere have influence on the surrounding areas. But in the past rapid construction, at least 30 old buildings have been demolished, and the original courtyard style has changed into a modern apartment, according to the aboriginal people. They urgently hope that the government can protect or transform the remaining old buildings, so as to preserve the cultural characteristics of the Manchu region.

CBAM is tested in Netlogo platform and three scenarios are simulated. Netlogo is chosen in this project because it has many functions, such as scenario-based analysis, GIS (geographic information system) environment, agent-based model[15]. Furthermore, this program is free in public domain and also has several extensions to link with other programs, such as statistical program R, numerical computing environment MATLAB. The first one focused on the model behavior of building heritage conservation by ignoring any policy adjusted influences. The other one inputted the policy influences in the simulation to conduct the interactions between policy implementation and community residents' responses. For considering the impact of planning policy, we define the spatial planning information and behavior information based on the typical urban form of Shenyang China. All the spatial information and building heritages information are taken as external conditions for the simulation model. This study concerns a urban space of 2500 cells (50 x 50) where each cell measures 500 m x 500 m. This hypothetical city has the characteristic of the investigation city of Shenyang. The land use zoning is based on the ratios of different land use types reflecting local urban plan in Shen Yang .

4. Model Result Analysis

4.1 Model Result

Based on the requirements of Netlogo set behavioral preferences for each agent, and the input variables will refer to the value of sample weight, protection behavior impact and condition factors. The optimization results of conservation behavior of multi-agent systems in each stage are obtained in Table 3. Stages 1 to 5 are five different stages of building heritage development. Stages 1 is the baseline scenario output of current data. Stages 2 to 5 are based on the conservation of building heritage and the tourism development policy, and the changes in weight of each agent are adjusted according to the policy of the tourism development.

Table 3: Stage of optimization results of conservation behavior of multi-agent system

Agent System	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
Tourist (F1)	0.26	0.15	0.34	0.40	0.55
Environmental practitioner (F2)	0.22	0.05	0.10	0.15	0.15
government agencies (F3)	0.14	0.22	0.12	0.18	0.18
Tourist practitioner (F4)	0.30	0.25	0.25	0.30	0.30
Residents (F5)	0.43	0.45	0.26	0.21	0.15
Order of protection behavior	F5＞F2＞F3 ＞F4,F1	F5＞ F1, F2＞ F3＞ F4	F1,F5＞F4＞ F2,F3	F1＞F4＞ F2,F3,F5	F1＞F4＞F2, F3＞F5
Selection of system behavior	F5 ,F2, F3	F5 ,F1, F2	F1 ,F5, F4	F1 ,F4	F1 ,F4

According to the order of conservation behavior, Netlogo recalculate the input parameters and achieve an optimization state of system behavior choice (Fig. 5).

4.2 Scenario analysis

A. Scenario One：baseline scenario without policy adjusted influences.

Based on different stages of tourism development, there are obvious differences for decision-making of conservation behavior. At different stages of heritage conservation, the agent weights are adjusted in Netlogo. Stages 1 to 5 indicate that during the tourism development period, the weight of the tourists increases, and the weights of other related agents will change accordingly, and show strong correlation. Therefore, the conservation planning should focus on the prediction of behavioral decision-making, propose a scientific subject system to protect behavioral decision-making, and formulate differentiated protection action strategies according to different tourism development periods.

B. Scenario Two：Community residents as the significant factor in conservation period.

The expectations of community residents around the architectural heritage for tourism development will affect their attitude towards heritage protection. Community residents play an increasingly role in the balance of tourism development and conservation of architectural heritage.

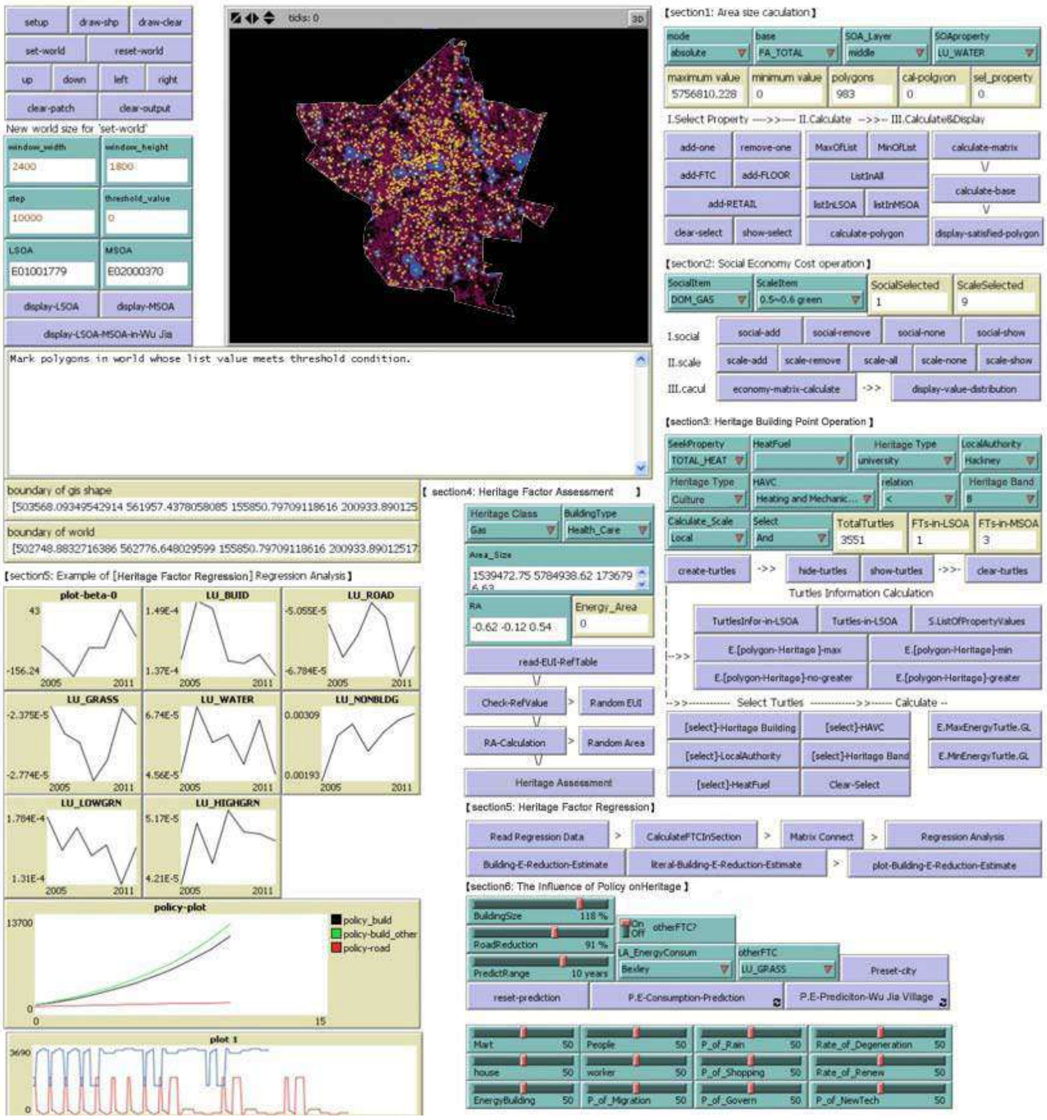

Figure 5: Graphs /Plots in Netlogo

The results show that the impact of positive tourism related to building heritage impact on residents' satisfaction is significantly stronger than that of negative impacts. The action of community residents in the conservation of building heritage and surrounding environmental is the most significant. Tourism development enhances community residents’ recognition of local history and culture. Therefore, the community residents should play a leading role in tourism development and conservation of building heritage by motivating of community residents. In the early stage of conservation planning of building heritage, government agencies should promote the mechanism of participation of community residents. We should actively follow up the mechanisms of community participation and deal with the relationship between development and protection. Government agencies could establish appropriate community participation policies to ensure that community residents can benefit from tourism development and participate in the conservation of building heritage and environments.

C. Scenario Three：The behavior choice of the agent in different characteristics of attitude.

Different from physical buildings and environment, residents are the behavioral perspective of building heritages . Each building heritage is evaluation by their government agencies who decides when and how to retrofit the building heritages. Different government agencies has different attitudes towards building conservation retrofit. It can be seen from Table 2 that external factors such as economic and social development level, and environmental conditions of government agencies will cause different effects on individual agents and have greater impact on environmental conservation. The differences in cognitive behaviors of different agents have a greater impact on the initiative of behavioral decision-making.

For example, the behavior of environmental experts is scientific and plays an important role in formulating specific measures for the conservation of historical and cultural buildings. The behavior of the government agencies play the coordinating roles as an optimization role in tourism development and the conservation, management of the local building heritages. Their attitude concerns on the economic benefits brought by conservation behaviors. The results indicate the differences in protection of investment, strategies implementation. Therefore, the impact of government decisions on the conservation of building heritages and the surrounding environment is increase in the whole period. Taking the Shenyang as an example, the conservation behavior of building heritages is at the basic level in the early stage of tourism development. It is close to nature, architecture and culture. The development is in the middle stage, the awareness of conservation behaviors enhanced, and the conservation strategies are continuously optimized.

5. Conclusions and Future Work

The research of sustainability of buildings heritages should consider the effects of spatial dependence when dealing with sustainability conservation at urban scale. Or at least, the immediate local environment factors should be analyzed to build spatial correlation in the process of urban development and heritages conservation.

Agent-based-model ABM can be a powerful tool to study the emergent properties in human-building heritages-urban developmental systems that typically have strong interactions. The hierarchical and classification coordination system of conservation behaviors is established by ABM. The decision-making conservation behaviors of every agent and system is intervened dynamically in the complex system.

In summary, the paper highlights how comprehensive and systematic research of heritages sustainable conservation becomes important for dynamic innovation in urban evolutionary processes in the coming anthropogenic era, during which decision-making and behaviors is becoming the dominant influence – not only in climate and the environment, but should mutual promotion collaborative visioning for the future.

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Urban Beautification in Beijing's Old City from the 1990s to the Present: Taking Housing Regeneration in Beijing Old City as the Case

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Abstract: Urban beautification is the package of urban policies and planning strategies aimed at creating a high quality and orderly urban built environment, so as to develop a competitive and attractive urban investment environment and (re)construct a good city image. This paper explains urban beautification in China as a kind of urban regeneration with spatial exclusiveness. By reviewing the urban regeneration in Beijing's old city since 1992 and taking the case study of ongoing voluntary housing relocation, I argue that urban regeneration in Beijing old city has always emphasized urban beautification to achieve economic or political goals through the spatial exclusiveness against citizens. Because the power structure in this process has not been fundamentally changed, the right to the city is hard to guarantee. From urban beautification to urban regeneration within citizen participation, the core issue is all the social groups should be guaranteed to have democratic participation in the domain of decision making in urban politics. Improving the rental housing system in the process of housing upgrading in historical districts might be one of the solutions.

Keyword: urban beautification, urban regeneration, Beijing old city, housing

1. Urban beautification: concept, evolution and the Chinese reality

What is urban beautification? In this paper, urban beautification is defined as formulating a series urban policies and related planning strategies to pursue the good quality and order of urban built environment, so that the competitive and attractive urban investment environment can be created and the good city image can be (re)constructed.

1.1 urban beautification in western countries

First of all, let's review the origin of this concept. In western countries, in late 19th and early 20th century, it referred to the urban beautification movement, designing city based on the aesthetic to solve the social and economic problems as well as improve the city fame（Hall P., 2009（198-207）；Fenske, G., 2011）. Since 1960s, it means urban gentrification in the inner city , the middle class replaced the working class in some residential areas spontaneously, and made the houses look like elegant and expensive (Smith, N. ,2006). After 1970s, under the context of neoliberalism, the local government, which had to undertake more local economic development than before, began to create the good urban landscape, such as the mega project in the center of the city to attract the investment and improve the city competition (Harvey, D., 1989). The concept of gentrification has expanded from housing sector to urban development. After 1990s, the urban gentrification has become one of the vital urban policies in many cities of the world. The new restaurants, museums, shopping malls were created to make the city become the ideal place to live and consume (Smith, N. ,2006).

1.2 urban beautification in Chinese urban transformation

In China, there are three manifestations of urban beautification. The first is the gentrification along with urban redevelopment. From the beginning of 1990s, under the context of decentralization from central to local government, the separation between the land ownership and land use rights, the increase of private enterprise and foreign investments, the housing privatization, the development of real estate accelerated under the promotion of high demands of luxury residence and office buildings. The local residents who lived in the inner city were replaced by the wealthy people who can afford the commodity housing, and then relocated to the periphery of the city（Wu,1997). The urban redevelopment reshaped the urban landscape, the lifestyle and aesthetic tastes of middle class were embedded in the built environment (He, S.,&Lin, G. 2015).

The second is the cultural-oriented urban regeneration after 2000. Instead of historical buildings demolition, the local government combined the historical area renaissance with modern consume spaces, so that the image of the local as the global city could be intensified, the consumer and travelling market could be stimulated, the value of the residence nearby could be promoted （Yue Zhang,2008，张京祥，2009；季松，2010). Xintiandi in shanghai is a typical case.

The third one is building façade painting. It means that before some urban events such as Olympic game, the local governments always paint the building façades along the streets to make the urban landscape look so good.

Above all, the nature of urban beautification can be considered as a kind of urban regeneration with the spatial exclusiveness.

2. Urban beautification: the urban regeneration with the spatial exclusiveness

How to understand the urban regeneration with the spatial exclusiveness? It can be understood from the relationship between the state, the market and the citizen in the process of urban regeneration. In Chinese researches about urban regeneration, the relationship between the local state and the market is described as the growth machine, which gets the benefit from urban redevelopment（王红扬，2016）. In this model, both the status and the participation of the citizen are not instituted（陈浩等，2010）, so that they have no political power to negotiate with the growth machine. The benefits of the people who are demolished and relocated are less likely guaranteed in the urban redevelopment （He, 2005）. The inequality of the power structure has led to the citizen be excluded from the new spatial reproduction and consumption. The new spatial reproduction refers to the urban beautification aiming at place marketing and the modernization of urban spaces.

in the next section, through reviewing the urban regeneration in Beijing old city since 1992, and taking the empirical research about the housing regeneration in one of the communities in the city center, I attempt to argue: the nature of the urban regeneration in Beijing old city is urban beautification. From 1992 to the present, although the manifestation of the urban regeneration is different, the goal is always the achievement of economy or politics through the spatial exclusiveness against the citizen. Because the power structure of the local state, the market and the citizen in this process has not been changed, the right to the city is always difficult to be guaranteed.

3. the multiple contextualization of urban beautification in the urban regeneration in Beijing old city from 1992 to the present

3.1 the housing issue in Beijing old city

Beijing old city was derived from yuan dynasty, which has a long history, about 800 years, the area is 62.5 km2 (Figure 1). The dilapidated housing regeneration in Beijing old city is one of the vital issues of city planning and construction in Beijing. The serious shortage of infrastructure, the unsafe housing structure and the poor living condition are always the serious problems over the past 50 years (边兰春，2010).

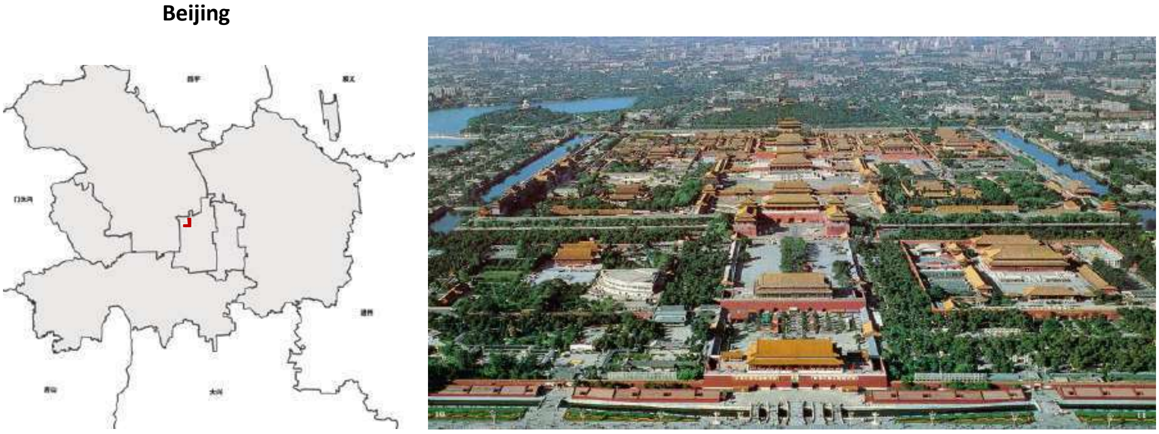

Figure 1: The Site and Image of Beijing Old City

In 1949, the total residential area in this area was 11.60 million square meters, among them the dilapidated housing accounted for more than 60%. The per-capital living space was 4.75m2. in the socialist planned economy period from 1949 to 1976, because of the shortage of the housing, residents built the temporary houses by themselves, the area of which was totally 2 million square meters, the building density was from 4500m2/ha to 6000 m2/ha, eventually. These temporary houses have been reserved until nowadays. By the end of 1988, according to the housing census, the total area of dilapidated houses in Beijing old city was 10.19 million square meters（董光器，2006:179）(Figure 2). A little more than half of traditional residence in the city center had suitable building structure and was safe to live (Zhang Jie,1997).

Figure 2: The Image of Dilapidated Houses in Beijing Old City

3.2 urban redevelopment at large scale: creating the modern image of in the capital

From 1992 to 2003, the city center experienced two phases of urban regeneration, taking the approach of housing demolition (方可，1998). The local government offered the preferential policies and benefited from land leasing and revenue after redevelopment, and private developers were responsible for the compensation of local residents who were demolished and benefited from real estate or mega project development（陈晶，2015）, so that large scale historical areas disappeared totally. From 1992 to 1999, there were 160,900 households being demolished and relocated, only one-third of them got the compensation of the new housing （Shin, H. 2009）. In 2000, the municipal government published the policy to require accelerating the dilapidated housing redevelopment （京政办发，【2000】19 号）， The housing demolition peaked in 2001, about 1,850,000 m2 dilapidated housing was demolished（吴良镛，2003）. At the same time, the luxury shopping mall, the CBD opened up the modern image of the capital city (Figure 3).

Figure 3: The Mechanism of Housing Demolition From 1992-2004 and The City Image After Housing Demolition

3.3 improving the city image in the period of preparation for Olympic game: The landscape promotion and place making of historical area which combined the traditional culture in beijing with the modern consumption and travelling

At the same time, in 2000, the planning of historical preservation in beijing was published. The landscape promotion and place making of historical area which combined the traditional culture in beijing with the modern consumption and travelling was the main approach of the urban regeneration in this phase/z/. This approach was intensified in the period of preparation for Olympic game in 2008. From 2005 to 2008, the city government invested about $52,000,000 to recovered some historical heritages which were demolished, and recovered the historical landscape including building facades and public spaces in some areas which were evaluated to have high historical value（孔繁峙，2004；北京文博，2004）. However, series/z/ policies in this phase focused little on improving the living conditions of the local residence (Yue Zhang,2008) (Figure 4). On the other hand, the residents had to endure the problems of noises, the street safety and the environment which were resulted from the consuming and travelling development.

Figure 4: The Old City Image in the Period of Preparation for Olympic game

3.4 At present: constructing the historical area in Beijing old city as the world-class cultural paradigm

In February, 2014, president Xijinping indicated that "historical culture is the soul of the city, protecting the historical heritage as protecting our lives…. Relocating non-core function of the capital city and controlling the population scale". This statement has become the new ideology of urban development in Beijing at present. In the " beijing master plan from 2016 to 2035" which was published in 2017, integrated conservation, reducing population density, no demolition in historical area in the city center have been proposed (beijing urban planning bearu, 2017). With this background, "housing vacation" and improvement of street built environment have become the main urban policies of urban regeneration at present.

Under the context of constructing the historical area in Beijing old city as the world-class cultural paradigm, in the current urban regeneration, how does the local state, the market, the citizen achieve their own benefits through policies design and mechanism operation? Whether the urban regeneration at present is also the urban beautification?

4. Empirical research: Still urban beautification?——"housing vacation" based on the public-private partnership which is local state-oriented

"housing vacation" is the local state-oriented housing regeneration with public-private partnership. It is applicable to the traditional housing in historical areas in Beijing old city. The local government formulates the policies about housing regeneration, and then authorizes the local state-owned enterprises to be responsible for negotiating with the local residents to vacate their house and give them housing placement in the periphery of the city. For the homeowners, housing vacation and relocation are voluntary. After that, the use rights of vacant houses are transformed from local residents to the enterprises. after being repaired and redesigned, the enterprises rent the houses to the new industries such as boutique hotel or studios. The financial support of housing vacation is from both public subsidies and mortgage from bank (Figure 5). The model of housing vacation was firstly attempted in 2010 in one historical community, and then was promoted in most historical areas in Beijing old city at present.

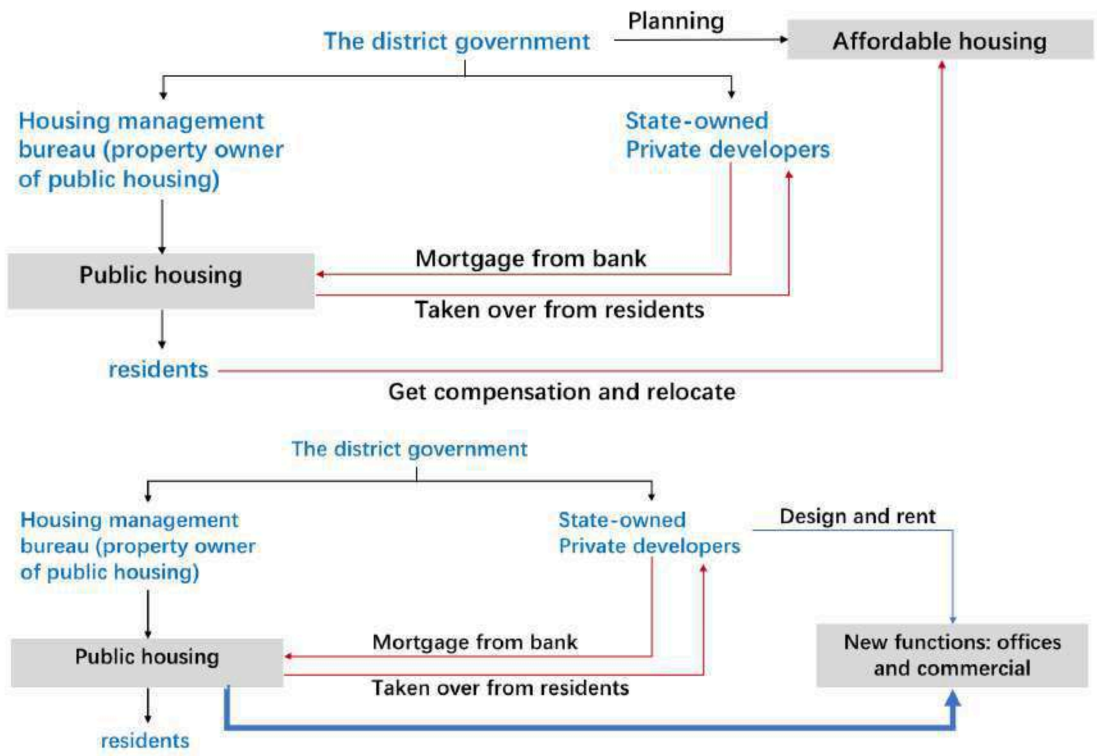

Figure 5: The Process of Housing Vacation and Re-using

The field study was proceeded from July to August in 2017 in BAIMI community, which is located in one of the historical preservation districts in Beijing old city. There are 583 households living in 98 traditional courtyards. The number of households in each courtyard is from 3 to 34. The housing property rights are divided into private and public which are belonged to the housing management department. From September 2013, the local state-owned enterprise began to be responsible for the housing vacation in Baimi community(Figure 6).

Figure 6: The Street-View of Baimi Community

There are four kinds of main participants in this process, the local government, the local state-owned enterprise, the housing management department and the homeowners. After interviewing these four, the paper find that there are three main contradictions in the process of housing vacation. The first one is in each courtyard, only all households are willing to vacate houses and relocate, the housing vacation will be valid. For this reason, the households in each courtyard become the collectives passively which have the common interests. Because many factors such as the public services, the job opportunities, the satisfaction about the standards of housing compensation and the divergence of opinions within the family affected the intentions of housing vacation, it is difficult to come to an agreement among all households in a courtyard. Although the housing vacation is willing, families who wanted to vacate and relocate couldn’t achieve the desires.

The second one is according to the policies, some families can’t be up to the standard of the new housing placement. There was a case when I had the filed study: there are 5 family members, an old woman and her sons who are more than 30 years old, living in a 30m2 room with property rights and another 6 temporary rooms which were self-built. According to the housing vacation policies, the living area of new housing placement is related to the present living area. In this case, there is no enough living area to accommodate these 5 family members if they choose housing vacation. This is one of the reasons why some families experienced the bad living condition, but they don’t want to vacate their houses.

The third one is in the period of housing demolition in 1990s, there was no way for the homeowners to have questions&comments. Whether the homeowners agreed the policies or not, they had no choices but to accept (陈晶，2015:59). In the model of housing vacation, this situation didn't change. From the standard of compensation, to the location of the resettlements, the homeowners just had right to know. local residents are lack of communication channels with local government, and they distrusted the state-owned enterprise, so that some residents missed the opportunities of housing vacation.

For these three main contradictions, there was a large gap between the number of residents who were willing to vacate the house and the real number of housing vacation. According to the investigation in 2014, there were 479 homeowners were willing to vacate, but until August, 2017, only 58 homeowners were successful to vacate.

After housing vacation, according to the planning of state-owned enterprise, there were three new functions being embedded in the vacant houses, the first is boutique hotel, the second one is high-end office and designers' studios, the third one is the public service based on the demand of local government. Taking one courtyard that has been vacated successfully, from housing vacation to the housing repaired and redesigned, the cost that the enterprise invested is about $19,800/m2. For the cost-recovering, the enterprise had no other choices but to rent the vacant houses to the high-end business types.

In the process of housing vacation and housing reuse, comparing with the housing demolition, the model of housing regeneration which is the local government formulated the policies, the enterprise provide the financial support, the local residents relocate in the periphery of the city, the housing get the higher value through spatial reproduction didn't change. The only difference is the local residents can choose vacate their houses or not. Housing placement in the periphery of the city is the only way to improve local residents' living condition. For those people who are not willing to vacant the houses or not up to the standard of compensation, there is no policy and financial support for them to improve their existing living conditions. From demolition-relocation to vacation-relocation, the local residents are marginalized in the urban regeneration.

5. Conclusion: From Urban Beautification to Urban Regeneration within Citizen Participation

According to the new statement of "Relocating non-core function of the capital city and controlling the population scale, no demolition in the historical districts in beijing old city", the urban regeneration in beijing old city gradually from incremental to the stock. At present, the political goal which is achieving the integrated conservation and renaissance in beijing old city is prior to the economic goal.

The case study shows that in the urban regeneration in Beijing old city, the civil rights are difficult to guaranteed because the power structure between the local state, the enterprises and the homeowners and the mechanism of regeneration don't change essentially. It manifested the spatial exclusiveness towards local residents or the tenants.

From urban beautification to urban regeneration within citizen participation, the first is restating the right to the city. All the social groups should be guaranteed to have democratic participation in the domain of decision making in urban politics （Qian, J.,&He, S.，2012）.

Series policies design and the improvement of institution are beneficial for the achievement of urban regeneration within citizen participation. For example, improving the rental housing system in historical districts in Beijing old city, developing the housing vacation and housing rent simultaneously. Taking the differentiated housing policies towards local residents who are (not) willing to vacate and relocate (Figure 7).

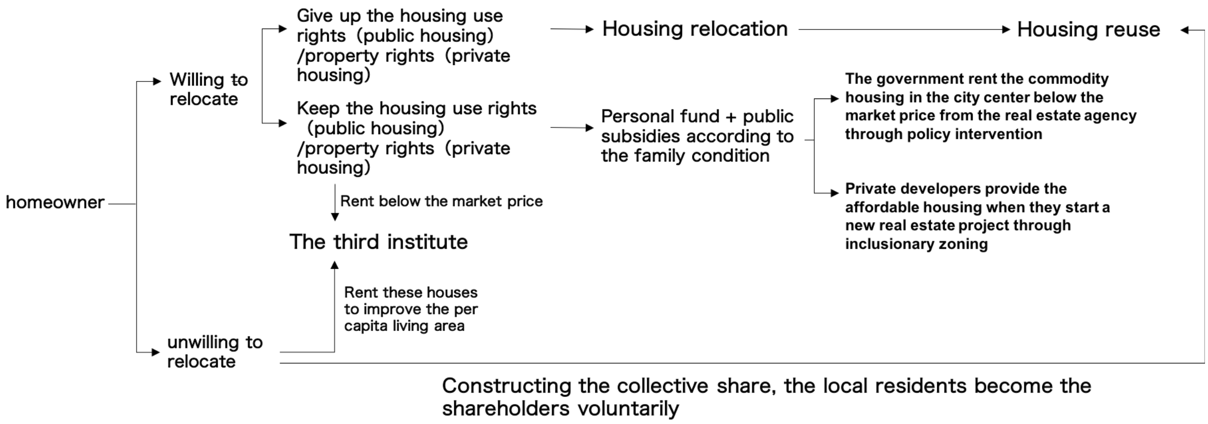

Figure 7: Housing Policies Design in Beijing Old City

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Applied Research on Public Participation in Urban Renewal Planning Based on the "Fanchang Model"

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Abstract

Many of the problems that arise in the urban renewal projects in old city are due to the neglect of the social cost of the urban planning and u rbanization. Furthermore, the action planning of urban renewal is no longer able to be implemented smoothly with the will of the leadership or the authority. Under the background of the development of the new normal in China's economy, urban and rural planning not only faces a p romising prospect, but also needs reform to meet the new requirements proposed in the new period of urban renewal projects.

Beginning from the public participation in urban renewal projects, this research tries to improve the original planning process of the urban renewal projects in China through enhancing the public participation and publ ic opinion survey process so as to form a framework of PIEA (Participation+ Investigation+ Evaluation+ Action) for urban renewal projects. This framework takes public opinion survey on a certain scale as the core method, which is divided into three stages: (1) the investigation stage; (2) the evaluation stage; (3) the action stage. The main idea is to maintain public participation through the whole process of urban renewal so as to improve the original urban planning process.

The case study of the urban renewal projects (an area of 2.8 square kilometres) in Fanchang County located in Wuhu city, Anhui Province in China, has a certain value both in terms of the complexity of urban renewalas well as for future reference. This research attempts to find revelations through practice and feedback analysis of the first phase of the framework in the hope that they would offer reference values for urban renewal in the future.

1. Introduction

1.1 Perplexity about Traditional Urban Renewal Context: Neglect of Social Cost

Social Cost means the total cost of various social production departments or the average social cost of a product. This concept is first proposed by Swiss-French economist Sismondi (Jean Charles Leonard Simonde) in his book New Principles of Political Economy, and then developed by scholars and 9 gradually applied in political economics, management, welfare economics, institutional economics and other fields. The most representative among the many opinions on “social cost” in China are the following two concepts, i.e. the “Average Social Cost Theory” and the “Social Cost Theory” (Lai’er LI, Xuan ZHAO, 2005) . From the viewpoint of the “External Diseconomy” caused by enterprises’ production and oper ation, scholars (Yi CUI, Wenli SHI, Qiuchan LIU, 2007) from South China University of Technology came to the conclusion that social cost is a negative external effect brought by business activities. They pointed out further that correct understanding of social cost is the basis of sustainable development.

During the development of urban renewal projects in the old city, developers carry out demolition, land development, planning and construction on t he premise that economic efficiency of the projects can be ensured. Furthermore, social friction cost, social management cost, ecological environment cost 23 and cultural value, etc. should also be included. (Yu ZHANG, 2015) Analysing from the external viewpoint of urban renewal projects, we find that the social cost of an u rban renewal project is usually much higher its own economic cost, due partly to rash reconstruction and renewal carried out without having being thought through, which in reality incurs a huge cost burden to the whole region and society.

1.2 New Challenges to Urban Development and Urban Renewal in the Transformation Period

1.2.1 Effect of the New Normal on Urban Development

In 2014, the Central Committee and the State Council pointed out that the development of Chinese economy in the future would appear to be a new normal, under which the growth of Chinese economy will reach a plateau, driving forces would be more diversified, the characteristic of growth would change from speed and quantity to coordination and quality, and a new planning and innovation thinking would be developing gradually (Sen FAN, 2015).

Urban development will go with general trend of the development of the productive force, i.e. transforming from extensive growth to intensive growth. (Yijia YANG, 2015) Henceforth, urban development would pay more attention to internal growth momentum and progressive development models, and the original urban renewal activities would decelerate. With the slowing down of the addition of construction land, urban renewal and ur ban renewal will gradually become a common urban planning project.

1.2.2 Diversified Demands are a New Challenge to Urban Renewal

The stronger emphasis of the society today on citizen's awareness of property rights as well as the diversification of citizen's own demands are a new challenge to urban renewal projects. Generally, with the progression of such awareness and demands, urban planning can no longer be as rigid and monotonous as before, for each person is an independent individual whose demands of daily living would be involved in urban renewal projects of the specific region. Therefore, compared with planning projects of other types, urban renewal planning has a greater requirement for urban planners to use advanced methods and exercise patience and effort to plan and improve living environment of the public in the region where urban renewal is taking place.

1.3 Public Participation in Urban Renewal Returns to the Attention of Academic World

According to Yun HU (Yun HU, 2005) from Peking University, public participation is a coordinative measure taken under the circumstance of social stratification and that requires the diversification of public and interest groups. Since the late 1940s, the theory and practice of public participation has gradually been developed in United Kingdom, Germany, United States and C anada (Zhicheng CHEN, Ronglin CAO, Xingping ZHU, 2003). After nearly 70 years of development, public participation has been practiced repeatedly as a methodology of urban planning and organizational basis of community planning and has a set of its own work models in foreign countries.

However, in China, according to the three types and eight levels of public participation divided categorized by American planner Sherry Amstein, we are now in the primary stage, i.e. symbolic participation (Yun HU, 2005). The reasons behind this phenomenon include not only a consideration of economic efficiency of urban development, but also the impact of the sophistication of the public as the subject of public participation on the effect of urban planning of public participation (Wenjing MO and others, 2012), which cause the mismatch between the theory of public participation in aspect of urban planning and the development speed of practice in our country, i.e. the theory goes ahead of the practice. The originally planned public participation and announ ced participation procedures centering on planning rather neglect public opinion survey in the whole planning process (a consideration based on the original planning and decision-making mode), and results of such planning are often difficult to reflect public opinion or even win support of the public when solving problems in urban renewal projects. In this background, as the basis of urban planning, public participation returns to the consideration about urban renewal projects. Through participation in public events, survey of public opinion and feedback of public feedback, the government plays a r ole closer to the public in urban renewal projects and also directly or indirectly improves the participation and satisfaction of the public, thus successfully implementing urban renewal plans.

1.4 The Function of Public Participation to Reduce Cost of Urban renewal Projects

When reconsidering urban renewal planning in the viewpoint of public resource allocation policy, we could well ascribe the increasing difficulty of urban renewal to its increasing cost, which is actually caused by the fact that the growth of policy-implementing cost (original cost

of project) is much faster than that of policy-making cost (original cost of plan), and these two costs are becoming increasingly inseparable. Although fast and hasty formulation reduces the planning cost of policies, it increases the uncertainty in the implementation of future policies, and policy-implementing cost (original cost of project) is often increased greatly due to resistance from the public and various circles of the society.
See the diagram below for details:

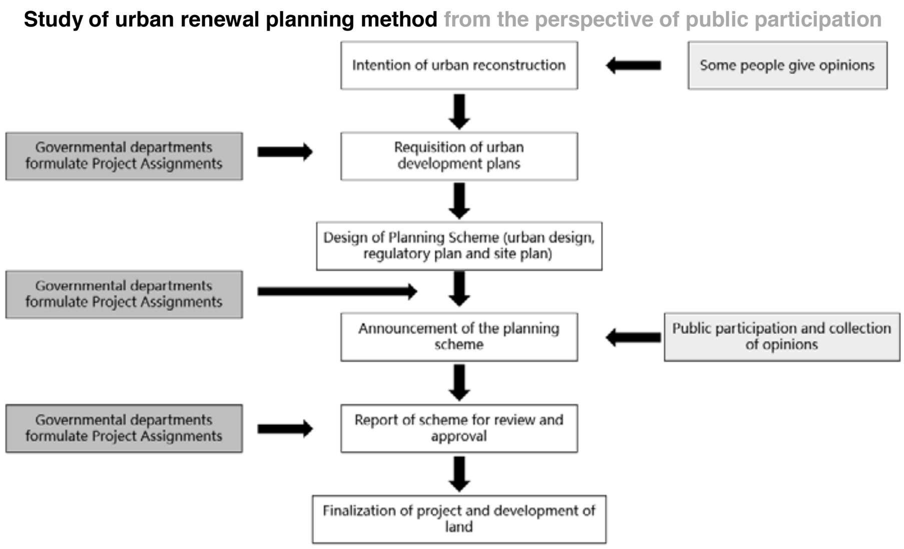
Type	Primary Cost	Primary Effect	Structure of Secondary Cost	Secondary Effect	Calculating Formula of Benefits	Overall Effect
Public Participation in Conventional Urban Reconstruction Projects	Cost of planning	Great increase			Great increase + Slight reduction + Slight reduction	Small loss and small profit
	Risk of projects	Slight reduction				
	Benefits of planning	Slight increase				
Public Participation in Current Urban Reconstruction Projects	Cost of planning	Slight reduction	Formulation cost	Slight increase	Slight reduction + Medium reduction + Great increase	Significant profits
			Execution cost	Great reduction		
	Risk of projects	Medium reduction	Probability	Slight reduction		
			Risk warning ability	Slight reduction		
			Range of risk	Slight reduction		
	Benefits of planning	Great increase	Economic benefits	Slight increase		
			Social benefits	Slight increase		
			Cultural benefits	Slight increase		

Figure 1-1: Comparison of Urban renewal Costs Before and After (Source: the author)

2. Framework of Concept: Structural Analysis of "Fanchang Mode"

2.1 Outline of Framework

This study tries to form a framework of PIEA (Participation + Investigation + Evaluation + Action) for urban renewal projects and analyse the function and mechanism of public participation in urban renewal. This is an attempt to improve the original planning procedures of urban renewal projects. This framework takes public opinion survey on a certain scale as the core method, which is divided into three stages: (1) the investigation stage; (2) the evaluation stage; (3) the action stage. The main idea is to maintain public participation through the whole process of urban renewal so as to improve the original urban planning process. In these three stages, the "investigation stage" is to collect basic attitude and actual requirements of each person in the region so as to conduct a special survey of key districts and surrounding people; the "evaluation stage" is about announcement, feedback and evaluation of planning programs so as to provide support of public opinion for policy decisions of the government; the "action stage" is a trial application according to the investigation and evaluation results, of which measures to prevent risks will be proposed. See the figure below for detailed improvements:



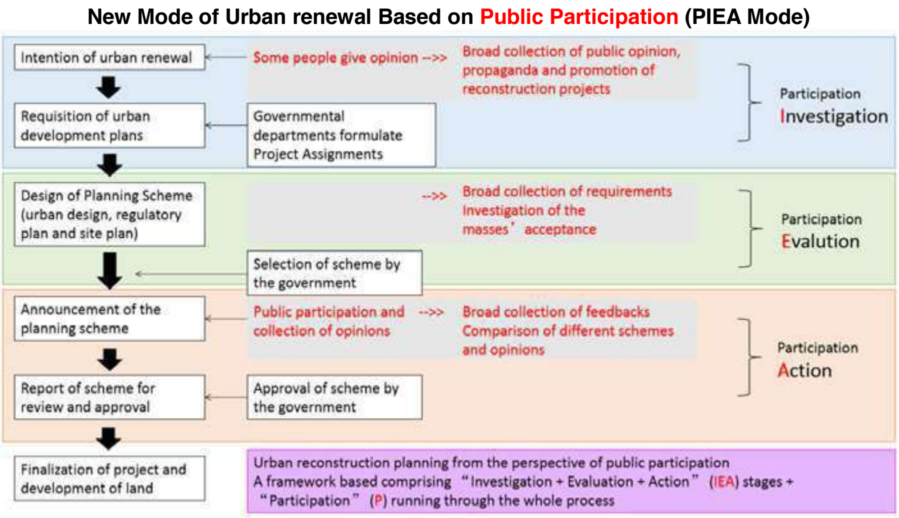


Figure 2–1: Comparison of Urban renewal Costs Before and After (Source: the author)

2.2 Key Issues to be Solved

2.2.1 Adjustment and Improvement of the Relationship between the Government and the People

The first stage of PIEA framework is the Investigation Stage where, in essence, a general pre-reconstruction survey of public opinion will be c onducted on the region to be reconstructed, i.e. the first general survey, which is also a propaganda and promotion activity. In practice, many issues reflected by the public in urban renewal are often resulted by an insufficient communication between the government and the masses, such as the insufficiency of propaganda by the government causes the masses to face demolition unknowingly, or the government fails to give a feedback to the problems that have long been reflected by the masses, or a misunderstanding arises from the gap between works done by the government and e xpectations of the masses, all of which indirectly show that improvement of the relationship between the government and the people in urban renewal projects is in urgent need. In practical cases, this study tries to communicate joint participation with the government in urban renewal to the public from a multi-dimensional angle by adopting a combination of propaganda, study and seminar.

2.2.2 Innovation of Public Opinion Collecting Technology: Fragmented Collection

One of the supporting technologies of this study is an innovative technology for collecting public opinion, i.e. our independently developed online planning and investigation platform ("Planbook Platform" ii), by which the three public opinion surveys as the core of IPA framework can be conducted on a large scale. As an online questionnaire survey platform based on the PHP technology, Planbook Platform may be logged in by mobile client software (Tencent, Wechat, etc.), webpage, pad and other means for completion, submission, collection and analysis of questionnaires for the masses.

Figure 2-2: Comparison of Urban renewal Costs Before and After (Source: the author)

In line with technical thought of other online investigation websites (such as wenjuan.com and SO JUMP, etc.) existing in the market, this platform tries to serve as an effective supplement to the original questionnaire method and makes it convenient for people to complete questionnaires in time fragments. What is more pertinent to urban planning includes the following two points: (1) the development of this DIY platform ensures the safety and full-range controllability of all the data required for urban planning and investigation works; (2) fragmented information provided by the public in their daily lives, after being professionally integrated by the systemic platform, that tries to provide a reference and basis for professional evaluation of urban planning and design through the transformation between the break-down and integration of questionnaires.

Figure 2-3: Schematic Diagram for Background Operation Interface of Planbook Platform (Source: software screenshot)

2.2.3 Design Principle of Questionnaire: Break-down and Integration

One of the objectives for the development of Planbook Platform is to communicate public opinions and governmental decisions. One question that needs to be solved is how possible it is for the public to participate in questionnaire investigation as conveniently as possible to reflect their intentions, and for planning practitioners to sort out fragmented information provided by the public and find out the trends of public opinion behind their choices. Therefore, by learning from the Analytic Hierarchy Process of the System Theory[iii] and the Break-down of Graph Theory, this study tries to introduce the break-down and integration theory of questionnaire investigation to break down the questionnaire into several parts that will be completed by different interviewees and use the logical consistency of the systemic platform to examine and integrate entire concept of the original questionnaire and make a judgment of trend. For example, break down a questionnaire comprising 50 questions into 5 to 10 simple questionnaires comprising 10 questions and integrate the all the results into effective answers to the original questionnaire through the background program. Not only does the results of doing so control the length and effectiveness of answering questions by the public, it also provide a theoretical basis for the exploration of parameterization design of the questionnaire investigation in intermediate and post periods.

2.2.4 Participation and Satisfaction: Pay Attention to Neglected Corners

The main idea of the urban renewal planning based on the PIEA framework is to enhance public participation in the whole process of urban renewal and improve the satisfaction of the public with urban renewal projects by increasing their participation. During the initial research period, we found that there is no statistical correlation between the participation of the public in urban renewal projects and their subsequent satisfaction. However, we also found that their participation in urban renewal projects may firm up and strengthen their attitudes toward such projects[iv].(See the figure below for details)

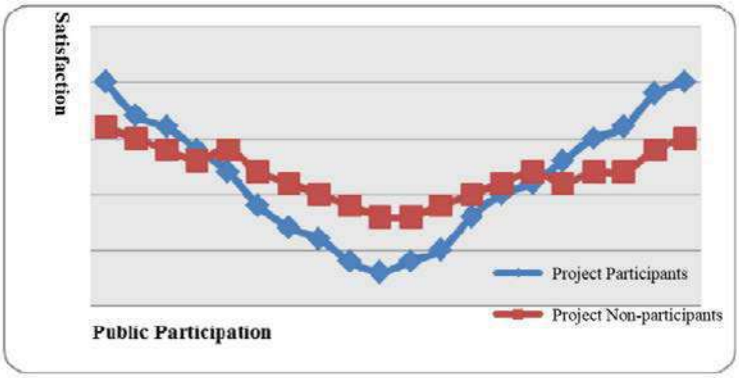


Figure 2-4: Schematic Diagram of the Correlation between Public Participation and Public Satisfaction(Source: the author)

We may explain this phenomenon in such a way: The public tends to express more clearly their satisfaction and disdain for the projects they are familiar with. To those they are unfamiliar with, some people will show an equivocal attitude, and involving the public in the projects is an effective way to increase their familiarity. Based on this assumption, the government may increase satisfaction of the public and communicate their expectations by enlarging the breadth and depth of their participation in urban renewal projects and pre-controlling and reacting to the conditions that may be reflected by the public.

2.3 Exploration on Minimally Invasive Planning Principle in the Field of Urban Renewal

The innovation of questionnaire investigation technology resolves the part regarding public participation in early stage of the PIEA action framework. After the relevant public opinions involving urban renewal projects have been known and collected, conventional urban renewal planning will be conducted. However, one difference from the past is that one of important methodologies of such urban renewal planning is the Minimally Invasive Planning Principle, which is about conducting full investigations and evaluating planned districts with advanced planning technology as well as implementing reconstruction plans with a small degree of intervention without affecting the original main functions of the city where urban renewal is going to take place. Compared with the “push-away style” construction mode in the original urban renewal, the practice of minimally invasive planning is an innovative mode in the background of new normal and transformation period of urban planning. The PIEA action framework with public participation involved may help the urban renewal region conducting minimally invasive planning with comprehensive evaluation of objective information of the region and subjective information of the public so as to guide planners to formulate local plans suited to local conditions.

3. Practical Study: Practice of Urban Renewal Projects in Fanchang County, Anhui Province

3.1 Project Profile

A city of the county level is selected in this study based on the following two considerations: 1. After more than thirty years of economic development since reform and opening up, the development of the material spaces of counties is often behind their economic development, thus showing the urgency of urban renewal; 2. nearly 2,000 administrative subjects of the county level of our country are the main force for the development of urbanization and the reform and opening up, which involve people’s problems in every aspect and have a general representativeness. Therefore, the case study will depart from some basic problems and study the practice of and public opinions about urban renewal in cities of the county level.

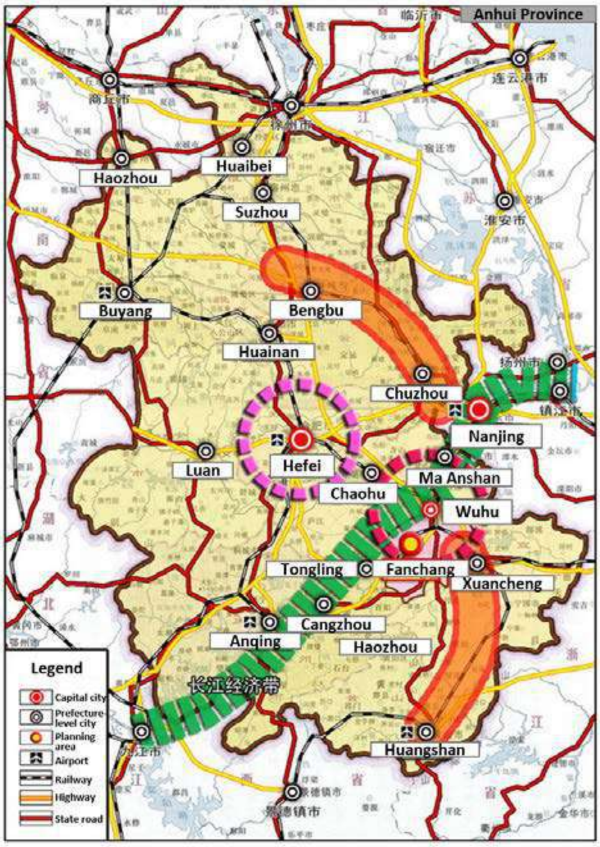


Figure 3-1 Location of Fanchang County in Anhui Province (source: the author)

Known as "Chungu" in ancient times and established as a county in the Xihan Dynasty, Fanchang is a county in southwest Wuhu City, Anhui Province. It is situated on the south bank of the Yangtze River and in foothills of southern Anhui (also the opening door to southern Anhui), where Shanghai-Tongling Railway, G50 Shanghai-Chongqing Expressway and Nanjing-Anqing Intercity Railway meet. The scope of this study includes the old city of Fanchang County to the south of Shanghai-Tongling Rail-way and to the north of Marenshan Road, covering a total area of 2.8 square kilometres. A public opinion survey will be conducted over the whole area of this region.

3.2 Action Planning Practice (Part I Investigation Stage)

The action planning of the project is divided into three stages, which are, respectively the stage of preliminary survey, that of intermediate participation and that of post-evaluation. So far, the primary stage of the project has been completed, and the following study will be conducted continuously under the former theory framework.

3.2.1 Preliminary Survey

The project began in earlier March 2015, and the preliminary tasks focused mainly on:

(1) Communicating with the local government to determine the working framework and confirming the purpose of the first poll, which was for the propaganda and promotion of the urban renewal, as well as carrying out a general survey of the basic opinions and attitudes of the public towards urban renewal.

(2) Onsite survey and the collection of objective materials;

(3) Negotiating key working timetableand time nodes;

(4) The Planning Bureau of Fanchang County, which assisted and cooperated with a symposium that is related to recent situations of the county construction and transformation projects and suggestions of the department for its future development in later March. The symposium was attended by the official authorities.

(5) According to the information above, the project research group designed the questionnaire for three types of targets (local residents and personnel of party and government institutions, foreign tourists, persons visiting their friends and family). More

than90 questions were designed, with each respondent answering approximately 10-20of them based on the automatic distribution of the system platform .The expected sampling rate of this survey was 1.0%-2.0% (of the permanent residents of the county). For detailed information of the questionnaire design, please refer to the diagram below:

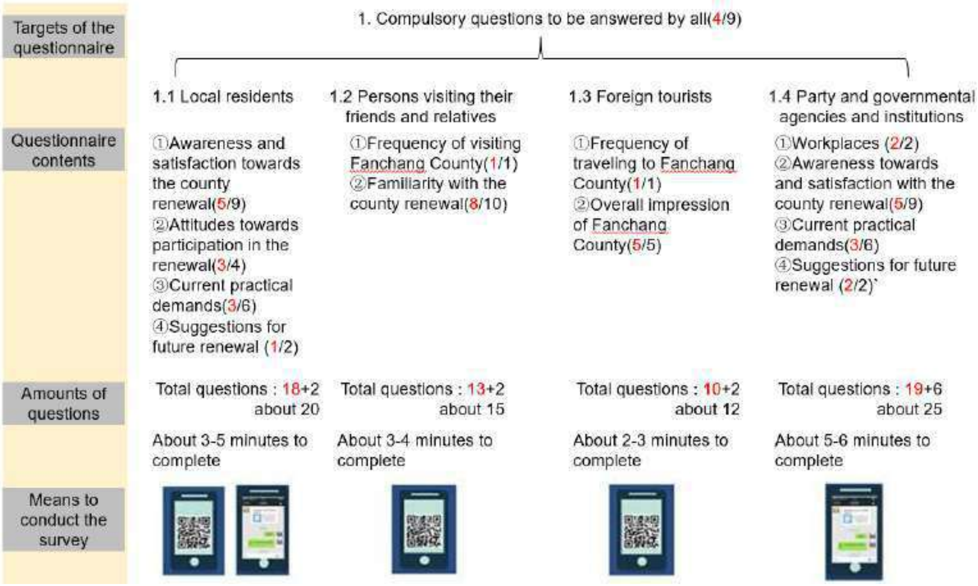


Diagram 3-2 Questionnaire Design Structure of the First Poll (Source: The author)

3.2.2 Preparation for the First Poll

Preparation for the first poll began in earlier April, 2015 lasting for 1 month, which mainly achieved the following goals:

(1) Submitting questionnaires to the government for discussing the related adjustment and modification;

(2) Testing the operating conditions of the service on the Planbook platform;

(3) Setting up an o fficial We Chat account of Planning Bureau of Fanchang County and publishing related information through the local media and Wuhu municipal newspapers and periodicals to propagate the poll and the related promotion activities. (For details, see picture 3-3 as follows.)

(4) Performing a small-scale test survey within the scope of the Planning Bureau.

Figure 3-3 Fanchang News and Wuhu Daily Published Relevant Information of the Poll

3.2.3 Preparation for the First Poll

The whole process of the first poll began in May and w as conducted during the month, lastinga month), which mainly achieved the following:

(1) The Planbook platform was officially initialed at the beginning of May, and the online questionnaire completed by the locals were received on t he online platform with the broadcast of relevant information through newspapers and periodicals and WeChat.

(2) Holding symposiums participated by the members of political parties and government agencies and institutions as well as representatives of community residents respectively,

completing online survey onsite as well as exchanging opinions and communicating adequately. (For details, please refer to picture 3-4 as follows.)

Picture 3-4 Scene of the Public Symposium for the First Poll

(3) Conducting thorough onsite research for all the seven communities in the old urban areas of Fanchang county, and holding symposiums in the communities and carrying out in-depth onsite researches and studies on the practical issues and demands reflected by the public in the process of urban renewal, which was combined with the contents of the former symposiums. (For details, see picture 3-5 as follows.)

Picture 3-5 Scenes of the In-depth Surveys in the Communities

(4) Choosing the places where the residents of Fanchang County usually gather to propagate and promote the poll of urban renewal by means of offering phone charges, little gifts and red envelopes of Zhifubao on Friday, weekends and public holidays. As the project research group from the third party institute, the relevant personnel offering gifts onsite and making inquiries about living conditions of the county is an efficient way for the government to communicate up close with the public. For details, please refer to picture 3-6 as follows.

Picture 3-6 Scenes of the Promotional Activities

3.3 Partial Conclusion of the Poll[v]

3.3.1 Public Awareness of the Recent Urban Renewal, including:

(1) Knowing what government has done;
(2) Knowing the channels of urban renewal;
(3) Level of familiarity with the specific urban renewal projects.

As far as the awareness of the public of the recent urban renewal is concerned, the public have broadened their understanding on the general situations of the recent “urban renewal and c onstruction condition” of Fanchang County. Among the respondents, only 15.2% chose totally don`t know(9.0%)and don’t know or care(6.2%). It can therefore be concluded that 84.8% chose quite familiar(23.8%)and know certain situations(61.0%).

As far as knowing about the approach of the urban renewal project is concerned, quite a large group of the respondents(41.7%)chose to make their own observations on the road, the remaining three most selected are, in order, see on the outdoor government advertisements with the aim of propagation(22.6%), see or hear in the TV broadcasting news(17.9%)and hear from the chats among friends or colleagues(10.3%).Unexpectedly, the least number of people chose (7.5%) the newest and most convenient option for broadcasting see on the website or forum.

As far as awareness of the specific urban renewal is concerned, the top three options of the respondents are, in order: No.1 Environmental remediation along Exi River, construction of Exi Park and Zhongtan Park(86 times);No.2 Renewal project of old communities(71 times);No.3 Construction of Chengguan Kindergarten and Library of the county, whereas top three of the least informed are Landscape regulating along the railway (28 times), Construction of the urban sewage interception project and drainage station(30times)and Renewal of shanty town(40 times)respectively. The main issue seen here is that public attention and awareness is closely related to the status of the project itself.

It is mainly concluded that:

①The survey shows that the publicist willing to know about the government's action in the urban renewal, and it is necessary to strengthen the propaganda and promotion of the urban renewal work among the county people which has both a public foundation and future expectations;

②The survey shows that the approach for the public to know about the urban renewal work is singular and the public is very passive.

③The survey shows that the public awareness of the image projects, nearby projects and frequently-used projects is higher and vice versa. Conversely, their awareness of the projects that are out-of-sight, more distant and in less-frequently-visited places and minor districts is lower.

Key suggested solutions including:

①The means of propagating and promoting urban planning and construction work should be expanded and new media and self-media (e.g. We Chat public numbers, forums, Web and government website,etc.) should be used to publicize the work of planning and construction.

②More in-depth surveys on satisfaction levels can be carried out for the urban renewal projects with higher public awareness.

3.3.2 Basic Attitudes of the Public towards Urban Renewal and Public Participation, including:

(1) Whether urban renewal is necessary;
(2) Whether they are willing to participate in urban renewal;
(3) Depth of public participation;
(4) Channels for the public to participate in the expression of opinions.

As far as the public basic attitudes towards the urban renewal and public participation are concerned, the majority expressed that they would like to play an active role in the process of urban renewal. As far as whether urban renewal is necessary is concerned, 66.3% of the respondents chose Urban renewal is quite necessary; and 23.5% chose Urban renewal is necessary to some extent, but not urgent. The combination of the two groups that thought that urban renewal is necessary made up approximately90%(89.8%)of the total sample size. If those who chose Uncertain and adopt the wait-and-see attitude towards the renewal plan to decide(9.2%)were added, up to 99.0% of the public in the county then agreed upon the good urban renewal projects. In fact, only 1.0% of the public chose the urban renewal is completely unnecessary and the present situation is good. It is necessary to do an in-depth analysis of those options. As far as the respondents who thought the urban renewal is not urgent(23.5%)and those who chose Uncertain and adopt the wait- and-see attitude towards the renewal plan to decide(9.2%)are concerned, it can be predicted that the two groups of the public are not the immediate stakeholders of the urban renewal, and they therefore appeared not to be very concerned. However, if conditions permit, they would join the first group of people.

As far as whether they are willing to participate in the urban renew is concerned, 29.8% of the respondents chose They are quite willing in any case; and 55.9% chose They are willing in the case of convenience and free. Therefore, it can be predicted that if in proper way and form, at least 85.7% of the public is willing to participate in the urban renewal in any and all respects. If the respondents(13.0%)who are willing to participate in such case as relating to their own interests are added, the willingness rate would-be increase to 98.7%.In other words, the public is very willing to participate in the urban renewal process with respect to issues that relate to themselves in most cases.

As far as the depth of public participation is concerned, the opinions of the respondents are scattered with different attitudes towards the means of public participation in the urban renewal, among which the options from the shallow to the deep were all chosen by the respondents. The options from the top to bottom are: To be willing to have a glance at the renewal information by periodically receiving the push messages of WeChat and free text messages(27.8%); Only willing(24.1%)to have a look at the propagate posters put up on the wall by the government; Willing to call a hotline to offer anonymous opinions(17.4%); Willing to attend the public opinion solicitation symposium held by the government and exploiter(16.5%). In fact, fewer chose to Be willing to participate into the whole process of the urban renewal symposium and open seminar of the project(6.6%)and to call a hotline to offer anonymous opinions(7.6%). It is predicted that these may have a greater attributive relationship with the respondents themselves.

As far as the channels of the public participation into opinion expressing are concerned, the channels for opinion feedback reflected by the respondents are not good.30.9% of the respondents chose only express opinions by chatting with friends and 20.8% chose do not normally express opinions owing to the lack of channels. When the above two groups were added together, a total of 51.7% (more than half) of the respondents indicated that it is the expression of opinions is not smooth and unhindered and they have been unable to do that. Among the rest of the respondents, 30.9% chose to reflect situations to the relevant authorities via hotline, mail and online forum, etc.; and 15.8% chose to direct reflect situations to the relevant departments of the county government. That is to say, approximate 85% of the respondents cannot express their own opinions directly to county government and management department.

It is mainly concluded that:

①The survey shows that the demands of the public towards urban renewal is very high, with 60% of the public supporting it directly and 30% adopting the wait-and-see attitude to see who would support the renewal work in case of good projects.

②The survey shows that the public is quite willing to participate in public participation work of urban renewal, however, two realistic problems, namely the lack of depth in the participation of the renewal and the lack of channels to express opinions, need to be solved urgently.

③The survey shows that approximately 80% of the public are not able to express directly their opinions in relation to their own interests to the county government and the management department in the urban renewal.

Key suggested solutions including:

①Persisting in offering multiple channels for participation by the public at the same time and taking in the opinions of the public that participate through the various channels.

②Whatever the circumstances, the enhancement of delivering the information to publicize the renewal through such means as propaganda posters put up on the outside wall by the government as well as sending WeChat messages and SMSes regularly are methods of public participation acceptable to the public and that are of higher efficiency.

③The broadening of means and channels for the public to express their opinions is the first step in resolving the people’s problems. This point alone can improve the issues of more than half of the respondents not being able to express their opinions unhindered and not being able to express their opinions at all.

4. Enlightenment, Conclusion and Prospect

4.1 Revelation of the Case

(1)Issues that need to be taken note of for the work in the primary stage include: Sufficient consideration of the opinions reflected by the representatives from each class and community (whether in large or small scale) within the old county should be taken, and the questionnaire should also be distributed in proportion based on the various classes. In addition, the form and agenda of the public participation in the democratic symposium deserve to be optimized when collecting public opinions on the urban renewal project with reference to Robert's Rules of Order(written by Henry • M • Robert, translated by Hangchang Wang, 1995);(2)As public opinions on the urban renewal project tend to focus on issues that were reflected collectively but had not received replies and those without channels for reflection, it is therefore much more vital to propagate and promote the means of public participation and communicate public opinions than survey questions themselves in the process of the first poll. This is because it is only on the basis of building good faith and mutual trust with the public can it the action planning of the follow-up framework be carried out more smoothly.(3)The planners should assume more transference and communication work in the study of this project so that they could present the professional planning information in formats that are understandable to and attract the interest of the public and collect and integrate public opinions on the one hand, and on the other hand, they could organize the fragmented public information and opinions professionally and analyse the motivation and trend of public opinions reflected by the data so as to offer more professional planning suggestions to the decision-makers of the urban renewal work.

It can basically be concluded that the public opinions and attitudes towards the urban renewal project through the study and practice in the primary stage are mainly determined by the three following aspects:

Firstly, whether and when the practical issues in daily life can be resolved. He issues that the public living and working at the urban renewal district are most concerned about are those related to their own living environment, such as housing maintenance, commercial disturbance and shortage of parking spaces, etc. which are more practical and specific than whether it would become an urban centre. Therefore, to the public, the urban renewal project can be basically classified into three categories: that which improves their own living environment, the urban renewal that has nothing to do with them and the renewal project which improves both their own living environment and the urban functions. They tend to participate more enthusiastically in the first and third projects. As for issues related to their own living environment, the public is more likely to wish to know the governmental timetable for the urban renewal.

Secondly, how the urban renewal project affects them and whether it would bring those benefits or trouble? The second category of the urban renew project mentioned above makes significant adjustment to the urban functions and spaces in the district for renewal. At this time, the public in the renewal district and its periphery tend to present certain worries and express objective opinions toward those changes. In such a case, the government needs to evaluate the driving force and the hindering force adequately, and pre-warn of the risk of public boycott risks so that such a project can be carried out smoothly.

Thirdly, whether participation in the urban renewal project is determined by whether the effect of the participation would affect its outcome. In the current public participation environment, whether providing conditions that make it convenient for the public to participate in the planning and to what extent public participation affects the planning outcomes would determine the means and depth of public participation in the urban renewal project. The general development trend of the planning transformation is to gradually transform public participation from negative emotions and boycott by the public participation to that of the district planning developing towards a more optimized and positive direction through public participation

4.2 Conclusions

More than a decade ago, when the Japanese and the Western community planning patterns were popularized in the Chinese planning college classes, the students did not seem to understand such a panning model that is very low inefficiency at that time when China's high-speed planning and construction pattern emphasized more on the scientificity and reasonability of the planning result. As time went by, with the slowing down of the pace of construction, the academic world started to realize that the scientificity and reasonability of the planning process also guarantees the achievement of the planning outcomes. Therefore, the way of thinking of public participation is being recognized.

Allowing the objects of the planning participate in the process of the decision-making for planning has always been the planning principle upheld in the theoretical field. This thesis explores the operation model of this principle from the perspective of practice and methodology. The predecessors once proposed that urban planning was a kind of work that specifically served the people, the weight of which is gradually felt in the practice of the current urban renewal project. Compared to the other types of planning, urban renewal can engage and communicate with the people more directly and realistically as well as feel the public expectations carried by the phrase 'urban planning 'in each piece of drawing.

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[ii] Planbook Platform is an online investigation platform for urban planning & design, which is independently developed by "City Lends" Topic Group, Urban Development and Evaluation Centre, Shanghai Tongji Urban Planning & Design Institute. It is now in the experimental stage, website: www.planinbook.com:8021.

[iii] Break-down of Graph Theory is to break down each graph according to its features and finally realize parameterized break-down design.

[iv] Relevant research results are quoted from doctorate dissertations of group member Laisen (Laisen, 2015)

[v] Subject to the page space, only the public awareness and basic attitudes towards the urban renewal part in the analytical conclusion of the poll regarding the urban planning and constructing of Fanchang County is abstracted. For the rest, please refer to the related public information in the Fanchang County Planning Department website.

Study on Endogenous and Inclusive Development of Old Residential Area

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Abstract: As it concerns many aspects, including urban society, economy, physical environment, etc., regeneration of old residential area is a complicated social system engineering. In the principles of resident participation, equal cooperation, progressive regeneration and inclusive development, the paper studies the substantial connotation, realistic meaning, fundamental principles, community organization, and regeneration mechanism. The paper indicates that old residential area regeneration, as a more inclusive approach aimed at sustainable, harmonic development of a community, is driven by internal demands, participated by local residents and based on public participation, community autonomy and multi-party cooperation, and combines "top-down" and "bottom-up" management. It proposes suggestions like an leading group for old residential area regeneration shall be established on government level to centrally plan the regeneration, a community planner system should be established on the discipline level to help the residents reasonably set regeneration targets and effectively start the program, a community organization shall be set up on community level to motivate and mobilize all residents and improve communication and cooperation among all parties, and a general work route that can take advantage of collective intelligence should be established on technical measure level so that the community organization and community planner will engage throughout the whole course of regeneration. The study has great academic value and positive realistic meaning for improving and deepening the regeneration of old residential areas at the present stage.

Keywords: Old residential area, endogenous urban regeneration, inclusive development, urban planning

1. Objective and meaning of the study

Regeneration of old residential area is a key part of urban regeneration, and a key factor of building harmonic society. However, there still are a lot of issues in the course of the regeneration and unharmonious events constantly occur: When old residential areas are renewed in some cities, approaches like reservation, repair, renovation and reconstruction are not comprehensively taken, but buildings in old areas are usually brutally "dismantled and reconstructed", so that the constructions are done in very large scale at fast speed, harming the interests of local residents and causing extra financial stress to government. When old residential areas are renewed, attentions are usually paid to the physical structure while the impact on the social structure is rarely considered, overlooking the protection of the connotation and social network for those live in old residential areas, especially, the social issues brought about by improper residents relocation are highlighted. Moreover, the planning methodology is outdated, policies and laws are not as good as expected, and systematic policies, laws and regulations are insufficient for government agencies to make planning for and manage the regeneration.

The fact is that in China, old residential areas are, on one hand, built at good locations, where density of occupancy is quite large, so that they can offer housing conditions for many residents. Although the buildings in the areas have been put into service for several decades, as most of them are in brick-concrete structure and are within the service life, the structure and quality are still in good conditions and can be used for the living in general. On the other hand, the social network shaped by the groups in an old residential area is relatively stable, unique social environment has been formed, and the living and social activities took by the residents in the long past use the area as physical carrier where conventional, stable social network is attached. The study aims to reflect the current approaches of renewal under the setting where "harmonious society", "social justice" and "inclusive development" are advocated in the transitional period, propose endogenous urban regeneration for old residential areas, explore the possibilities for "Top-down" regeneration, study old residential areas from the roots of these social issues, especially from the social nature, and expand and improve the contents and approaches taken by existing regeneration planning so that the regeneration can fulfill the material and spiritual demands of the residents as much as possible.

2. Nature and connotative of endogenous urban regeneration

2.1 Origin of endogenous development

Peru (1983) proposed that comprehensive development of man should be the yardstick to evaluation development and the goal of development. The shift of focus from "things" to "people" marks qualitative leap of the concept of development. Since 1980s, theoretic study of endogenous development entered some other disciplines. In sociology, Tsurumi Kazuko (1989) defined "the theory of endogenous development" as "the people and groups in different areas become adopted to the existing natural ecologic system, follow cultural tradition, consult to foreign knowledge, technologies and system, voluntarily achieve approaches of development goals, create ideal social forms and development conscious lifestyle". In the science of environment and regional economy, Japanese scholar Kenichi Miyamoto (1989) believed that old exogenous development would neglect environmental protection and cause huge waste of resources. In addition, European scholars including Friedmann, Musto, Garofoli kept developing the theory of endogenous development during their studies of issues in regional development.

2.2 Connotation and meaning of endogenous regeneration

Endogenous urban regeneration refers to combine the regeneration of an old residential area with endogenous development, take advantage of community planning's organizational approaches and action pattern and explore resources and demands of the area to promote community integration; take advantage of urban planning's work route and implementation system, establish lawful position of the urban regeneration project, and provide fund and policy assurance for the project implementation. In short, endogenous urban regeneration is a work route based on public participation, community autonomy and multi-party cooperation, integrated with urban planning and combining "top-down" and "bottom-up" approaches. From the viewpoint of urban development's long-term target and universal value, endogenous development is significant for sustainable development of an old residential area, mainly in the aspects below:

(1) It can more easily motivate and mobilize the residents.

Residents of a residential area are the owners. An urban residential area with indisputable ownership has everything to do with each and every resident's interests. It takes resident's participation to promote the development of the area in a sustainable way. The residents of a residential area have the right to participate in the decision-making for any issue concerned with development of the area. Only in this way, the activeness and creativity of the residents can be stimulated and activated. Meanwhile, it can promote social activities among neighbors and communication and cooperation among the residents so as to promote sustainable development of the area.

(2) It can effectively cut the costs of regeneration and management.

The prevailing mode to renew old residential areas, in which the renewal is led by government and carried out by developer, is reasonable to some extent. However, its disadvantage is also obvious -- the management costs paid by the government is quite high. In contrast, endogenous regeneration can effectively cut the costs of regeneration, post management and maintenance of the area. A "social" residential area can be built through endogenous regeneration. It can not only effectively reduce the regeneration costs by taking advantage of social power, but also fully utilize the rich human resources. Therefore, it is advantageous for the area's sustainable development.

(3) It can keep and enrich the area's features of its own.

Due to historic reasons, most residential areas have been built in nearly the same patterns. In this construction mode which overlooks regional diversity, distinctive features of the urban residential areas will be lost gradually. Also, it cannot completely fulfill the demands when any residential area is developed in sustainable way. Endogenous urban regeneration is just an effective approach to enrich features of the areas while their diversities are developed. By taking endogenous approach, the residents can decide on regeneration methods and management systems that are suitable for their individual development according to their respective features while the features can be enriched step by step.

2.3 Fundamental principles of endogenous urban regeneration

"Endogenous urban regeneration" is different from the "top-down" regeneration approach taken by government in essence. According to the theory of endogenous development and experiences in organic regeneration, small-scale improvement and "community construction", "endogenous urban regeneration" includes the fundamental principles below:

(1) Residents participation

Residents, as owners of their old residential area, are the most familiar with the environment they live in, and can specifically point out issues in existence. Any old residential area is renewed for the residents to live in a better way. The urban regeneration with resident’s participation can truly fulfill their demands. Therefore, residents should join in the whole course of the urban regeneration. But, as residents are in different levels, have various demands, and cannot easily have control over the real estate and funds, public participation is an evolving progress. The main aim of endogenous regeneration is to expand public participation's depth and breadth as much as possible.

(2) Equal cooperation

Endogenous urban regeneration advocates equal cooperation among residents, professionals, outside investors and government on community level. Therefore, a powerful community organization should be set up in the first place before an urban regeneration. Secondly, the importance of "conformity to the laws" shall be stressed, which means that all participants shall exercise their power and undertake obligations according to relation national laws and policies. Only in this way, equal cooperation will not become empty talk.

(3) Progressive regeneration

The key to steady urban regeneration lie in the control of regeneration scale and progress. Although the residents want changes take place in their old residential area, changes in excessive scale and speed can result in physiological and emotional discomfort, and bring impact on the traditional links from all aspects. Therefore, renewal of housing and environment should be done prudently so that old and new constructions can blend in. This is the only way to build a vibrant residential area.

(4) Inclusive development

The urban regeneration based on the concept of inclusive development is no longer up to the only utilitarian guidance by economic interests, but will emphasize that social rights and interests should be fairly allocated during the course from a more inclusive viewpoint of social progress and justice, fully safeguard the city's overall interests, reflect the public policies, fully realize the legal rights and interests of all residents and property owners, and fulfill their reasonable claims as much as possible, achieving comprehensive balances among social, economic and environmental benefits, between partial and holistic interests, and between individual and collective interests in relation to the overall interest.

3. Specific measures of endogenous urban regeneration

3.1 Organize a complete regeneration design agency

(1) System guarantee

While the management system of the old residential area is streamlined and a community organization is set up, the community organization shall take the lead to set up a full-functioning urban regeneration design committee. As part of the community organization, the committee shall be governed and coordinated by the community organization, and mainly be responsible for handling issues related to the endogenous urban regeneration.

(2) Members

From the very beginning, the committee should engage in the course of urban regeneration. Its members should include an advisory committee (which represents all parties to be involved in the regeneration. Its members shall cover all walks of life, including experts of planning, construction, law, etc., as well as representatives of investing parties), residents living in the area and their neighbors, user representatives (residents in an old residential area where similar regeneration has been done can be user representatives, and will offer valuable suggestions from their experiences in past regeneration), property management (who can offer valuable advises on how should a regeneration be done to offer favorable, lasting living environment from their job experience). With efforts of the committee, claims of the residents living in the area and their neighbors will be fully examined and considered so that the area can be renewed in a healthy, steady fashion.

(3) Choose community planner

Community planner can be one or more relatively fixed planners or professional organizations. As a professional, community planners act between government and residents, and work as the bridge to connect both parties. Community planners need to take part in the whole process of urban regeneration. With the help of community organization, the regeneration design committee chooses community planner(s) under monitoring of the residents. "Community planner" can be either a component of the committee, a professional planner, a member of a NGO, or a volunteer who offers the service free of charge. The community planner's scope of job includes investigating current conditions and existing issues in the area to be renewed and having understanding of the residents' actual demands, taking part in the planning of physical and non-physical space in the regeneration area, coordinating the relations and conflicts among all interest groups like the residents, government and developer, providing the residents with professional consultation services and helping them to renew old residential area, and giving training to improve the residents' professional knowledge and enhancing their awareness and level for participating in endogenous regeneration.

3.2 Improve physical space as need.

The physical space and social space of a residential area have impact on and act against each other. Although, transformation of physical space acts only on the physical environment, it can bring deep impact on the social space of the area. Firstly, transformation of physical space can have impact on the factors in the physical environment in the area that can develop sustainably. Secondly, the transformation, together with the community planning system in which the users take part in, can motivate more residents to pay attentions to and join in the whole course of the transformation, and can fully stimulate their creativity and activeness. Necessary transformation of physical space in an old residential area can be started mainly from the three aspects:

(1) Rebuild security space

Rebuilding security space of a residential area is to improve the psychological security space of the residents by improving its physical environment. While population in cities increases, the gap between the rich and poor expands, and the society is divided, urban residents become more and more insecure by the day. In urban residential communities recently built have hired a lot of security personnel for patrol, and a lot of hi-tech security measures like camera, access control with intercom and trespass alert system, have been used. As old urban residential areas have been built a long time ago, and equipment like these cannot be fitted in, therefore, they can easy become targets of crimes. Meanwhile, even though these passive security measures are adopted, they will consume a lot of money, make the living environment intense and unnatural, disturb normal social activities of the neighbors, and get in the way for them to develop into good relation.

(2) Offer space for the neighbors' social activities

At present, pathways in many urban residential areas have not exert their role as space for the neighbors' informal social space, and are just used by the residents to travel. Therefore, when an old residential area is regenerated, the road system can be re-planned and the space along the road can be improved and further utilized so that the streets can be turned into space for the neighbors' social activities. Firstly, sufficient walkway is the basic condition of rich activities on walkway. The internal road system in an residential area can be regenerated by conditionally separating people flow from car traffic, centrally arranging parking lots, etc. Secondly, in-depth research shall be done to observe the residents' travel habits and informal social activities, offer healthy place for neighbors' social activities so that the walkways in the residential area will be turned into informal place for social activities with rich connotation and affinity.

(3) Expand utilization elasticity of the space

During endogenous urban regeneration, through coordinate of community organization, upon the residents' decision, and under instructions from professionals, some buildings, whose functions cannot meet the demands or are outdated, can be regenerated, so that the space of the building can be utilized in another way. For example, there are too many kindergartens in many old residential areas while the number of senior people increases. Therefore, the building which is formerly used as kindergartens can be turned into elder homes. Or, part of the facilities can be improved to intentionally enhance their functions.

3.3 Vitalize the more inclusive, more humane endogenous development

A community organization set up by the old residential area shall coordinate to integrate resources, find and solve issues arising during the regeneration, improve the area's environment, improve the residents' living quality, create their sense of belongings, identity and community, encourage community participation, stimulate mutual assistance and senses of autonomy, improve community cohesion, establish new, harmonious relations, develop the community, actively initiate mutual assistance in the community and offer job opportunity to the residents by means of training and help provide by the community.

(1) Increase humane care

1) Elderly care

As there are more and more senior people in old residential areas, the issue of elderly care becomes more and more urgent. Therefore, during an urban regeneration, elderly care services shall be improved and facilities built for elderly care, sports, health care, etc. In addition, senior people have stronger desire to participate in social activities, sports, amusement and other public activities. During an urban regeneration, attentions should be paid to improvement of the space and facilities for their activities according to their physical conditions and demands.

2) Offer jobs for laid-offs.

As the residents in old residential areas have not received much education, it is difficult for them to have opportunities of re-employment. Therefore, the community organization can offer job training for the residents on services that do not require much technology but are high in demand, like house appliance repair, haircut, housekeeping, nursing, etc. Pay salary to some of the residents in need through events arranged by the residents themselves, for example, security and elder care activities in the residential area. It can not only promote endogenous development in the area, but also offer job opportunities for the residents.

(2) Improve social environment

1) Organize public events, and encourage residents' social activities

In order to promote the construction of spiritual civilization in an old residential area, enhance the residents' sense of belongings and sense of identity, promote the construction of harmonious neighborhood relationship, various public activities need to be carried out. The community organization shall be responsible for event organization, and arrange related events for different groups. Government agencies should offer some funds. Especially during the regeneration of an old residential area, events like training, participation, report, and public exhibition should be regularly organized to motivate the residents, which may guarantee successful regeneration, and promote residents' relation, improving the area's social environment.

2) Improve service facilities

During the regeneration, attentions should be paid to improve service facilities in the old residential area so as to offer quality services to the residents. For example, additional signs, outdoor furniture, newspaper stands, billboards, phone booth, environmental sanitation facilities should be equipped. Convenient services should be offered to the residents by means of the events arranged by the community organization. Meanwhile, jobs can also be provided.

3) Improve social welfare system

Carrying out and improving social welfare system in old residential areas are important factors for harmonic development of old residential areas, and are significant to social stability and development. Improving social welfare system should be based on social insurance, social assistance and social welfare, focus on basic social security system, social medical system and minimum income system, be supplemented by charity and commercial insurance, so that social stability can be promoted and the residents can live and work in peace and contentment.

(3) Increase resident’s cohesion

Improved residents cohesion can be advantageous in fostering common awareness among residents and improve their relation. First, resident participation shall be encouraged. They shall be motivated to truly participate in the regeneration construction so as to achieve management, construction and investment by them and benefit for them. Meanwhile, the community organization shall host a variety of public events to create favorable living environment. Secondly, the community organization should encourage the residents to voluntarily offer services, initiate independent- and mutual-assistance events to solve difficulties and issues arising in daily life, stimulate the residents' awareness about public welfare and offering, improve public conduct and help with the construction of spiritual civilization.

3.4 Build a holistic route in which collective intelligence should be brought into play

Endogenous urban regeneration is a comprehensive issue that widely involves all levels and interest groups of the society. To effectively carry out the regeneration, collective intelligence should be brought into play and communication and cooperation among all parties be improved. An just and fair operating mode should be set up, in which the government can make overall central plan for regeneration, motivate all parties, and guarantee the interests of all participants. An urban regeneration public participation system open to the public should be established so as to emphasize the course in which a variety of interest groups are involved, including residents, public sectors, enterprise departments, professional institutions and client groups, fully motivate all parties, form consensus and promote healthy development of urban regeneration. In the actual operation, endogenous regeneration is divided into three stages: (1) initial and discussion stage, (2) project and planning establishment stage, and (3) project implementation and feedback stage (Fig. 1). All parties in participation play different roles in different forms in all stages including conception, investigation & research, planning, design, audit, implementation, supervision and management, so that the roles of community organization and community planner will be played in the whole procedure.

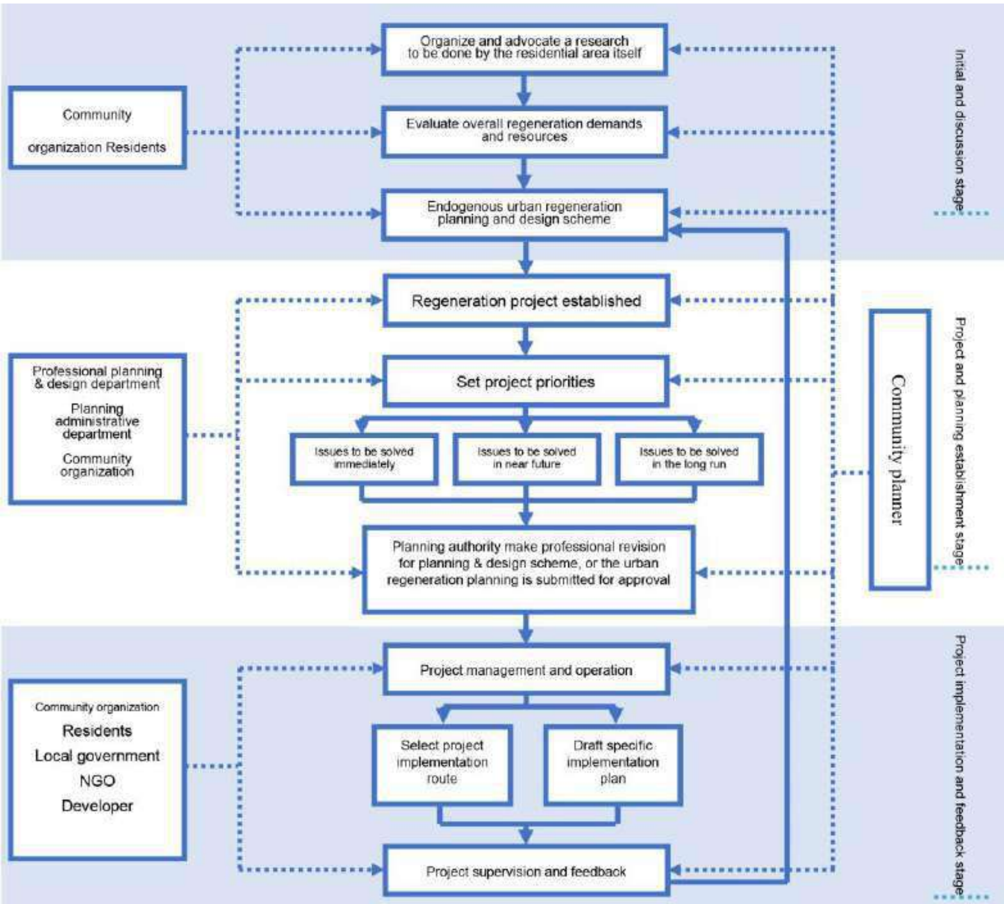

Figure 1: Route of endogenous urban regeneration

4. Conclusion

Endogenous urban regeneration of old residential area, as a more intelligent and inclusive approach aimed at sustainable, harmonic development of a community, is driven by internal demands, participated by local residents and based on public participation, community autonomy and multi-party cooperation, and combines "top-down" and "bottom-up" management. The study has great academic value and positive realistic meaning for improving and deepening the regeneration of old residential areas at the present stage. The paper's opinions and views are presented in the aspects below:

(1) The aim of endogenous urban regeneration is to combine the regeneration of old residential area with endogenous development, take advantage of community planning's organizational approaches and action pattern and explore resources and demands of the area to promote community integration.

(2) Endogenous urban regeneration can effective cut the costs of regeneration and management, can more easily motivate the residents for participation, and is advantageous for the area's sustainable development.

(3) It proposes that a leading group for old residential area regeneration shall be established, a community planner system be established, a community organization be set up, all residents be motivated and mobilized, and communication and cooperation among all parties be improved.

(4) On urban planning implementation level, it proposes detailed workable measure for endogenous urban regeneration, and establishes a holistic route in which collective intelligence should be brought into play.

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Track 6

CONTEMPORARY PLANNING PRACTICE:
Projects and Paradigms

Reframing citizen participation for a sustainable city transition – the case of Bodø ByLab

Moderator: BAER, Daniela (Norway)
Speaker: BAHR-SIMONSEN, Marianne (Project manager Bodø ByLab)

ABSTRACT:

Reframing citizen participation for a sustainable city transition – the case of Bodø ByLab

The **aim** of the session is to present and discuss examples for citizen involvement in planning for cities and neighbourhoods with high environmental goals.

The starting point for the session is Bodø. Bodø is in a unique position; having a large piece of land available to expand their city center with the "New Airport – new City" project, a zero emission district wich will be developed over the next 80 years. The city lab 'ByLab' just opened in April 2018 to connect the municipal planning closer with the citizens of Bodø.

The ByLab is a digital platform and a physical meeting place at the library in Bodø, where new technologies as VR-glasses will be in use to test new methods for citizen participation as well as possibility for planners and municipality employees to gain more competence for citizen involvement in planning processes. To show plans of the future development of the area in 3D with the help of VR glasses enables citizens to get a better understanding for the plans. To connect physical plans to other development goals and measures like emission reduction, energy production in neighbourhoods or new forms of transportation could help to shape a better understanding for the vision of "New Airport – new City" project. Especially development goals like emission reduction and energy saving are often difficult to address in participation processes. Based on a better understand, citizen will be enabled to participate in the future planning within the ByLab. Technology is providing new opportunities for how citizen participation can happen, yet we need help to think 80 years ahead on how to think.

In this session we will use design thinking approaches to explore how ByLab and citizen participation can be reframed to become a transitional factor for the city, citizens and other involved stakeholder like industry and academia.

After giving a short presentation about Bodø ByLab, we would like to invite others to present their attempts to involve citizen in planning for city developments with high environmental goals.

What are the good examples for…

Visions: How to develop and communicate the visions?Demand: What kind of participation methods are neededWhich are the greatest challenges - glorious failuresConcrete measuresUse of new technologiesNew meeting places for citizens involvementSensitization for intangible goals like emission reduction

5 cases should be presented as short pitches (5 minutes), leaving room for further discussion.

The hybrid urban renewal model - Entrepreneurship, income, employment, innovation everywhere

Davidovici, Marton, TEL-AVIV, Israel

ABSTRACT:

The urban economy rested upon the basic assumption that sees the residents as an economic "burden", which needs to be covered through profit-making economic activity in the city.

This value concept is a basic, since the city as a whole is meant for its residents and should regard the citizen and the local community as its central and leading asset. Mayors and decision makers lead planning policy to minimize population and maximize employment and business zones; A city that will 'cover' the cost of a citizen. While 'The I generation` and the currant needs are the opposite: urban inspiration, opportunities, sense of belonging and involvement, pushing innovation.

From here it is easy to see that the development of employment parks is not a direct result of market forces, demands, entrepreneurial needs or investments – but rather a tool for municipal management and primarily for the benefit of the city's coffers.

It is not possible to continue to grow in an economic-business fashion, with an approach that continues to add employments zones / parks – who's their existence becomes irrelevant.

. Today, technology and lifestyle needs entrepreneurship and work possibilities from any place and under any land use – from parks and streets, benches and homes, and up to designated employment parks. All these are relevant to entrepreneurship; beyond this, municipal management is needed to cross the conceptual revolution and to recognize that even schools, colleges, community centers or playing fields can be levers for entrepreneurship, innovation, temporary uses and developmental spaces – under management with a new and different outlook.

D.M.R. Planning and Development Ltd. served as the leader of the strategic planning team for the renewal of the city of Bat Yam – a city with a population of about 130k residents, bordering Tel Aviv on the southern edge, and a direct continuation of it along the sea coast, and of its transportation infrastructure. The strategic program is based on an vanguard holistic renewal program; using current tools, to turn the entire municipal space into an urban, entrepreneurial, profit-making space, and thus create a unique economic lever for the entire metropolitan area – including Tel Aviv.

Currently, D.M.R. Ltd., in cooperation with the Bat Yam municipality, to implement the principals and create a holistic renewal planning model – social, economical, environmental and municipal managing. A model which can open new urban management, technology and values.

We will be more then proud to present the process and the principals – as an aspiring case study.

Better Planning Systems for Cooler Countries and Cities

Frank D'HONDT, UN-Planning Expert, Director Territorial Capital Institute, Greece

In this paper, the author presents an indicative Questionnaire to Self-Assess the current planning approach or planning system in each country or city around the warming globe. The Questionnaire is rooted in the International Guidelines on Urban and Territorial Planning, which was acknowledged as a tool to implement the New Urban Agenda and SDG11. The aim is to reform planning systems to effectively enable more compact and inclusive, better integrated and connected, and more climate resilient cities and other territories. Currently, most planning systems tend to result in just the opposite, making it a daunting task to achieve on the key qualifiers of sustainable planning. The paper is based on the author's contribution to UN-Habitat's Handbook to apply the International Guidelines on Urban and Territorial Planning (UN-HABITAT, 2018).

What are planning systems?

A 'system' can be defined as (1) A set of things working together as parts of a mechanism or an interconnecting network; a complex whole – e.g. 'the state railway system', with synonyms such as structure, organisation, order, arrangement, complex, apparatus and network; (2) A set of principles or procedures according to which something is done; an organised scheme or method e.g. 'a multiparty system of government', with synonyms such as: method, methodology, technique, process, procedure, approach, practice, line of action, means, way, manner, mode, framework or *modus operandi*.

Both elements are useful to define urban and territorial or spatial planning systems in general terms: (1) A set of spatial components working together as parts of a mechanism or a complex whole, with components such as spatial structure, spatial organisation, spatial order, spatial arrangement, spatial complex, spatial apparatus and spatial network; (2) A set of spatial principles or procedures according to which spatial planning is done; an organised scheme or method with components such as: planning methodology, planning technique, planning process and procedure, planning approach, planning practice, planning means, planning manner, planning mode and planning framework.

As a matter of fact, the second part is needed to achieve the first part: to achieve a complementary national system of cities, tailor-made planning processes and procedures will be mandatory.

Although 'planning system' is usually associated with the public and governmental sector in a given national context, the above definition does not rule out the way the private sector and people in general shape and make use of the planning regulations, nor that planning systems are confined to more than only national governments and governance – leaving room for subnational and city-specific planning systems or sub-systems. Overall, planning systems can be viewed as the methods and approaches used by the public and private sector to influence the distribution of people and activities in spaces of various scales in a given country or territory.

A recently concluded authoritative ESPON study defines 'spatial planning systems' as "the ensemble of institutions that are used to mediate competition over the use of land and property, to allocate rights of development, to regulate change and to promote preferred spatial and urban form" (ESPON COMPASS, 2018). This is linked with the notion of 'Territorial governance' which comprises the institutions that assist in active cooperation across government, market and civil society actors to coordinate decision-making and actions that have an impact on the quality of places and their development[1]. Formal planning systems thus consist of bundles of public and private development and building rights, agency authority, coordination mechanisms and procedural protocols that are defined by formal political and legal authorities. This, however, is not to suggest that informal planning systems do not exist.

Numerous planning systems exist around the world. While the activity of spatial planning is recognised and practised in most parts of the world, the contexts within which it operates vary greatly. Different urban and territorial issues, different political, economic and institutional systems, and different cultures and value systems all shape the planning system in different ways. Therefore, designing a planning system cannot be readily approached with an ideal template. This is well illustrated by the ground-breaking International Manual of Planning Practice (ISOCARP, 2015). In this manual, planning systems are assessed by planning practitioners on seven components: (1) Where lies the administrative competence for planning? (2) What is the main planning legislation? (3) What are the key planning and implementation instruments? (4) Who is doing development control? (5) How is planning related to sustainability policies? (6) What kind of governance system is applied in planning? (7) How does the planning system work in practice?

This work builds on earlier findings stemming from the 2009 Global Report on Human Settlements: 'Planning for Sustainable Cities' (UN-HABITAT, 2009). While we will further elaborate on the outcomes of these three authoritative publications in the next section, the approach taken here is to suggest an entirely new list of normative principles against which all planning systems can be assessed, reviewed, improved, adjusted or reformed. Planning systems in different parts of the world may meet these principles in different ways, using different institutional structures and processes.

Physical and cultural differences and contexts matter a lot – rendering a one-size-fits all global planning system senseless. Yet, as I will argue, the International Guidelines on Urban Planning (IG-UTP) – underpinned by the Sustainable Development Goals (SDGs) and New Urban Agenda (NUA), provide a coherent set of principles to readjust the locally applied systems to these universal principles. Therefore, a universal approach of what a planning system should contain to better enable sustainable urban and territorial development is worth further exploration. Framing this new planning system approach within the ''Theory of Change' model could be depicted as suggested below in Figure 1.

In this view, planning systems are part of the resources needed to achieve the desired sustainable urban and territorial development goals. They highly depend on national normative, legal and financial frameworks and development polices, but by including all planning actors, planning systems will become more bottom-up and people-oriented, considering all the planning scales, including the transnational and trans-boundary level. A planning system should include the three-pronged approach to planning (plans, legislation and finance), combined with the institutional and human resources and skills needed to operationalise the system through the application of appropriate processes and phases of the planning cycle, to produce outputs, outcomes and desired impacts as results.

Acknowledging the risk that (re)designing such a *multiplex planning system* approach could have a discouraging or even intimidating impact on actors of change, any entry points of discussion, minor or major, large or small scale is meaningful if the environment is conductive to address and redress the issue in an integrated way, by making smart links with other components of the planning system in a given territory.

[1] See unpublished Input paper for the ESPON COMPASS workshop on Comparative Analysis of Territorial Governance and Spatial Planning Systems in Europe, Brussels, 20 March 2018

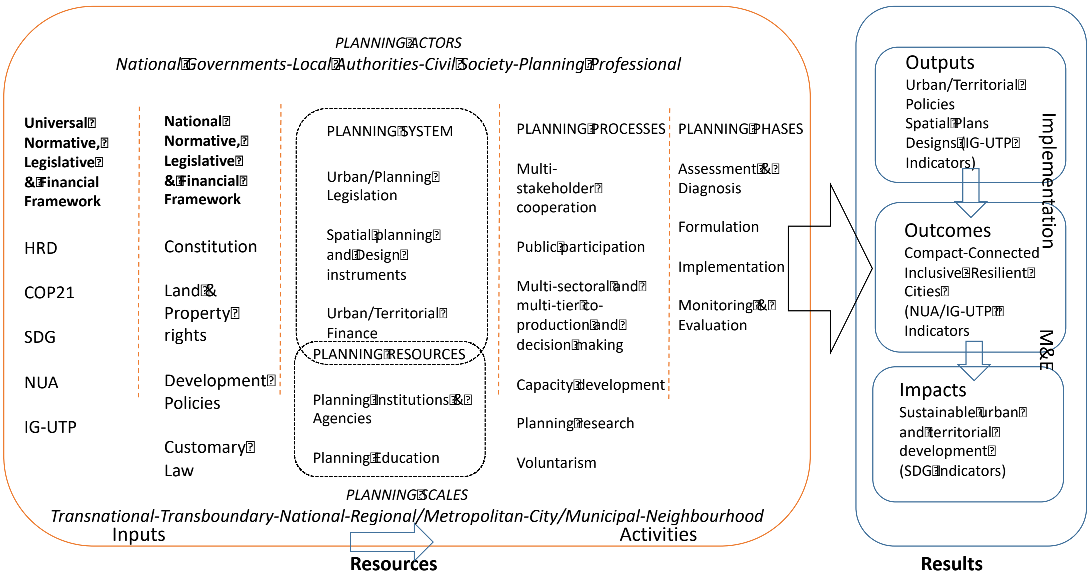

Figure 1 – New planning system approach as part of 'theory of change'

This new planning approach integrates all key elements of NUA/IG-UTP and will provide a reference model to review and redesign planning system anywhere in the world.

What is the problem with planning systems?

The combined conclusion of the three authoritative studies referred to in previous section is clearly that most if not all planning systems are a) outdated, b) not (sufficiently) addressing emerging territorial issues such as climate change and social inequality, c) are no longer synced with decentralisation and new governance arrangements and – last but not least – display a growing mismatch between theory (law) and praxis.

The earlier cited International Manual of Planning Practice (IMPP) draws some critical conclusions on the state of planning systems in the 135 countries included in the 2015 compendium - as experienced by its member-planning practitioners:

- All countries have a physical planning system, only few since recent times. The main aim of planning is to regulate land-use; the most widespread being for the common good, to safeguard property rights, to create harmonious communities, and to protect the environment. Yet, market mechanisms are at work in all IMPP countries. Some are treating land and real-estate as pure commodity, even where all land remains state-owned;
- Planning focuses predominantly on cities while mostly ignoring rural settlements, eco-systems and climate. Attempts at more balanced 'regionalisation' floundered at the weakness of intermediary levels between the state and the local level. Regional planning is weak or non-existent, even in more or less autonomous entities of federal countries. Innovative voluntary regional agreements to tackle polarisation, excess gentrification, as well as shrinking cities lack institutional anchorage in existing power bases to sustain their momentum in the longer term;
- There remains a gap between often complex and bureaucratic planning systems and their effectiveness in the real world. Informal settlements are rife not only in the developing world where they constitute up to 80% of the built fabric; usually in the poorest countries. Often IMPP contributors state that planning systems are not working in practice and that planning seems to be in crisis in many places;

- Popular demand for decentralisation and more local autonomy is a prime contributor to changing governance. Decentralisation remains an illusion as long as the centre retains fiscal powers and planning is subjected to the *ultra vires* principle. For many countries, governance means greater involvement of the private sector, not only in the development process but in the plan making itself;
- While public participation has been incorporated into most planning systems it is ineffective in practice, and often practiced only at the end of a plan making process. Despite rising preoccupation with the environment, due to the debate on climate change and the incorporation of 'sustainability' in the planning system, its meaning and operational competence have to be much more clearly defined to be of use to planning;
- Concrete reasons given for the difficulties with implementation are the lack of planning skills and education, lack of professional planners as well lack of resources attributed to planning. The greatest obstacles of planning when seen as a tool of spatial and social justice are market driven development processes on the one hand and persistent adverse existential conditions, poverty above all, on the other hand.

Enriched by personal planning system experiences in a variety of countries and continents (Europe, Balkan, Middle-East, Asia and Caribbean), I can draw at least five compelling reasons why countries, cities and their citizens should jointly review the way urban and territorial planning and development is organised, managed and practiced to implement the NUA and attaining to the SDGs:

- The legal basis of national or devolved planning systems are often designed and developed in the 20th century and no longer fit for purpose in the fast urbanising and environmentally deteriorating 21st century;
- The planning system might be rooted in colonial times and not designed or developed according to the local context and specific challenges and opportunities of communities and territories;
- The planning system might be designed and developed under a different socio-ideological framework that no longer (should) exist;
- The planning system is only addressing the formal planning while much if not most of the recent and ongoing urbanisation and territorial innovation occurs outside the formal planning system;
- The planning system in place might simply not be up to task to deliver on the SDGs (Goal 11 in particular) and the NUA – think of climate change as one of the most pressing matters!

The bottom line is that any country, city or community taking the effort of having a serious look at the conditions for sustainable urban and territorial planning and development, as laid down in the NUA/IG-UTP, will most likely come to the conclusion – through an open and multi-stakeholder reflective process – that the planning approach and system - with its distinct set of planning instruments, legal rules and regulation, human, financial and technical resources, and its distinct planning practices – will require some sort of adjustment, if not a more fundamental reform in case the initial objectives and ground rules of planning do not longer align with the reformulated objectives and goals to meet the challenges of today and tomorrow. Where there is no coherent or very limited planning system in place, countries and cities can leapfrog towards better designed systems by earning from the hard lessons learnt by older planning systems – see also the ESPON COMPASS study.

What are the international benchmarks for cooler planning systems?

The International Guidelines on Urban and Territorial Planning (IG-UTP) serve both as a source of inspiration and a compass for decision makers and urban professionals when reviewing urban and territorial planning systems. The Guidelines provide national governments, local authorities, civil society organisations and planning professionals with a global reference framework that promotes more compact, socially inclusive, better integrated and connected cities and territories that foster sustainable urban development and are resilient to climate change. Because normative frameworks such as the Sustainable Development Goals (SDGs), the New Urban Agenda (NUA) as well the IG-UTP are by default of a global and universal nature, they do not explicitly address national and subnational planning systems as such. This paper explores the role of national and sub-national planning systems as the contextual tissue to connect all the dots and lines sketched out by the emerging global normative planning frameworks – the first column of the new planning approach as sketched out in Figure 1.

On the pressing issues related to climate change, the IG-UTP promotes climate resilience as one of its five qualifiers for a more sustainable territorial development, while the four other qualifiers also need to contribute to climate resilience (through integrated planning and more compact and better connected cities that are socially inclusive).

The IG-UPT is structured around 12 guiding principles including principle 8 on planning for climate resilience: *"Urban and Territorial Planning contributes to increase human security by strengthening environmental and socioeconomic resilience, enhancing mitigation of, and adaptation to, climate change and improving the management of natural and environmental hazards and risks."*

Therefore, any policies, plans and designs that promote resilience to climate change should specify the expected climate change effects, based on the available climate change science and other data, on the spatial scale of policies, plans and designs, i.e. climate change effects on the national urban system – regional and metropolitans scale, on the city as a whole and down to the neighborhood level. Thy should also include adaptive measures for the expected negative effects if climate change, include mitigation measures for reducing the contributing factors, especially GHG emissions, for climate change; and support, where possible, the development, application and scaling of climate friendly and resilience technology, including eco-system-based adaptation etc.

Sustainable Development Goal 13 commits to *"Take urgent action to combat climate change and its impacts"*, by – *inter alia* – integrating climate change measures into national policies, strategies and planning, implementing the commitment undertaken by developed-country parties to the United Nations Framework Convention on Climate Change, and promoting mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing states. Also, SDG 11 contains climate change related engagements, linked with risk and disaster management:

"By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015–2030, holistic disaster risk management at all levels" (SDG 11.b) – as well *"Support least developed countries, including through financial and technical assistance, in building sustainable and resilient buildings utilising local materials"* (SDG 11.c).

Building resilience demands a whole-of-society approach, especially in cities, where the key sectors of local government must be fully engaged and coordinated. Private sector, the scientific and technical community and community actors (including women, youth and persons with disabilities among others) are increasingly involved in building urban resilience. Efforts to pro-actively engage expertise in issues of economics, environment, health and related areas will help to ensure that resilience building efforts are holistic.

The New Urban Agenda and Guidelines provide guidance on how to operationalise a resilience agenda by providing a positive role for urbanisation - one that connects the physical, social, environmental and economic elements of cities and other territories.

While the international community is still working out the indicators for monitoring the SDGs, NUA and IG-UTP, we could think of specific territorial indicators such as:

- Spatial policies and plans include climate and hazard resilience assessment;
- Spatial plans include climate and hazard resilience indicators/incentives;
- Spatial plans and designs include low carbon and renewable energy indicators/incentives;
- Spatial plans and designs include green building indicators/incentives.

Inspiring practices are part of the international benchmarking and have informed the redaction of the 12 guiding principles and 114 recommendations of the IG-UTP – see for instance the case of Norway in Box 1.

Box 1: Norway – Cities of the Future Integrating Climate Change Adaption

Norway is a Scandinavian country positioned in Northern Europe, with a population of just over 5 million inhabitants. Its economy has been dominated by oil and gas exports, positioning it as one of the top 20 countries with the highest CO2 emissions. According to forecasts made by the Intergovernmental Panel on Climate Change (IPCC), Norway's annual mean temperature is expected to rise by 3.4 degrees Celsius this century and precipitation has already increased by 20% since 1900. Acknowledging the vital role cities play in mitigating climate risk, Norway has adopted a multifaceted urban policy approach. In particular, municipalities were identified as having significant responsibility in influencing the urban environment at a local level and in turn influencing constituent attitudes to energy consumption. The 'Cities of the Future Programme' invited thirteen of Norway's largest cities to take part in a collaborative project to reduce emissions and make cities more liveable. Integral to this was the concept of compact cities, those which favour walking and cycling and promote dense, liveable urban forms. The value added to the programme through integration of urban planning and sectorial policies has improved Norway's resilience to climate change and created an ongoing dialogue between key actors, an important asset in urban management for the future.

Source case: UN-HABITAT, 2015 – Source picture: http://www.uib.no/

Among many other planning issues, the climate resilience policy aims indicate the need to assess the current planning systems on its effectiveness and efficiency to address climate change and other natural and man-made disasters.

A Questionnaire to review planning systems

Basically, planning systems are to be re-defined as the localised 'multi-tier and multi-partner governance framework for improving urban and territorial policies, plans, designs and implementation processes, aimed at more compact, socially inclusive, better integrated and connected cities and territories that foster sustainable development and are resilient to climate change'. Hence, a planning system should also be considered as the combined performance of 'planning in theory' and 'planning in practice'. This section explores an indicative Questionnaire to Self-Assess the current planning approach or planning system in any given country or city, after elaborating on the reasons to review, what to review exactly, who should review and how planning can be reviewed in an organised way. Questions are formulated as positive statements, to allow a scoring along the scale of Likert from 1-5, with an indicative set of indicators on a scale of 0-1.

Although a comprehensive Self-Assessment Questionnaire need to address all issues, Box 2 presents a sample of questions related to climate change and the broader issue of urban and territorial resilience.

Box 2: Self-Assessment of Planning Systems

Self-Assessment for Planning Approach/System in general	
Statements (Score 1-5)	***Suggested indicators (Score 0/1)***
1. The planning approach/system in general aligns with the universal definition of spatial planning as a decision-making framework for improving policies, plans, designs and implementation processes and projects that is:	
a. Better integrated and aiming at a multi-sectoral approach;	*An inter-ministerial territorial coordination in in place*
b. Participatory and aiming at informed and engaged citizens;	*There is a culture of public participation in place*
c. Socially inclusive and aiming at improving the lives of poor and vulnerable people (including slums) through territorial cohesion;	*Plans include Social Impact Assessments*
d. Environmentally sustainable and aiming at protecting eco-systems and bio-diversity;	*Plans include Environmental Impact Assessments*
e. Resilient to climate change and other natural and man-made disasters;	*Policies/Plans include Climate/Hazard Resilience Assessment*
f. Human rights based and aiming at realising development rights for all, with focus on youth, women and minorities.	*Policies/Plans include Human Rights markers*
2. The planning practice is in general in line with the 'planning theory' as enshrined in the legal and customary framework:	
a. Territorial developments and projects are mostly compliant with plans and rules;	*A plan-compliance check is in place for projects*
b. The planning rules and regulations are mostly enforced;	*Inspection of constructions is a common practice*
c. Laws, policies and plans are regularly reviewed through a permanent monitoring and regular evaluation.	*A parliamentary commission on land-use and spatial planning is in place*
3. The planning approach/system recognise and foster a multi-stakeholder participatory approach including partnership with and between:	*A National Urban Commission/Forum is in place*
a. Local and other sub-national planning authorities and institutions;	*Local Authorities takes part in the National Urban Commission/Forum* *A national association of local authorities is in place*
b. Civil society (including vulnerable groups such as children, women, youth, elder, disabled and ethnic minorities);	*Civil Society takes part in the National Urban Commission/Forum*

c. Private sector and business community associations; d. Planning professionals and their associations; e. Planning schools and their teachers and students.	*Granting schemes for civil society incentives are in place*
	Private sector and business community takes part in the National Urban Commission/Forum
	Planning professionals takes part in the National Urban Commission/Forum
	Planning school/academia take part in the National Urban Commission/Forum
4. The planning approach/system or components of it explicitly refer to global or continental policies on sustainable urban and territorial development, climate change or resilience against natural and man-made disasters.	*Your country was involved in drafting one or more of those international policies and guidelines*
5. Overall, there is a planning approach/system in place consisting of three inter-related enabling components: a. Sound and flexible spatial planning and design framework at multiple scales (see question 2); b. Enforceable and transparent legal framework; c. Financial framework to diagnose, formulate, implement and monitor spatial planning.	*The planning system is generally highly repudiated and respected*
Self-Assessment for Resilient City Planning in particular	
6. The local authority promotes the construction, retrofitting and management of "green buildings" through incentives and disincentives, and monitor their economic impacts.	*Plans and designs contain 'green building' indicators/incentives*
7. The local authority uses urban and territorial planning as a tool to improve access to water and sanitation services and reduce air pollution and the amount of water wasted.	*Plans and designs contain access to water/sanitation indicators/incentives*
8. The local authority formulates urban plans as a mitigation and adaptation framework in response to climate change and for increasing the resilience of human settlements, especially those located in vulnerable and informal areas.	*Plans contain area/community-sensitive climate mitigation indicators/incentives*
9. The local authority locates essential urban services, infrastructure and residential developments in low-risk areas and resettle, in a participatory and voluntary way people living in high-risk areas to more appropriate locations.	*Plans contain risk-avoidance/mitigation indicators/incentives*
10. The local authority assesses the implications and potential impacts of climate change and prepare for the continuity of key urban functions during disasters or crises.	*Special climate and disaster resilience plans are in place*

Self-Assessment for the climate resilience qualifier on different scales of planning (1-5)		
National/Regional	Metropolitan/City-wide/Municipal	Neighbourhood
1. Does the policy/plan/strategy assert the role of cities as major contributors to climate change through their increased CO2 emissions and the vulnerability of urban populations and infrastructures to climate change? 2. Does the national policy, plan or strategy address the local impacts of climate change (e.g., sea-level rise, urban heat wave, etc.) and promote cooperation between national and sub-national governments/groups/ organizations? 3. Does the policy, plan or strategy promote low-emissions development (LED) and/or reduce greenhouse gas (GHG) emissions below a specific baseline? 4. To what extent does the policy/plan/strategy place adequate emphasis on the following: a) Climate change adaptation b) Mitigation of emissions	1. Does the policy, plan or strategy address the metropolitan impacts of climate change (e.g. sea-level rise, urban heat wave, etc.)? 2. Does the policy, plan or strategy incorporate an urban resilience profile? 3. Does the policy, plan or strategy promote low-emissions development (LED) and/or reduce greenhouse gas (GHG) emissions below a specific baseline? 4. Does the policy, plan or strategy include a metropolitan-wide or city-wide emissions inventory 5. Does the policy, plan or strategy reflect commitments or agreements to meet metropolitan emissions reductions targets?	1. Does the policy, plan or strategy address the local impacts of climate change (e.g., sea-level rise, urban heat wave, etc.) through adaptation strategies (e.g. floodplain avoidance, emergency preparedness, etc.)? 2. Does the policy, plan or strategy promote low-emissions neighbourhood development strategies (LEDS) (e.g., compact development, mixed-use development, transit-oriented development, etc.)?

This indicative Self-Assessment Questionnaire sample need to be tested and further refined. While customising the statements and indicators to the local context might be required for meaningful response, using a common set of questions will allow exchange, comparative analysis and world-wide monitoring and evaluation – essential for monitoring the implementation of the New Urban Agenda.

This Questionnaire can be combined with a more specific assessment framework targeting the urban and territorial legal frameworks. The Planning Law Assessment Framework (UN-HABITAT 2018b) is a self-assessment tool to be used during focus groups to identify strengths and weakness of all the laws, regulations, and decrees applicable in a city or any other given territory, enacted at different levels.

Reviewing to reform planning systems

Planning System Review methodology

While there can be good reasons to be pragmatic and look at ad-hoc ways to improve the planning system, it is however more effective to follow the classic planning cycle from

is to implementation and
on, at all planning scales,
g all stakeholder groups,
g urban/territorial legislation
ported by adequate human,
l and financial resources. In
ords, moving from an ad-hoc
a more ‘planned’ adjustment
rm of the planning system in
igure 2 illustrates this
l review and adjustment of a
g system on the three-
l-components, starting with a
is, e.g. by using the self-
nent questionnaire (see
by prioritising the most
g issues and formulating
llowed by the implementation
combined with permanent monitoring and evaluation, which can lead to further review and adjustment.

Figure 2 – Planning system review cycle

In addition, the review also need to look into the other resources as well the capacities needed to plan, implement and manage urban and territorial development:

- Institutional review: assessment of the institutional resources and their capacities in place for spatial planning and management – not only the governmental structures at national and sub-national levels; also the para- or non-governmental planning agencies, as well planning professional organisations, related civil society and business community organisations, including the domestic private planning consultancies;
- Educational review: assessment of the national and sub-national educational sector, both public and private, contributing to planning capacity development for all ages and gender, from primary schools to universities. Special attention is needed to review R&D capacities to support evidence-based spatial planning.

Planning legislation and overall planning systems are most commonly established at country level but obviously affect all the other territorial levels, from supra-national to local and neighbourhood level. The Guidelines advocates a subsidiary co-productive governance approach with planning and implementation mechanisms at the appropriate level, driven by partnerships and co-production of policies, plans and designs at all planning levels. Hence, the assessment of a planning system should also consider this territorial urban-rural continuum throughout the different scales and levels of planning and governance. This entails:

- Urban-Rural planning review: assessment of policies, plans and designs for both urban and rural areas, including the hybrid territories where urban-rural linkages or the lack thereof can make or break food-security and resilience to natural hazards and climate change. ‘Rural’ in this case also comprises entirely natural and non-cultivated or inhibited areas;
- Multi-scale planning review: assessment of the national planning scale - including the national land- and planning-relevant legislation – should be complemented by

reviewing planning approaches and instruments – or the lack thereof – at sub-national planning scales, including metropolitan and city-wide planning. Anticipating exponential growth and share of metropolitan urban regions all over the world, tailor-made 'metropolitan planning systems' will be required to meet the specific challenges of each metropolis, with its own set of urban legislation, institutions and resources. But also planning at transnational and transboundary scales need to be reviewed, as well the bottom-up approaches and participatory planning instruments at hand for urban and rural communities.

In the spirit of the NUA/IG-UTP, it is strongly recommended that respondents from all four key stakeholder groups are involved in the Self-Assessment: National Governments, Local Authorities, Civil Society and Planning Professionals. The mobilisation and selection of respondents for the Self-Assessment and the planning review is primarily a local matter. However, some suggestions can be made regarding the four key respondent groups, while keeping in mind that any stakeholder group at any time can address any planning issue to review as a starting point or led by a sense of urgency. The sections below however suggest possible ways to undertake a more comprehensive assessment of the entire planning system or approach. Each country or city can organize the Self-Assessment according to local best practices, inspired by international best practices. The methodological approach as suggested below is therefore indicative. Although it is possible for individual and associated respondents to answer the Questions independently and without further exchange, the preferred situation would be an established Multi-Stakeholder Planning Review Task Force to organize and coordinate the activities related to the Assessment. In the absence of a consensus among the four key stakeholders group to undertake a joint evaluation of the planning system, the partial Self-Assessment can still contribute to raise awareness, provide arguments for advocacy and feed a public debate on review and reform of the planning system in place. The Self-Assessment Task Force will establish a roadmap and workplan according to human and financial resources that are available or can be mobilised – see Figure 3 for an indicative Planning Review roadmap.

Planning System Reform methodology

With respect to ensuring use, the key is found in securing a commitment to the Self-Assessment as a learning and change process - both within and external to the affected stakeholder organisations. Ensuring buy-in on a clearly defined purpose, a credible process that stays focussed on the relevant issues. Findings that are universally understood and meaningful and practical to their users will encourage the adaption and application of the assessment findings. The tools and principles presented in previous section are also readily adaptable to periodic follow-up and monitoring to gauge progress and document changes.

The second element for maximising the benefits of the Planning Self-Assessment lies in building a greater body of knowledge around conducting and using self-assessments. To extend the benefits beyond the primary organisations related to the design and operation of the planning systems, we need to make our experiences accessible, to be shared and built on by others. The resulting synergies and learning can then deepen our understanding of the complexities of planning self-assessment and expand the number of stakeholders and organisations conducting them and learning from them

Linking the Planning Self-Assessment with the Theory of Change, a number of specific steps could be considered to maximise the use of the planning review – see Figure 3.

With Step 1 and Step 2 addressed in the previous section, this section will concentrate on the 'resulting' Steps 3-5. Having designed a self-assessment process and methods consistent with the clearly-defined purpose, established buy-in across the stakeholder-organisations, and secured the participation of ethical, credible evaluators, the exercise then needs to be pursued with rigour. Stakes can be high in changing deep-rooted planning rules and the information on which the changes are based needs to be reliable and complete. Using the technical expertise available to it, the assessment team ensures this by monitoring the design, methods and outputs throughout the process. Quality control to maintain the reliability of the data analysis and interpretation ensures that both the spirit behind the assessment and the methods chosen for its overall design are adhered to. At the analysis and reporting stages, a willingness to rigorously verify the findings with stakeholders strengthens the basis on which the recommended actions are built.

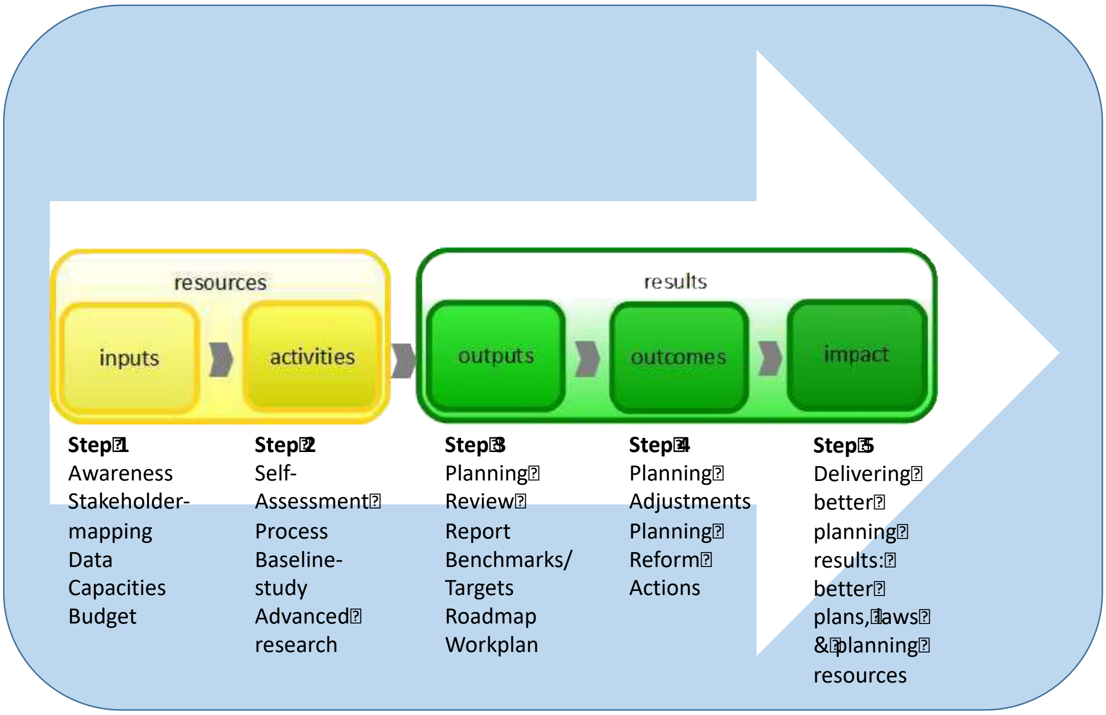

Figure 3 – Step-by-step planning system review and reform process

Step 3 starts with completing and endorsing the Planning Review Report. The modes selected for reporting and disseminating the results need to be tailored to the users and relevant to the organisational environment. Reporting starts early in the assessment process in order to verify accuracy, to increase the volume of the data and to establish a reporting pattern which is comfortable and effective for stakeholders. Depending on the feedback, adjustments can then be made to the way the data is packaged and/or the modes of reporting. Gradually building up knowledge across the stakeholder organisations about the assessment's findings, means that they can be verified and gradually understood and accepted. In the final reporting, the assessment team can then move directly into **action planning** because the stage has been set for the team to move stakeholders to respond to the findings by committing to and scheduling actions. The bridge from reporting tot action planning is the **prioritisation of planning issues** to be redressed through adjusting or reforming the current planning approach/system, while also including new topics to be addressed in a planning reform process.

Steps 4 and 5 is about reaping the incremental benefits of the planned planning review. While Step 5 is only measurable on the longer term – the desired change in urban and territorial deliverables such as more compact-walkable, socially-diverse and healthy neighbourhoods, cities, towns and villages – Step 4 is the real implementation phase of fixing as much as possible and developing new planning tools and instruments as required by the Planning Reform Action Plan. While 'friction' in planning-led urban and territorial development can not and should not be entirely eliminated – effective sustainable societies are usually characterised by planning systems with a set of well-thought publicly controlled and enforecable rules and regulations – adjusted, reformed or entirely planning systems should be primarily designed to enable sustainable devlopment, through multi-stakeholder and participatory co-production of planning outputs and planning outcomes. Co-productive tools and instruments such as multi-stakeolkder 'urban forums' and 'urban pacts' should become key components of improved planning approaches and systems.

Making the change happen

Spatial planning needs to change because the world has changed and keeps changing – a world of 10 billion is a different planetary proposition from one of 5 billion, as much as a world heating up with another 2-4 degrees Celsius will require adaptive territorial responses. "One reason why planning in many countries has not kept abreast of these deep changes is that it has been too parochial. Because legislation, procedures, institutions and policies have been shaped at national or, in federal states at provincial level, planning practice has been locked into the specifics of those systems." (UN-HABITAT/SALGA, 2018). While climate change has created a global awareness among planners and decision makers, the SDGs, NUA and IG-UTP provide the markers for reviewing and reforming outdated or dis-functional planning systems. While there is no ideal template for better performing planning systems, all relevant territorial stakeholders need to partner to review and reform defunct planning systems against the international benchmarks for a more sustainable territorial development. Planning systems in different parts of the world may meet these principles in different ways, using different institutional structures and processes, and different methodologies and outcomes, but using common tools such as the suggested Self-Assessment Questionnaire, can largely enhance communication, peer-to-peer learning and convergence on the planetary development goals. Planners and their professional associations such as ISOCARP must champion this change for cooler planning systems.

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The Periodic Table of Urbanism

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Synopsis

Just as the Periodic Table of Chemistry identifies the physical components of our universe and is able to predict the relationships between them, a Periodic Table of Urbanism is proposed. This table provides a comprehensive framework for describing the “general reign of order” in our towns and cities while also enabling the development of an algorithmic framework for planning as a necessary step towards the application of artificial intelligence to urban planning.

1. The Rural-to-urban Transect

Andres Duany and Emily Talen first published the rural-to-urban transect[1] in 2002, a scientific insight that is comparable in importance and structure to the publication, in 1869, of the periodic table of chemistry by Professor Dmitry Mendeleev (1834–1907). It is a planning technique that is both comprehensive and nuanced, but at its core it currently provides six prototype zones in a prototypical progression along a notional transect from rural-to-urban, plus ‘special districts’ (see figure 1).

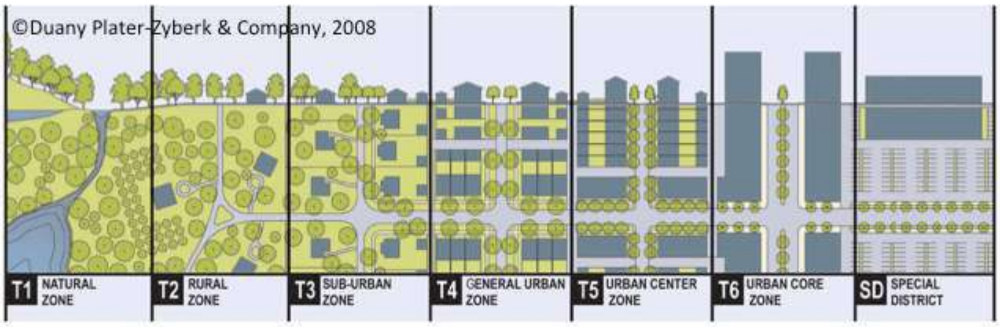

Figure 1: The Rural-to-urban Transect

These transect zones, or urban-ecological zones, are balanced combinations of land use, built form, road design and landscape. They are similar to agro-ecological zones[2], but they should not be confused with the eight ecozones used in environmental science. In this paper the term “urban-ecological zone” will be used when speaking generally and the term “transect zone” (or T1, T2, T3, etc.) will be used when referring to specific zones on either a prototypical or an actual transect.

2. Community Units

In practice urban-ecological zones are usually grouped into community units to ensure greater sustainability through a fine-grained diversity of built form and land use. The urban structure is then formed from these units and their supporting infrastructure in accordance with the principles listed under “The Neighborhood, The District, and The Corridor” in the 1993 Charter of the New Urbanism[3].

The standard community units are:

- Clustered Land Development (CLD), e.g. a hamlet, typically consisting of the transect zones T2 (rural), T3 (suburban) & T4 (general urban) zones;
- Traditional Neighbourhood Development (TND), e.g. a village or a neighborhood, typically consisting of T3, T4 & T5 (urban centre) zones;
- Transit Oriented Development (TOD) e.g. a neighborhood or district centre with good transit, it also typically consists of T3, T4 & T5; and
- Regional Centre Development (RCD), e.g. a regional centre, typically consisting of T4, T5 & T6 (urban core) zones and generally with good transit.

It is a massive oversimplification to say that urban planning is the art and science of specifying and distributing the community units and the "big" infrastructure of the town or city, while urban design is the art and science of laying out the streets, plots and parks, etc., and also specifying the built form and detailed land use within the community units, but it is sufficiently accurate to assist those unfamiliar with transect-based planning to visualise the process in that way.

3. The Planning Cycle

One of the great strengths of transect-based planning is that adopts techniques that are common in environmental science, while adding a method of describing urban places that is applicable at all stages of the planning cycle (figure 2).

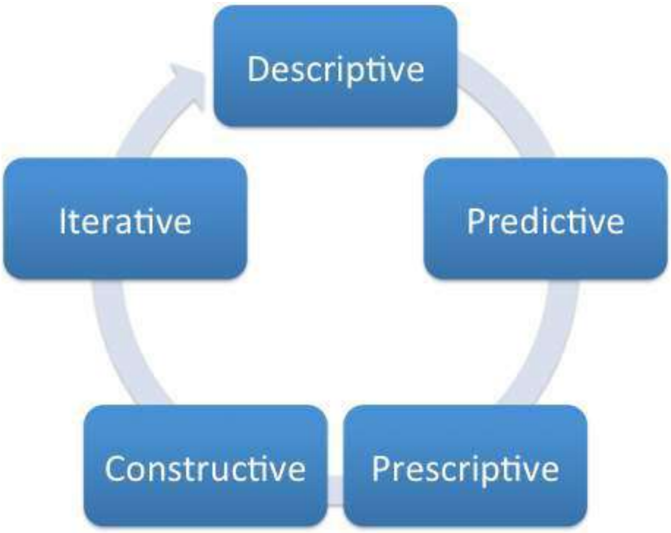

Figure 2: The Planning Cycle Improved by Transect-Based Planning

Transect-based planning starts with detailed observation and a scientific approach to describing an existing urban area. When analysis and design are added to this description then, through comparison with similar transect patterns elsewhere and in history, it becomes predictive. By adding law and governance to a plan developed from such an analysis it becomes prescriptive and, with funding, the responsible surveyors, engineers, architects and landscapers should find it constructive, in that it should produce good, sustainable urbanism and not destructive environments, such as post-WW2 urban sprawl. After the new place has been inhabited for a generation or two it may be appropriate to consider some improvement, repair, or succession to the next transect zone, in which case the cycle may be reiterated.

The core strategic management problem for city planning directors and their mayors is how best to manage the planning cycle efficiently and effectively. Too much emphasis on strategic planning (the descriptive and predictive stages) and the statutory process and economic development (the prescriptive and constructive stages) will be under-resourced, slow and error prone. Too much emphasis on statutory planning and the process of issuing planning consents will be confused, for want of a coherent purpose. Getting this balance right can be greatly facilitated by adopting a planning system that uses common terminology consistently throughout the process, from environmental study to post occupancy survey. A transect-based planning system, such as Smart Code[4] (which is specifically designed to suit United States planning law) is currently, the only planning system that provides for this.

City administrations are responding to this challenge by adopting transect-based planning codes (and their close relation, known as form-based codes) in rapidly increasing numbers. From 1981 to 2017, 387 have been adopted (341 in the United States and 46 across the other inhabited continents); however, 88% of these have been adopted since 2003[5]. In simple terms, this is an average of two form-based or transect-based codes adopted each year over the twenty-two years from 1981 to 2003, jumping twelve-fold to twenty-four each year over the fourteen years from 2003 to 2017. If an exponential rate of increase is sustained, this form of planning control will be dominant across North America within a decade and will become very common across much of the rest of the world during the same period.

If the acknowledged benefits of transect-based planning can be improved upon, as I hope this paper demonstrates, then perhaps the rate of adoption will become even faster, but first it is important to identify the gaps in the current practice by examining transect-based planning in a truly urban environment.

4. Case Study: Palermo, Sicily, Italy (part 1)

The “wedge” illustration of a prototypical transect (figure 3) demonstrates the fact that the area covered by the natural and rural transect elements is usually significantly larger than the area covered by the more urban elements.

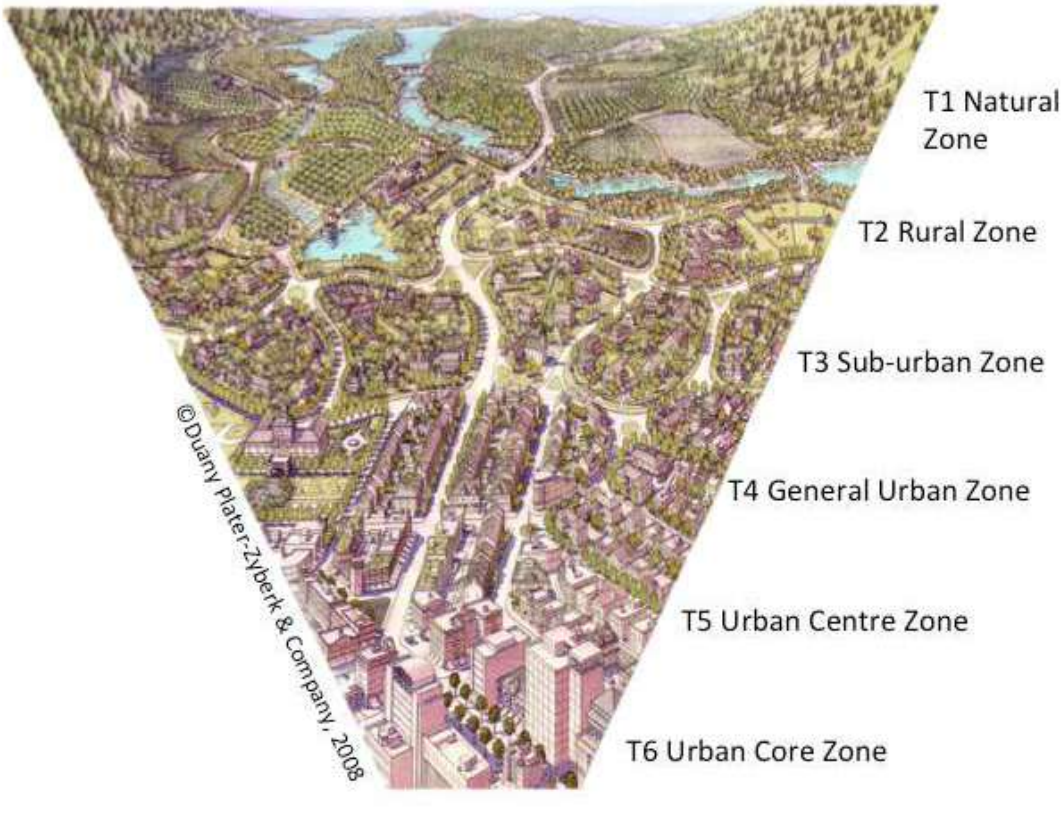

Figure 3: The ‘Wedge’ Transect Illustration (Andres Duany, Sandy Sorlien & William Wright: The SmartCode v9 and Manual, New Urban News Publications, 2008).

Figure 4: Watershed to urban core: Palermo, Sicily, looking west towards Monte Pizzuta.

For comparison, a real example is shown at figure 4 above. It is taken from the roof of the Hotel Ambasciatori on Via Roma in Palermo looking west towards Monte Pizzuta. In the centre of the picture, the dome of the Cattedrale di Palermo is immediately behind the lantern of the Chiesa del Santissimo Salvatore with the bell tower of the Cattedrale di Palermo slightly to the left of centre. The transect from the T1-Natural zone along the watershed, through the T2-Rural just visible in the distant valleys, the T3-Sub-urban along the foothills and the T4-General Urban of the old city is clearly apparent. The T5-Urban Centre Zone is to the right, out of view.

However, looking north from the same vantage point (figure 5, below) the Sicilian Baroque Chiesa di Sant'Anna and its piazza are in shadow, but still dominate the foreground, Monte Pellegrino is in the distance and there are many cranes to the right, along the shore of the Golfo di Palermo. So, while figure 4 shows an almost perfect example of a transect from watershed to urban core, figure 5 shows (from left to right) the urban core to the sea shore, something not well explained by the rural-to-urban transect as it is currently understood.

The Port of Palermo handles around seven million tonnes of cargo and two and a half million passengers a year. It has been the raison d'etre of the city since its founding by the Phoenicians in 734 BC. Figure 6 shows some of Palermo's parks and what transect-based planning would currently classify as special districts in roughly the area covered by the photograph at figure 5. This demonstrates that if the transect at figure 1 was extended to a regional context, from the watershed to the water's edge, then it would currently have significant gaps, as highlighted in figure 7.

Note that 'Special District' in figures 1 and 7 is drawn as a sprawl 'big box',such as a stand-alone hypermarket and massive car park, so before we look for the missing transect zones we need first to consider how to identify sprawl.

Figure 5: Urban core to sea shore: Palermo, Sicily, looking north towards Monte Pellegrino.

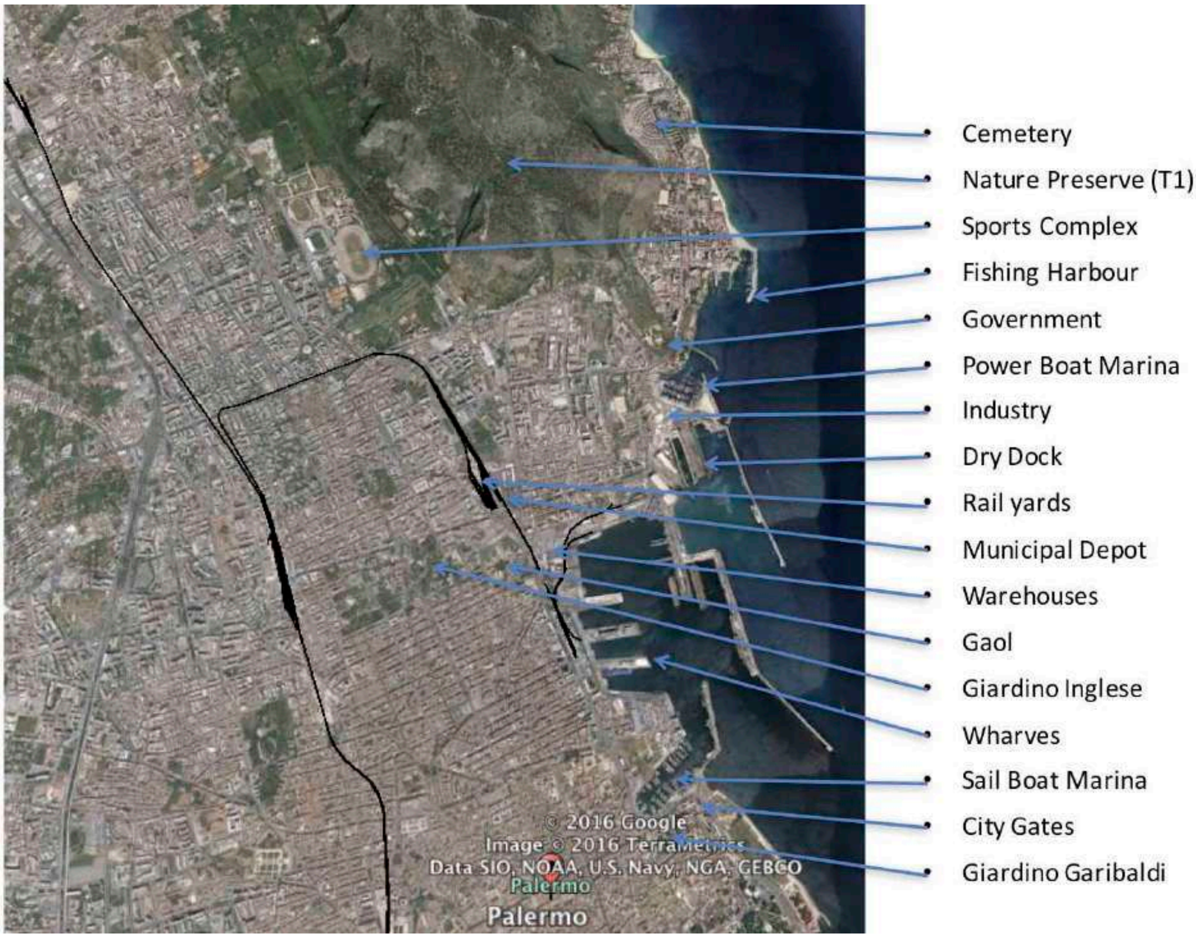

Figure 6: Palermo (courtesy of Google Earth) with possible 'special districts' indicated.

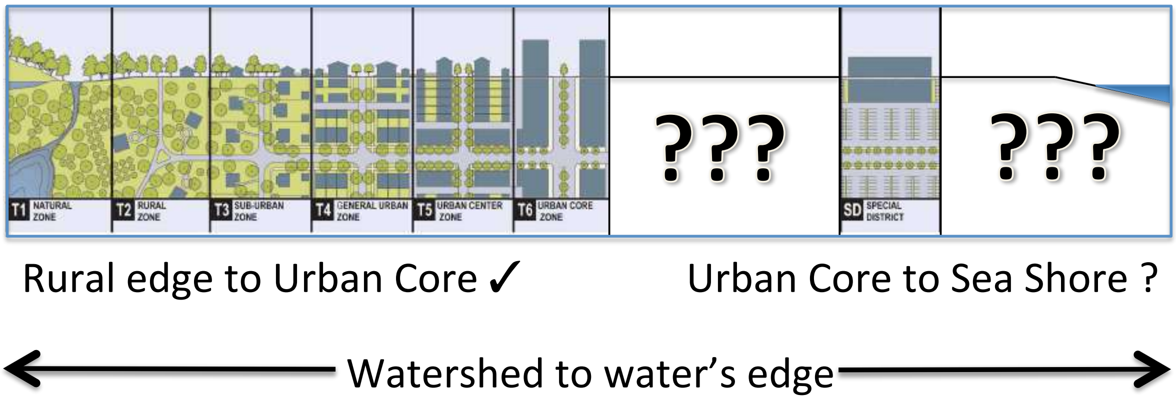

Figure 7: The missing transect zones.

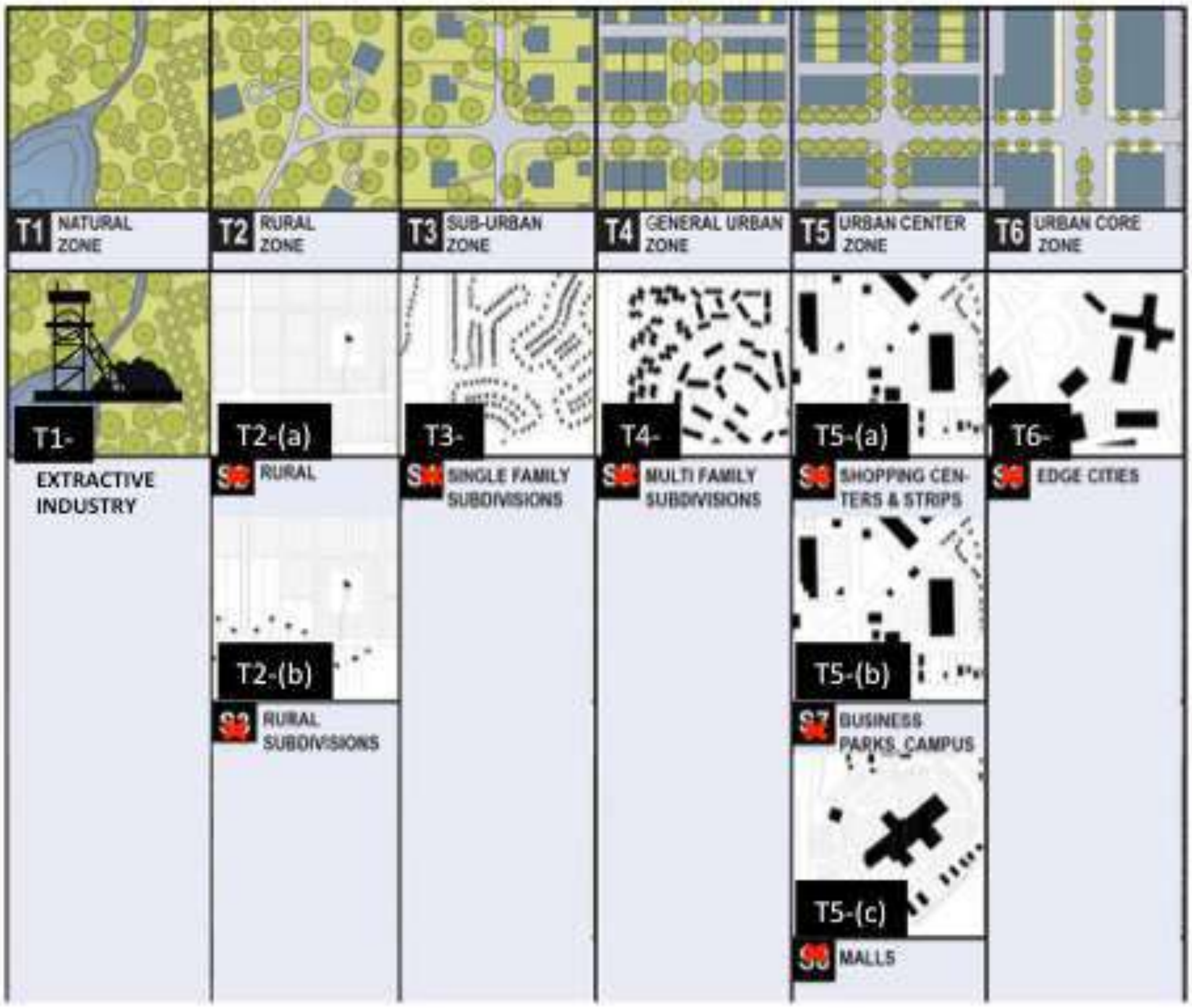

Figure 8: Classifying urban sprawl (© Hazel Borys 2012, but modified by author with permission)

5. Classifying Sprawl

Figure 8 above shows a slightly modified version of a very insightful transect analysis of urban sprawl prepared by Hazel Borys in 2012[6]. It builds upon earlier, ground-breaking work on the sprawl transect done by Galena Tachieva[7]. The only changes proposed here are the addition of the extractive industry and a new numbering scheme. This last change requires some explanation: imagine a natural area that is being mined for some natural resource, while it is being mined it is a degraded area and when the mining stops we would usually like to see it returned to as close to its natural state as possible, so we might designate the area as T1 minus, indicating both its current use and built form, and its intended future.

The same terminology is then applied for all of the sprawl elements, and similarly their present state and likely desired future character are immediately apparent. But note that the future succession to good urbanism is not necessary an automatic move up the diagram, within the same column; it will require analysis and consideration.

Of course, when this system is applied to a statutory plan it will require “existing use” provisions that enable current land uses and built form to continue as they are, while enabling all or part of a ‘minus’ transect zone to up-zone at some time in the future, in accordance with an approved master plan. Up-zoning is used here very generically, it may be that, for example, a sprawl repair masterplan for a T3 minus zone (i.e. single family subdivisions) might both provide street improvements to create something close to a proper block structure (i.e. T3-Sub-urban) for most of the area while also providing a neighbourhood centre of T4-General Urban and T5-Urban Centre zones. This latter component being a more accurate example of “up-zoning”.

Changing the categories from S1 to S9, where ’S’ stands for ‘sprawl’, to T1 minus to T6 minus is also advantageous because the word ’sprawl’ limits and understates the problem. It limits it to certain first-world countries and it does not give enough emphasis to the point that these types of development are at best temporary (e.g. mines until the resource is exhausted) and at worst destructive, locally and globally. In addition, some people see nothing wrong with sprawl. So, there are at least three good reasons for using a much stronger term: aberrant. Sprawl, slums, etc. are unsustainable aberrations from the truly sustainable forms of urbanism that are identifiable throughout the history of civilisation and should be referred to as such.

Note that it is not proposed that this become a system that grades urbanism from outstanding to horrific, because it would involve a massive effort to no good purpose. It is proposed that there is good urban form that is stable over the long term, and aberrant urban form that is unstable over the long term. This is a binary situation, so only normal (T1, T2, T3, etc.) and aberrant or deliberately temporary (T1-, T2-, T3-, etc) are all that are required. A transect of built form with elements coded as T1+, T2+, T3+, etc. is therefore neither warranted nor useful.

Note too that the transect zone ‘Special District’ from figure 1 is identical to T5 minus—type c (i.e. an enclosed retail mall) in figure 8. Clearly, replacing the transect zone ‘special districts’ with nine different categories of sprawl allows a greater understanding of aberrant urban-ecological zones and how they might be repaired. This adds to the strength of transect-based planning, while leaving open the opportunity to use the term ‘special districts’ much more constructively, but before we can make sense of the true nature of special districts it is first necessary to understand boundary conditions.

6. Boundary Conditions

Surveys of existing conditions and similar planning studies rarely pay attention to the boundary condition of large areas devoted to a single purpose, but it is key to how such areas relate to the rest of the urban fabric.

The Acropolis, rising majestically above the central area of Athens, Greece (figure 10) is possibly the archetype of all special districts. It is about the size of three city blocks, so it is not as large an element as it seems. Clearly, the defining feature is its fortified boundary, a wall designed to add to the natural defensive qualities of the hill on which it sits, while also increasing the area within which people could shelter in time of attack. Over the centuries, defenders of the Acropolis have never been defeated by direct assault, only by encirclement and the threat of starvation.

Figure 10: A fortified boundary, approx. 250 x 150 metres or 820' x 490', surrounds the Acropolis.

Buckingham Palace in London (figure 11) occupies a much larger area. The site is irregular in shape, but perhaps it could contain around fifteen city blocks. Unlike the Acropolis it has a secured boundary, one designed to be guarded, but not to withstand a heavily armed assault.

Figure 11: A secured boundary surrounds Buckingham Palace, part of an irregularly shaped complex approx. 520 x 610 metres or 1,700' x 2,000'.

In contrast to the two preceding examples, a fenced boundary is very common. The term ‘fence’ is used here to indicate a demarcated boundary, as in the magnificent hedge around the ΣAE Fraternity House in figure 12. ‘Fenced’ also includes ha-has and the wide expanses of ‘free-fire zone’ lawn and shrubbery used to discourage unregulated pedestrian access to campus style developments, such as a business park. In this context then a “fence” is any form of physical demarcation that is more than a line on a map but less than the sort of fence or wall intended to deter a purposeful intruder.

Figure 12: A fenced boundary (or in this case, a hedge) demarcating the front garden of the ΣAE Fraternity House’s 420’ x 200’ plot (approx 130 x 60 metres).

To complete the set we need only to add the case where the only demarcation of a boundary is by a few surveyor’s pegs or marks. This gives us the simple, but very useful symbology proposed at figure 13, in which the symbols for surveyed and fenced boundaries are standard drawing practice and the symbols for secured and fortified boundaries are standard NATO map-marking practice (respectively a barbed wire fence and a trench line). Finally, when a fenced, secured or fortified boundary encloses an area greater than four hectares (ten acres) drawing these symbols in red will highlight them as potential special districts.

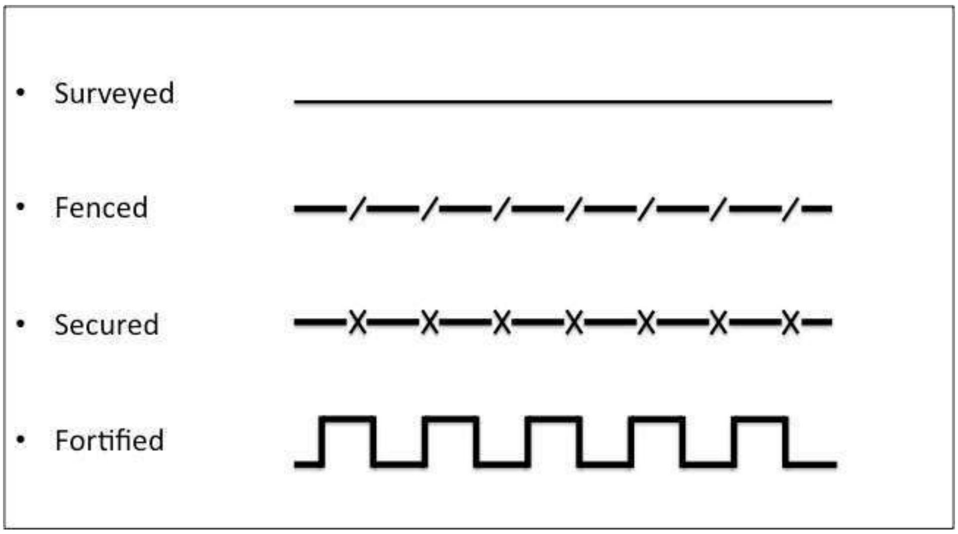

Figure 13: Graphics for boundary conditions.

The key point is that physically defined (i.e. fenced, secured or fortified) boundaries constrain movement. The areas outside and inside might be walkable, but the community is prevented or discouraged from walking from one to the other. When these areas are smaller in size than a large city block (say 200 metres or 660 feet square) there is usually little impact on walkability, but when they cover even slightly larger areas than a single block they have a major impact on the urban fabric. Obviously, the impact is situational, but generally the larger the area enclosed, the greater the impact. This factor allows us to distinguish true special districts from the missing urban-ecological zones and to complete our understanding of the elements of urbanism.

7. Case Study: Palermo, Sicily, Italy (part 2)

Applying the symbology for boundary conditions developed above to our earlier analysis of Palermo (figure 14) allows the list of unclassified uses to be usefully divided into three groups.

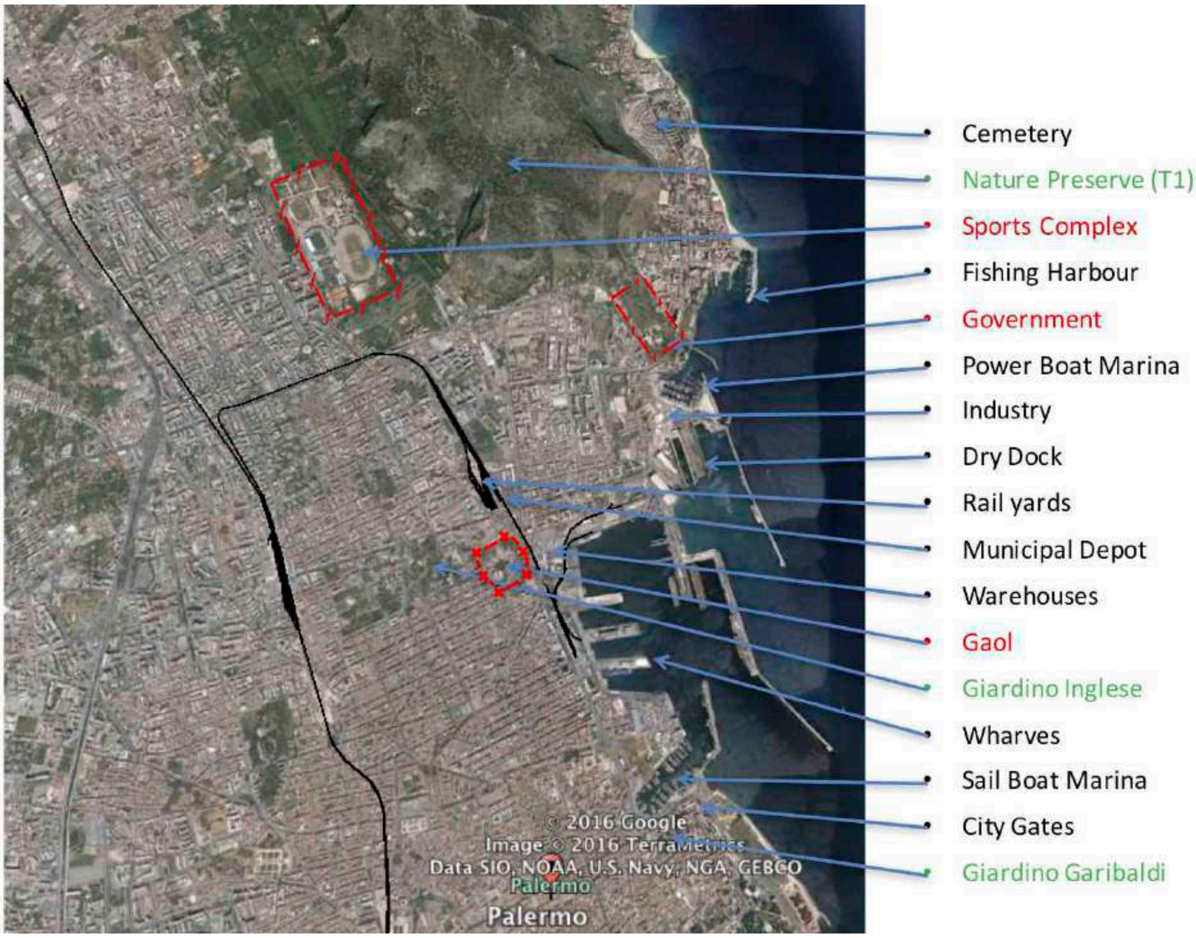

Figure 14: Palermo (courtesy of Google Earth) with fenced and secured boundary conditions

Firstly, special districts (as proposed to be defined): three areas have a boundary condition that is more than just to dissuade trespassers: the Stadio La Favorita sporting complex and the offices of the President of the Sicilian Region based around Villa Belmonte are securely fenced to prevent unwanted ingress, while Ucciardone, Palermo's nineteenth-century Bourbon prison secures its convicted occupants with massive stone walls and guard towers.

Secondly, parks and recreation (as opposed to natural areas): the Monte Pellagegrino nature preserve clearly has very different characteristics to the Stadio La Favorita sporting complex, which is in itself quite different to the formal urban parks in this part of Palermo (the Giardino Inglese and Giardino Garibaldi).

Finally, the missing transect zones: none of the other land uses (cemetery, harbour, marina, etc.) appear to qualify as special districts, they are simply urban-ecological zones that exist in an almost identical form in most urban areas.

8. The Missing Transect Zones

The standard rural-to-urban transect (figure 1) provides for agricultural production, housing and commerce, but towns and cities cannot exist without governance, manufacture and transport. In addition, urban populations usually also demand (or have thrust upon them) utilities, religion and culture. A complete prototypical transect requires that the missing urban-ecological zones, such as warehouses, refineries, ports, universities, etc., which are usually the economic base of a city or town be separately classified. As figure 15 illustrates, they are not difficult to distinguish from each other, in both land use and built form, so it should be quite possible to identify prototypes and to arrange them along a prototypical transect, just like T1-Natural to T6-Urban Core in figure 1. Similarly, distinct urban-ecological zones should also be able to be identified for parks and recreation uses and structures, because - as the Palermo case study demonstrates - a national park and a city park are very different urban-ecological conditions.

Figure 15: Uses that typically constitute the economic raison d'etre of most cities (main building of Hamburg University courtesy of Wikipedia, other photos courtesy of Pixabay).

A complete list of the missing transect elements in a typical progression that builds upon the familiar T1 to T6 rural-to-urban progression, might consist of:

- T7 Major Civic:
    1. Cultural;
    2. Religious;
    3. Government; and
    4. Royal, presidential and ambassadorial.
- T8 Parks & Recreation:
    1. Landscaped;
    2. Sporting;
    3. Structured (stadia, amusement parks, etc.); and
    4. Marinas.
- T9 Major Utility Infrastructure.
- T10 Industry:
    1. Services and trades;
    2. Manufacturing and warehousing (including cleaning, sorting and packing primary produce, and road transport depots); and
    3. Refining and smelting.
- T11 Transport facilities:
    1. Ports and harbours;
    2. Rail yards;
    3. Airports, airfields and helicopter landing zones; and
    4. Space ports.

'Major' in the context of the proposed T7 zone is meant to distinguish large civic buildings and precincts, typically found only in regional centres, from smaller versions of the same function that are typically found in or near to district and neighbourhood centres. In the context of the proposed T9 zone, 'major' infrastructure is any that requires its own plot of land.

One important reason for identifying the missing transect elements is because:

> "Some things will always be separated from residential, but often can still be walkable in context. Just because some uses aren't compatible with residential, doesn't mean they can't be compatible with each other, and the rest of the city."[8]

And a second reason is because transect-based planning is already being applied to places dominated by governance, manufacture and transport, for example the El Paso Airport Regulating Plan, Santa Fe Barrio Capital Regulating Plan and El Paso Medical Centre of the Americas Regulating Plan[7]. While these plans are no doubt individually excellent, the lack of a common language for the civic and economic zones, along with differing interpretations of what a special district is, reduces the ability to transfer knowledge across the profession and thereby learn from one project to the next.

9. Special Districts as a Community Unit

As explained under "2. Community Units" above, the transect zones are usually grouped into community units and the urban structure is formed from these units and their supporting infrastructure. The preceding discussion has now made it clear that the term 'special district' is not required to describe or classify the elements of urban sprawl, nor is it required to provide for the missing transect zones that have been tentatively catalogued above; however, there is a need for a term to describe special groupings of transect elements in circumstances that meet the following proposed definition (see figures 10 to 13 regarding fenced, secured and fortified boundaries):

> *A Special District is a special purpose community unit containing at least three urban-ecological zones within a physically defined boundary.*

Typical examples include airports, boarding schools, citadels (a heritage feature in many European cities), colleges, convents, hospitals, military bases, monasteries and universities, and would be labeled 'special district—airport', 'special district—boarding school' etc. Along with a defined boundary, these urban elements will also have an internal transect structure, as the examples at table 1 above notionally demonstrate. They are almost cities within cities.

Special District - Jail/Gaol	Special District - Barracks/Fort
Secured boundary (–x–x–)	*Secured boundary (–x–x–)*
T5 Administration, classrooms and theatres	T3 Married quarters
T5 Cell blocks	T4 Town centre
T8 Sports fields	T5 Bachelor quarters & barracks
T10 Workshops & stores	T5 Administration, classrooms and theatres
	T10 Workshops & stores
	T8 Sports fields & firing ranges
	T1 Close training area
Special District - University Campus	**Special District - Hospital Complex**
Fenced boundary (–/–/–)*	*Fenced* boundary (–/–/–)*
T5 Dormitories	T4 Specialist treatment & support facilities
T5 Theatres, lecture halls & seminar rooms	T6 Wards, theatres and administration
T6 Administration & libraries	T8 Gardens
T8 Gardens & sports fields	T10 Workshops & stores
T10 Laboratories, workshops & stores	T9 Incinerator
* 'fenced' means anything intended to demarcate private land, but to a lesser degree than 'secured' or 'fortified'.	

Table 1: Likely transect zones across some typical special districts.

Returning to the three examples, the Acropolis (figure 10) can now be classified as a Special District—Heritage with a fortified boundary and mostly containing the transect zone T7(b) Religious—Historic; Buckingham Palace (figure 11) as Special District—Palace with a secured boundary and dominated by the transect zone T7.4 Royal; while the ΣAE Fraternity House (figure 12) is not a special district, just a very nice element within a T4 zone.

10. The Periodic Table of Urbanism

Bringing it all together, figure 16 below shows the expanded transect from watershed to waters edge, within which there will also usually be a number of special districts, such as a jail, university, boarding school, etc.

It is now possible to arrange into one ‘urban periodic table’ (table 2 at page 15) the standard rural-to-urban transect extending from watershed to water’s edge and including the productive, transport and other uses in the city, along with some of the subclassifications that are now commonly used in transect-based statutory planning, the temporary and aberrant types of development, and an expanded range of community units, including special districts as now defined.

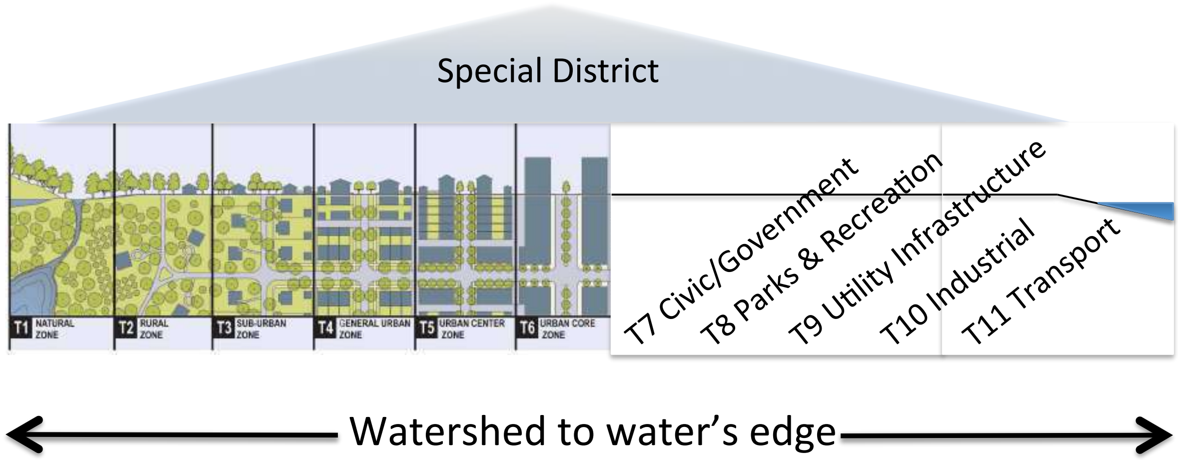

Figure 16: The expanded transect with special districts option.

The Periodic Table of the Elements is deliberately arranged to demonstrate the periodicity and grouping of the atoms. Similarly, the columns in the Periodic Table of Urbanism are all grouped by function, while the core box of twelve transect zones (outlined in lilac) demonstrate the urban equivalent of periodicity. These three rows across four columns (T3.1 to T6.1, T3.2 to T6.2 and T3.3 to T3.6) are typical local transects identifying four distinct, but co-dependent arrangements of built form. For example, suburbs at 5 to 15 units per hectare (2 to 6 units per acre) are only going to support general urban development one to two storeys in height and so on.

Note that within Table 2, in the left hand column, ‘*x*’ represents the relevant T-zone, e.g. T1.1 and so on. Note also that the numerical values given for some transect zones are tentative and require ground-truthing through case studies.

Studies and research to identify the mathematical relationships between each transect element, stable and unstable, are currently underway and may form the subject of a future paper.

11. Conclusion

Whether towns of thousands of people and cities of millions are more or less complex than the 118 chemical elements so far discovered is debatable, but as Professor Dmitri Mendeleev is quoted as saying:

> “It is the function of science to discover the existence of a general reign of order in nature and to find the causes governing this order. And this refers in equal measure to the relations of man - social and political - and to the entire universe as a whole.”[9]

COMMUNITY UNITS:	*Natural*	*Rural*									
		Clustered Land Development									
			Traditional Neighbourhood development								
				Transit Oriented Development							
				Regional Centre Development					*Industry & Infrastructure*		
	Special District (coloured as appropriate to main purpose and containing at least three zones within a physically defined boundary)										
TRANSECT ZONES:	**T1** Natural	**T2** Rural	**T3** Sub-urban	**T4** General Urban	**T5** Urban Centre	**T6** Urban Core	**T7** Major Civic	**T8** Parks & Rec'n	**T9** Major Utility	**T10** Industry	**T11** Transport Facilities
SUBCLASSIFICATIONS											
Key Factor:	**Science**	**Science**	**Density**	**Building Height**			**Use**	**Use**	**Site Area**	**Use**	**Use**
Tx.1	Refer to environ-mental science for more detailed classification.	Refer to agricultural science for more detailed classification.	5-15 units/Ha.	1-2 storeys	3-4 storeys	5-12 storeys	Cultural	Landscaped	Up to 500 sq m.	Services & Trades	Ports & Harbours
Tx.2			15-30 units/Ha.	2-3 storeys	3-5 storeys	5-20 storeys	Religious	Sporting	501 sq m to 2 Ha.	Manu-facturing & Ware-housing	Rail Yards
Tx.3			30-45 units/ac.	2-4 storeys	3-6 storeys	5-21+ storeys	Government	Structured	More than 2 Ha.	Refining & Smelting	Airports, Airfields & Landing Z's
Tx.4			Civic uses that adjust their form across the transect (e.g. schools, places of worship, post offices, etc.)				Royal, Presidential or Ambass-adorial	Marinas			Spaceports
TEMPORARY AND ABERRANT DEVELOPMENT											
Tx-(a)	Forestry	Un-economic Farms	Single Family Estates	Multi Family Estates	Shopping Centres and Strips	Edge Cities	Any of the above not adjoining or adjacent to T4, 5 or 6, as approp-riate to their scale	Any of the above not wholly adjoining roads, streams, rivers, etc., T1 and/or T2	To be identified	Industrial 'Parks'	To be identified
Tx-(b)	Drilling & Wells	Hobby Farms	Mobile Home 'Parks'	Slums	Business 'Parks'						
Tx-(c)	Quarries & Mines	Rural Residential	Shanty Towns		Shopping Malls						

Table 2: The Urban Periodic Table

Just as the Periodic Table of Chemistry identifies the physical components of our universe and is able to predict the relationships between them, the Periodic Table of Urbanism provides a comprehensive framework for describing the "general reign of order" in our towns and cities while also enabling the development of an algorithmic framework for planning as a necessary step towards the positive application of artificial intelligence to urban planning.

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The Practical Limitations and the Reference of Key Technology of Mixed Land Use

(A Discussion of Practicing Mixed Land Use in China)

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Abstract: The mixed land use origins from the planning theory and practice in Europe and America, which aims at breaking the mechanical function zoning, reshaping the vitality of urban and community and reducing the pressure on the ecological environment. The mixed land use is a sustainable development model which promotes the compact and efficient use of spatial resources. According to the practice in China, generally the mixed land use is conducted in two scales: the land parcel and the region. At the level of the land parcel, the mix of categories and proportions dominates and at the level of region, the development is leaded by the government. It presents limitations as focusing on the cities and ignoring the communities spatially, focusing on land compatibility and ignoring multiple mixes during planning and focusing on government-led and neglecting collaboration during implementation. By comparing with the practice in America and considering the practice in China, there are three keys to overcome the limitations of mixed use of land. Firstly, in the early planning stage, by demarcating the appropriate range of “walking orientation + spatial mixing”, the living space and public transportation are connected in order to achieve the "people-oriented, pedestrian-oriented" traffic travel goals, promoting the concept of green life. Secondly, in the planning and design stage, establishing a "mass control + market-oriented" planning mechanism, making the regulation of the development of a single land parcel appropriately flexible, the management and control of development behavior will transfer the functional matching and spatial layout to the market to enhance the vibrancy of the hybrid unit. Thirdly, explore the development mode of “multi-party cooperation and government services” in the implementation stage of construction. The government that uses administrative power for supervision and assistance and the public as important group, will provide strategy for project development that suits public opinion and market demand, creating an open and fair environment of mixed development.

Key words: Mixed Land Use, Practical Limitations; Planning Technology, Ecological Environment

1. Introduction

With the rapid process of urbanization, the problems of natural resources consumption and environmental crisis have been increasingly severe. In this case, the focus of urban planning is gradually changing from "increment" to "stock" in urban space, which means the focus of developing new are of urban is changing to optimize the land use in developed are of the city. Thus, finding the planning methods to improve the efficiency of land resources allocation and to reduce the negative environmental impacts has become one of the main concerns of academic society. In the 1990s, the theory of MXD (Mixed-use Development) was introduced into China (Zhu 2014). MXD is an innovative concept of land use, which is based on the reflection of the traditional functional zoning. This theory has been developed from the 1960s to the 1970s in the United States and to some extent it laid the foundation of urban development models such as TOD and TND (Wang and Li 2009). MXD provides a sustainable land use mode, which has significant advantages in breaking the bottleneck of urban land use, promoting the integration of functions and stimulating the social vitality. However, based on the research of the practice of mixed land use in China, it is found that, from the perspective of theory, the discussions of mixed land use mainly focus on the introduction and discrimination of the concepts, the concept of mixed land use and the similarities and differences of the compatibility of land use and the constructability of land, for instance, attempting to improve the operation mechanism of management, planning and implementation during the practice process (Xu et al. 2014). From the perspective of practice, most of the discussions focus on the mix of compatible land use or the development of large scale urban areas or small scale urban areas as land parcels, which are contrary to the original idea of the mixed land use that the development should be started from the communities instead of land parcels. The contraries have reduced the effectiveness of the mixed land use as a sustainable land use mode, in solving the problems of providing job-housing balance and creating vital community and in alleviating the natural environment pressure. Based on the current practice, this paper compares the “present mode” with the “conception of past” in order to explore the approach of adopting the “introduced experience” in the “local practice”.

2. The Supposed Utility of the Mixed Land Use

2.1 Break the Mechanical Function Zoning

In the second half of the 19th century, the traditional methods of urban planning were questioned one after another. At that time, the functional zoning thought was questioned the most, which was one aspect of the Charter of Athens focused on. In 1961, Jane Jacobs criticized that the loss of urban vitality and diversity were caused by the functional zoning thought. She suggested that "Cities should be based on the principle of mixed functions." In 1977, the Charter of Machu Picchu states that "Today, in planning…efforts should be made to create an integrated, versatile environment." The diversified characteristics of mixed land use respond to this trend of development. The mixed land use advocates flexible combination of various functions of modern cities and is an active reflection on the traditional mechanical mode of functional zoning.

2.2 Reshape the Vitality of Urban and Community

From 1940 to 1980, the population in American suburbs increased from 20.2 million to 100 million. The decline of inner cities caused by the lack of urban vitality intensified this trend of suburban sprawl. The "New Urbanism", which rose in 1980s, advocated the creation and reconstruction of diverse… mixed use of community…forming perfect urban, rural and neighborhood units (Talen 1996). Adopting the mixed land use had brought changes, for example, gathering the multi-purpose facilities in urban centers and communities, prolonging the duration of outdoor activities of residents, enhancing communications among neighborhood and promoting a sense of community belonging (Zhang and Wang 2012), thus facilitating the gradual return of suburbanization populations and reinvigorating the inner city.

2.3 Reduce the Pressure on the Ecological Environment

The expansion of urban development has intensified the urban sprawl. During the process of expansion, the boundaries of cities have been approaching the sensitive areas of ecological environment and the single-functional mechanical combinations of land use have resulted in the inefficient use of land resources. The mixed land use promotes more intensive and dense development modes, creating more efficient methods of land use, reducing the consumption of urban resources, such as buildings and spaces, and decreasing the consumption of energy and the pollution caused by commuting traffic, so as to weaken the negative effects on the ecological environment (Steiner and Butler 2006). Through the multi-dimensional mixing of multiple functions within a certain spatial range of area, diverse project functions can be achieved with less land resources, thus reserving more ecological space for urban development and increasing carbon sinks. Finally achieve the goal of building low-carbon cities.

3. Main Methods and Limitations of Practicing Mixed Land Use in China

The original purpose of introducing the concept of mixed land use to China is that “Reduce the working-class daily pendulum between living quarters and working areas” (Qiu 2009). Since introduced, the theory has been practiced in cities for more than 20 years. The theory holds that "the mixed land use should achieve the goals of basic skills, harmony and vitality" (Xu and Xu 2009). There have been many cases of mixed land use at the level of regulatory detailed planning (hereinafter referred to as "regulatory planning"), but the achievements of ecological and vitality goals have not been widely approved yet. By analyzing the cases of mixed land use in various places, the authors find that there are some limitations of the practice of the mixed land use in China. Those limitations are relevant to the space, planning and implementation.

3.1 Current Main methods of Practicing Mixed Land Use in China

3.1.1 At the Land Parcel Level: Based on the Mixed of Categories and Proportions

（1） Mix of Land Categories Based on the Compatibility of Land Use

The mix of land use at the level of land parcel reflects a strong thought of planned economy in terms of category. The government leads to draw the blueprint for mixed development and to define the category of mixed land use within each land parcel when the mixed land is sold publicly. The work basically follows the suggestion of land compatibility in the *Standard for Classification and Planning of Urban Land and Construction Land (GB50137-2011)*(hereinafter referred to “the Standard of Land Use”), such as the categories of R (residential), B (commercial and business facilities) and S (Road, Street & Transportation) (Table 1).

There are two reasons for the departments relevant to land management to specify the categories of the mixed land use. The first reason is to comply with the legal process of land transfer and to consider the price of land, in order to minimize the disputes over interests in the process of land transfer. The second reason is to try to control the market, by combining and arranging the uses which are considered to have greater benefits within the land parcel.

Table 1.Cases of Mixed Land Development in Typical Land Plots

Case	Area(hm^2)	Type of Mixed Land Use
Land Plot of Jiangning Science Park, Nanjing City	9.9	R2+B14
Land Plot of Pukou Science Park, Nanjing City	5.9	B1+R2
Land Plot of Taihu New Town, Wuxi City	22.0	R2+B1+B2
Land Plot of Wuzhong Economic Development Zone, Suzhou City	6.5	R2+B1+B2
Land Plot of Chuan Cotton Factory Phase II, Chengdu City	6.4	R2+B2+S41

Sources of Data:By the Author.

（2） Mix of Proportions Based on the Regulation of Function

There are two ways to limit the proportion of mixed function in the level of land parcel: one is limiting the portion of different land use categories in the Standard of Land Use and the other is determining the proportion of different minor categories of land under the same main land use category. The proportion limitation is usually determined by the government, which is based on two purposes. Firstly, constrain the developers, preventing them from taking advantages in the process to expand the share of the operational land development, and seizing private profits in the name of mixed use. For example, in the *Pilot Opinion on Comprehensive Land Use Planning and Land Management in China (Shanghai) Free Trade Pilot Area (2014) 443,* it is stated that “strengthening the regulation of comprehensive land use, and the composition and proportion of the use shall not be changed without authorization.”Secondly, reach the original goal of the mixed land transfer and achieve the expected functional attributes of the project. For example, in a mixed land sale by Guangzhou Science City, it is stipulated that the proportion of industrial manufacturing land must be equal to or more than 70, so as to ensure that there is sufficient industrial land to support the identified development of Guangzhou Science City, as well as to reserve development space for high-tech enterprises.

3.1.2 At the Regional Level: The Government Lead the Mixed Development

The area of mixed regions is basically above 1km^2 (Table 2), showing the spatial characteristics of "not suitable for walking". This kind of development is generally led by the government and can be roughly divided into two categories. One is a new city or a city-level public central area, whose mode is arranging and combining the pluralistic modern city-level service functions within a specific region, supplemented by appropriate residential functions, in order to create a dynamic space. The other is a park with a certain professional function. Within the park, in order to integrate the park and the city, in addition to the leading function, the mixed use of land and space is advocated, transforming from single land use to mixed land use (Liu and Wang 2013). For example, for the college towns in Guangzhou, in addition to educational and scientific research sites, the teachers and students are accommodated with sports centers, shopping malls, apartments for faculty and staff and other facilities, due to the long distance between the university and the central city.

Table 2. Cases of Mixed Land Development in Certain Planning Areas

Case	Planning Area(km^2)	Main Type of Mixed Functions
College Town, Guangzhou City	34.4	Education and Research (60%), Business (5%), Residence (20%), Convention and Exhibition (2%), Sports Activities (2%)
Smart New Town, Foshan City	1.8	Residence (20%), High-tech Industry (25%), Finance (15%), Business Office (15%)
Zhongxin Ecological Town, Tianjin City	30.0	High-tech Industry (15%), Education and Research (5%), Health Care (3%), Residence (25%)
Zhujiang New Town, Guangzhou City	6.4	Residence (20%), Business & Finance (30%), Culture and Recreation (5%), Administration (10%), Foreign Affair (2%)
Liuhe New Town, Nanjing City	1.3	Residence (30%), Trade and Business (10%), Culture and Recreation (5%), Health Care (5%)
Futian Central District, Shenzhen City	6.1	Business & Finance (35%), Convention and Exhibition (3%), Residence (15%), Administration (18%)

Sources of Data: By the Author.

3.2 Current Limitations of practicing Mixed Land Use

3.2.1 At the Spatial Level: Focus on the Land Parcel or Region and Neglect Community

The mixed land use in China is divided into two spatial scales: land parcel and region / group, but little attention is paid to the mixed use of community / block level. In one study (Linbo Qian, 2000) of the spatial distribution of travel of residents in Nanjing mentioned that "Because the employment is relatively concentrated in the center (area) and the land use of the new area is relatively single…The peak of work travel is mainly flowing into the central area…The contradiction between traffic supply and demand has become quite prominent." According to a report from the government, in the college towns in Guangzhou, the average price of newly built commercial residential buildings has reached 33,333 RMB / m2, which close to the price of those in the old urban area, due to lacking of reserved residential land. As a result, the faculty and staff of the universities can't afford the high price and have to live farther way, which is against the utility of mixed land use to change the separation of jobs and housing.

3.2.2 At the Planning Level: Focus on the Land Compatibility and Neglect the Pluralistic Mix

In China, the modes of mixing adopted in the practice of mixed land use are basically further interpretations of the land use compatibility based on the Standard of Land Use. In the relevant normative documents of land use management issued in various places, there is still no escape from the inherent shackles of traditional mixing of compatible land use only, which is limited to the form of "commercial and residential mixing" (Zhang and Zhou 2015). For example, in the Technical Guidelines for Regulatory Detailed Planning in Shanghai (revised edition 2016), it is suggested that three types of residential group land(residential group land mainly for high-rise residential buildings) are not suitable for administrative office use, scientific research and design use, industrial research and development use and logistics use. Another case is in the Technical regulations of Urban Planning and Management of Foshan City(2015 revision), taking the second class residential land (R2) as an example. It is stated that the land in R2 class shall not be compatible with the second class industrial land (M2), the logistics storage land (W), the urban road land (S1) and the square land (G3). Although the Land Nature Guide Compatibility Table has certain guiding significance, it includes the subjectivity and limitations of the planners or the departments in charge of planning (Zhang and Li 2016), which to a certain extent questions the potential of positive benefits brought by the multiple mixing mode.

3.2.3 At the Implementation Level: Focus on the leadership of the Government and Neglect the Multi-cooperation

Most of the mixed land use and development projects in China are guided by the will of the government. From the planning preparation and approval, planning and construction management to land transfer management, the government is in the role of dominance and the developers are in the role of executors. The public, representing social forces, has little way to participate, although in the context of institutional innovation, there has been a cooperative development mode between government and enterprises, giving the market more autonomy. For example, in the development of Xiongzhou District in Liuhe, Nanjing City, the government only regulated the volume ratio, the green space rate, the public facilities land and other compulsory construction index that involves the public interest. To other construction index, the government only does the guidance control. In the planning of the new area of west coast of Qingdao, it is clear that all the land types can be mixed without conditions, except 9 kinds of land types which involve the public interest and are not suitable for functional mixing and 11 kinds of land types which must be mixed conditionally.

However, at present, the urban planning in China is restricted by the strict and rigid regulation system. The hysteretic system of regulatory planning restricts the development of rational mixed land use. In fact, the new attempts of practicing mixed land use have not fully mobilized the enthusiasm of developers and social forces to participate in the whole process of developing and decision-making. Lacking of the participation is likely to cause the implementation of the mixed land use project to be difficult to carry out in the later stage of development, or likely to make the project have little effect after the completion.

4. Lessons of the Key Technologies for Mixed Land Use

4.1 Early Planning Stage: demarcating the appropriate mixed range under "Spatial Mixing + Walking Orientation"

Identifying a reasonable and suitable scale of land use range is the first challenge to the early planning stage of the project regarding to mixed development. The identified range will impact on the follow - up layout of function, fund - raising and market acceptance.

Since the 1970s, most research on mixed land use in the United States has focused on a community scale, that is, within a 10-minute walking zone or a 0.25 mile-radius core service circle, mixing residential with industrial, cultural, commercial, administrative and other functions. By this means, the scale is smaller and the development cycle is shorter, which is easier to implement (Xing 2005). For example, the grid partitioning model in Los Angeles is based on the community scale. In this case, for each partitioned district, the mixture of residential and non-residential is the main means. As a result, the local absorption rate of traffic demand of residents is very high and the pendulum type of cross-regional traffic is relatively small. Thus the whole transportation system is relatively efficient (Sung and OH 2011). Another example is the planning of downtown areas in Denver. In the planning, one of the key objects is building a pedestrian-oriented city, advocating mixed land use at the community level, arranging retail, catering and recreation along the street areas outside the community and leaving the central community for official and residential use. In the subsequent mixed development projects (such as the Milton Gaines New Town construction),the modes of identifying the range were adopted, by considering the public transport facilities and the major regional highway systems, identifying the areas of mixed development within a certain distance around these public transportation facilities. This mode actually divides the communities into multiple mixed units based on the public transport nodes. Usually the units are pedestrian-oriented and promote a non-motorized lifestyle. With the efficient use of public transport facilities and the transportation of people within the mixed unit, the development and construction of the surrounding areas will be driven and more functional facilities will be attracted. As a result, the benefit of the mixed land use can be radiated to a reasonable service radius.

When identifying the range of land mixed development in China, the thought of either choosing land parcels or regions should be abandon. Combining with the popularization of "block system", planners should make overall arrangement and partition of the mixed units with suitable spatial scale in the city level. There are two recommendations to define the range of a mixed project. The first recommendation is advocating an efficient mix of living space and employment space functionally. Hongyu Zheng et al. (2016) adopted GIS spatial analysis technology to analyze the spatial development characteristics of mixed land use degree in Shanghai, and pointed out that in suburban new city area, the effective matching between residents and service facilities should be ensured and affordable housing supply should be encouraged. Therefore, improving the equalization distribution of affordable housing in the city and promoting deep mixing of residential space and diversified functions are positive responses to the supposed utility of mixed land use. The second recommendation is guiding the integration of mixed units and public transport in space. After an empirical analysis of Shenzhen Metro Line 2, Zhang Yan et al. (2017) found that the higher the mixing degree of land around the station (500m hinterland) is, the higher the ride rate will be. Therefore, in order to create a pedestrian-oriented and non-motorized travel atmosphere, with the new public transport facilities such as the "shared bikes", planners should strengthen the seamless connection of different modes of transportation and identify the mixed units with high walking accessibility. By this means, the interactive mechanism of urban traffic and land use could be formed and the "low carbon" process of the city could be promoted effectively (Deng et al. 2016).

4.2 Planning and Design Stage: Flexible Regulatory Mechanism under "Mass Control + Market-oriented"

The use control measures adopted in the planning and design of the mixed development project affect the rate of future investment and utilization of the project. Because the mixed land use is closely related to the construction use control, the higher the flexibility of the construction use control is, the higher the degree of the mixed land use will be.

When planning and designing a mixed development project in New York City, only an overall target amount is limited and the specific development of a single land plot is not further controlled. Any behavior of development that does not violate the overall development goal and the dominant functional attributes of the project can be allowed. For example, in the long Island mixed-use area, the overall goal is broken down into seven objectives, "encourage medium and high intensity commercial developments in a transportation-oriented area…", according to the City Planning Commission of the City of New York. At the same time, under the overall goal, the mixed development project guides the multiple mixing mode. For example, in the special mixed-use area of the Franklin Street, it is stated that "residential use shall not be located on or below the same layer of industrial or commercial use and a safe circulation system should be provided in the residential use and industrial use mixed area"; This positive planning regulation employs new planning tools to eliminate the interferences among the traditional incompatible uses, to encourage more effective and innovative mixing modes and to break the functional mechanical zoning fundamentally. The multi-purpose mixing of the plane space is extended to the multi-dimensional mixing of the stereo space as well.

At present, in China, because both of the division of land rights and the management of regulatory planning act on the horizontal dimension, there is no standard for the regulation of vertical mixed land use to follow. However, it is necessary to realize that the rise of new industrial space and the improvement of building construction provide the possibility for a new mode of mixed land use. In terms of the industrial and residential land use, the point is not the proportion of residential area that can be mixed with industrial use, but the rules of conduct (such as the sewage discharge standard, the noise standard and the constraint of the transport period, etc.) that should be observed by the main body of the industry in residential area (Yin 2008). In this way, the conflicts between industrial behavior and residential behavior are reduced to form dynamic and efficient mixed units. It is suggested that loosening the regulation of specific development behavior of a single plot appropriately, transfer the allocation of function matching and spatial layout to the market; changing the rigid regulation containing the spatial representation index only, avoid the fuzzy division of the land use to breed market profit space via improving the land classification standard and compatibility regulation system (Zhou and Qi 2008); Setting the bottom line of the standard for the behavior of spatial utilization, ensure the positive development of mixed land.

4.3 Implementation Stage: Shared Construction Mode under "Multi-party Cooperation + Government Services"

In the process of realizing the blueprint framework of mixed land projects, multi-party collaboration becomes a more important strategy, because of the complex problems of the funds, property rights and functions of the mixed projects. An efficient and personalized collaborative development mode is the driving force behind the smooth implementation of a project.

Mixed land use projects in the United States were initially developed and built by the businessmen concerned with the signs of decline in downtown areas, and then real estate companies participated. The government provides services as the main focus. The services include: (1) allocating land resources with administrative authority;(2) making policies supporting land price and tax relief; (3) providing infrastructure, such as parking and other facilities required by the project; (4) revising established development plans and construction standards; (5) optimizing the urban structure and regulating the key roads, etc.; and (6) providing technical support for project development (Schwanke et al. 2003). In the early stage of the project, the developer assesses the typical market potential associated with each of the mixed uses and the market potential generated by the collaboration of various uses within the project, and tailors to different collaborative development programs according to a specific mix of combinations (Miller and Miller 2003). At the same time, the active participation of social forces such as communities, non-profit enterprises, organizations or associations has changed the absolute dominant role of the government or the market, so that the urban public interest and grass-roots demands can be received and responded in time, to avoid the interest disputes among the relevant groups.

In China, for the development of mixed land use projects, the government should guide market forces, appealing to social forces, and reserve channels for the market regulation and public participation, which is an important direction for changing the role of the government in the development of mixed land use. Taking social funds as the main source and combining public sector and public participation, the open and shared construction mechanism is established. The government provides supervise and assist with executive power, taking the lead in formulating land price and tax policies, providing infrastructure, improving planning methods, etc. The public playing an active and important role, provides strategies for project development based on the public opinions and the market demands. This multi-cooperation exploration mode accords with the current trend of market economy reform and makes the environment of mixed development more open and fairer.

5. Conclusion

The mixed land use is not only a technical means of planning, but also a sustainable-development-oriented strategy, which is an innovative strategy in land use and an advantageous approach to realize the coordination and symbiosis of urban life and ecology. The concepts of "compact city", "smart growth strategy" and "ecological city" have affirmed its role in the field of ecological environment. However, the concept of mixed land use, which was introduced from the United States, appears to be “hard to accept” in the Chinese urban planning system as the operating environment is very different with that in the United States. As a result, it is hard to adopt the mixed land use to guild practice.

Furthermore, the limitations of the mixed land use in practice reflect the deviation of government’s role in the market operation. In the near future, the market economy of China will be in the “2.0” era. In this era, there will be a market open to all market players, in which the monopolies and administrative interference from the government are eliminated (Wu 2013).In the context of the transformation of national governance and the deepening of reform, it is more fundamental to optimize the functions of the government and increase the efficiency of the market in allocating resources. Planning as an action of the government, the main responsibility is building a platform and controlling the bottom line. Spatially, the efficiency of the “deployment” of the government is far less than that of the “creativity” of the market. In the process of mixed development, encouraging the active participation of social forces and social capital and constantly improving the technical and institutional support system, is the fundamental way to realize the utility of mixed land use.

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Emerging Forms of Neoliberal Governance on Public Space: An Informal Business Improvement District in Istanbul

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1. Introduction

The discourse of urban redevelopment and revitalization mutated notably through the past decade. As competition between cities deepened, the buzzwords like “image creation” and “promotion” became the advocates of urban renaissance and new urbanity for cities, especially for the city centres which were at a loss to competition with both suburban developments and other cities, to attract the industries of office, retail, tourism and entrainment (Kotler, 1991; Kearns & Philo, 1993; Fainstein, 1994; Savitch & Kantor, 1995; Bradley, Hall & Harrison, 2002). The market oriented new tropism increased the importance of safety, security, sanitation and place marketing. In other words, creating new “live-work-play” and safe- clean public spaces for attracting potential investors, consumers, tourists is becoming more and more important due to the local governments economic limitations.
A new innovative tool called Business Improvement District (BID) flashed as an answer to these problems. Generally speaking, a BID implementation is based on the levying of charges on businesses to provide local services which could not be efficiently supplied by the municipal government. This means that those municipal services once provided by the public sector, such as cleaning, lighting, maintenance, and security could be offered by the private sector (Steel & Symes, 2003). This new kind of public-private partnership went beyond creating safe-clean environments and, as both declared and mostly criticized by many scholars, became the instrument of creating a new social infrastructure based on privatization, surveillance, governing transaction and police monitoring which most frequently eventuate with the emergence of gentrification, exclusion, discrimination, spatially close but socially-world apart neighbourhoods in city centres. (Briffault, 1999; Steel & Symes, 2003; Hoyt, 2006; Ward, 2007; Minton, 2010; Morçöl & Wolf, 2010; Peyroux, Putz & Glasze, 2012).
In Turkey, there is no legal framework for BID implementations. However, a quite similar BID implementation, like those in UK and America, exists and can be called as “informal BID” in Turkish context. The “informal BID” appeared for the first time in 2005 in the hotel district of Talimhane, a part of Beyoğlu district, which was subject to transformation. In 1994, the central government designated the area as a tourist and hotel zone. Subsequently, an Urban Design Implementation Project was launched by the local government in 2004 which positively affected Talimhane's development as a touristic zone. Meanwhile with the help of Talimhane Hotels & Investors Association the first steps of Talimhane BID Implementation were taken.
The aim of this article is to investigate the evolution and form of “informal BID” in Turkey and evaluate the adaptability of the BID model in Talimhane, Istanbul under these findings. To achieve this, in the first chapter, the evolution and changing characters of BIDS are reviewed with critiques from both supporters and opposites. The second section analyses Talimhane case study, its socio-economic and political transformation and development of “informal BID”. Finally, the article summarizes key research results, draws some conclusion about development of the new concept and its spatial and socio-economic effects in Talimhane.

2. Business Improvement Districts: an Introduction and a Review

As a complex and still evolving phenomenon, there is no standard definition for BIDs in the literature. Due to the differences in the names, objectives and structures of BID model, most scholars and practitioners describe BIDs as self-imposed financing mechanisms implemented by business and property owners for local improvements, specifically the enhancement of public services. As Hoyt (2004) stated the BID model can be also defined as:

> "a flexible form of governance that allows participants to craft solutions in a way that is sensitive to the local context and where state and local funding is limited. The model provides an opportunity for multiple stakeholders to organize, operate with autonomy, and manage programs to improve the physical, economic, and social conditions within their geographical jurisdiction."(Hoyt, 2004, p.3)

It is possible to argue that the BID concepts borrow some elements from Middle Age Europe, in which merchant guilds or associations provided basic security and maintenance services of market places voluntarily (Milgrom & North, 1990). However, BIDs first appeared in city centres in the 1970, as a new downtown model for revitalization, which had lost their economic viability and had difficulty in competing with suburban shopping centres (Mitchell, 2001). After the 1970s, as a result of economic decline and structural changes, the provision of many municipal services became more burdensome for local authorities. In such areas, local businesses organised themselves to collect contributions. Legal arrangements were also made to ensure the continuation and routinization of this process of partnership. As Peyroux, Putz and Glasze (2012) explains, they are legitimized by public law and deliver services that local governments used to deliver.

As a relatively new and so called innovative tool, the first implementation was set at a commercial quarter in Toronto, Cananda in 1970. In US, the first established BID was the Downtown Development District in New Orleans, in 1975. Especially after the late 1980s and 1990s, the BID implementations exploded, the estimated number of BIDs in US, are over 1200 (Hoyt, 2006). BIDs in US, approved and set by the state and according the state they constituted in, the structure, form, function of BIDS varies. This state to state changing arrangements also echoed as different name variations like: "special improvement districts (New Jersey)", "parking and business improvement associations (Washington)", "improvement districts for enhanced municipal sevices (Arizona)", "self supported municipal improvement districts (Iowa) (Mitchell, 1999; Hoyt, 2004, 2006).

In Europe, BIDs have first been implemented in the UK, and later spread to rest. According to Ward (2006, p.68) London acted as a 'centre of persuasion' to diffuse American operations throughout Europe. The first legal arrangement was made in 2003-4 and the first BID started to operate in 2005 (Dawkins & Grail, 2007). Out of 100 applications 53 were chosen, and among them 22 areas were chosen as 'pilot' BID areas (Ward, 2006, p.66). Besides the rapidly increasing number of BIDs in US and UK, BIDs were established in 16 different countries including Germany, Holland, Japan, France and South Africa due to their adaptability, the hegemonic discourse on entrepreneurial city, copy-paste based international imitations and promoting, facilitating activities at international organizations (Hoyt, 2006; Ward, 2006; Peyroux, Putz & Glasze, 2012).

As mentioned before, according to the context of where they are located BIDs might have differ. While in some cities like New York BIDs are solely a private sector initiative, in some cities like London, Tokyo and Hamburg, they take the form of a public-private sector of a business might change in accordance to its scale, revenue, number of employees, area size and rent (Steel & Symes, 2005, p.325-327). For example, BIDs in the UK are more of a public-private partnership than those set up in America. As Hoyt stated "the majority of the initiatives are funded by both the local authority and private sector while others are funded by solely by the public sector." (Hoyt & Glopal-Agge, 2007, p.950). Another important discrepancy between the UK and American BIDs is the veto power of local governments on disbursing the sources (Hoyt, 2006; Hoyt & Glopal-Agge, 2007).

Although there is not one type of model for these BIDs, there are five main elements that can be called as general attributes of BIDs. Firstly, all BIDs are responsible for governing a defined specific area. This means even though the size of the BIDs varies, the borders are defined explicitly. Secondly, BIDs receive most of their funding from the assessments from the business or property owners in the BID area. Also in some BIDs, fixed fees or voluntary donations are paid instead of assessments. Thirdly, BIDs are expected to concentrate on efficiency in their areas. This is achieved by spending their funding on only within a specific BID area, not distributing to whole city.x Another point is, despite the fact that BIDs are controlled by different organizations (governmental, quasi-governmental cooperation, planning departments) they are much more flexible, free and quick in compare to governmental equivalents since the formation and running of BIDs are based on voting system. Lastly, BIDs are quasi public entities as they formed by a specific form of public and private. Even though most of the time BIDs are called as as private non-profit organizations, as a consequence of their economic-funding structure and concentration on improving the quality-of-life and profitability, it is very likely to influence the activities of BIDs and local governments according to economic interests. This characteristic of BIDs also cause to interpret them as the privatized urban development policy tools (Mitchell, 1999; Ward, 2005; MacDonald, 2000; Mitchell, 2008; Briffault, 2010; Peyroux, Putz & Glasze, 2012; Ward & Cook, 2014).
While defined more at length above, the BID model relies on special assessments on a defined specific area to augment services to the area. These services typically include sanitation, security, marketing, and planning efforts. Ward and Cook (2014) describe the main BID activities as a service provider as the most visible elements of BIDs:

a. Public space cleaning and maintenance, in terms of providing basic services and monitoring the appearance of the streetscape
b. Securing public spaces and businesses, often through form of hiring security guards to coordinate with local police and installing surveillance technologies; and
c. Marketing the BID area and organising events to compete with other areas inside and outside of the city (Ward & Cook 2014, p. 13)

After discussing the definition and the general activities of BIDs, it is also interesting to notice that, BIDs are also used for creating integrated successful spaces. As Mallett (1994) mentions, redevelopment projects to produce post-industrial spaces always produced private spaces, but at the same time destroyed the public spaces by leaving them undefined without management or service. “For realizing the full potential of post-industrial city”, BIDs are utilized as a tool to integrate the public spaces with private spaces to (creating united consumption spaces) consume as a whole. This can also be interpreted as a new kind of urbanity, which is formed by new revitalization and entrepreneurial policies both to citizens and spaces. Several issues about BIDs on regulations, democratization, accountability and inequalities are still debatable and will be discussed in the next section (Ward, 2007; Peyroux, Putz & Glasze, 2012).

2.1 Debates on BIDs:

BIDs are often considered to be an outcome of neoliberalism (Hoyt, 2005, 2006; Ward, 2006, 2007; Hoyt & Glopal-Agge, 2007; Ward & Cook, 2014). The state on the one hand downsizes itself by cutting down many responsibilities, and on the other hand it leaves the control of central areas and public spaces to private sector interests, with the rhetoric of revitalization a spur for increased real estate prices (Ward, 2006, p.68-70). In doing so, central governments are criticized for spending public money on the establishment of BIDs and since their establishment, debates and concerns are raised on their formation, structure and effect. They are generally criticized by their lack of accountability, equity and also for privatization and over-regulation of public space (Hoyt, 2006; Hoyt & Glopal-Agge, 2007; Ward, 2007;

Peyroux, Putz & Glasze, 2012; Ward & Cook, 2014; Briffault, 1999; Hochleutner, 2003; Wolf, 2006; Morçöl & Wolf, 2010).

As Hoyt (2006) stated "In a democratic system, elected representatives are accountable to the public for their decisions and activities." As the nature of the structure of BIDs, which gives voting right to business or property owners instead of public electeds, give rise to question their accountability. Through the operation of a BID, property and business owners are given the right to have a say on how BID funds should be spent. This characteristic of BIDs increases the risk of ignoring the needs of local people and thereby causing social discrimination due to the different expectations and needs of local people and business owners (Hoyt, 2006; Morçöl & Wolf, 2010; Ward & Cook, 2014).

Another critical point on BIDs accountability is the BID performances. "To compile a public account of their activities, prove their worth to participating property owners, and bolster their reputation, many BIDs opt to implement and monitor performance indicators like customer surveys, crime rates, occupancy rates, retail sales, number of jobs created, and pedestrian counts" (Hoyt & Glopal-Agge, 2007, pp. 952). Although some models to evaluate the performances are proposed by scholars, thus far no accepted criteria to measure their performances and the real impacts of the BIDs emerged (Briffault, 1999; Hochleutner, 2003; Wolf, 2006; Morçöl & Wolf, 2010).

In return to these critiques BID proponents claim that; BID leaders and advisory boards are not elected through the traditional systems and they also emphasize the weighted voting system as an important part of decision making process. Instead of calling BIDs as "quasi-governmental" entities, they call themselves as a "vital leadership", which creates strategic alternatives and entrepreneurial solutions to urban problems. Additionally, some scholars and BID proponents claim BIDs as one of the most effective and transparent tools for customer oriented urban revitalization with annual reports or interest rules and by improving physical environment creating opportunities through economic development. Although in some cases these could be true, the common use of benchmarks like amount of trash collected, graffiti removed or renovated urban furniture are not enough for claiming accomplishing healthy urban economy or urban policy objectives (Levy, 2001; Hoyt & Glopal-Agge, 2007).

Equity issue is another main concern and criticism on BIDs among many researchers (Zukin, 1995; Mallet, 1995; Hoyt & Glopal-Agge, 2007). Although the presence of BIDs in the Anglo-American world has been explained by the need to renew and regenerate old neighbourhoods in cities, they are criticised for causing disempowerment among local communities. Consequently, while business circles advocate BIDs for regeneration and rehabilitation purposes, local people consider BIDs as more likely to be a process of creeping gentrification (Steel & Symes 2005, p.332). There is also an issue of equity with regard to BID security services.

As the first and foremost aim of the BIDs is the creation of 'safe and clean' environments, this ultimately results in the employment of uniformed private security forces and surveillance cameras. According to the BID managers, not only provision of the safety in the area, but also making sure of the prevention of any activities which are dangerous for commercial interests such as the use of skateboarding, begging, and other anti-social behaviours should be sustained in the area. As a result, BID managers think that, by implying exclusionist policies for objectionable social groups, they can dictate people how to behave in a BID area, so they can force homeless people and beggars to move from the BID area. This way, the poverty in the city is displaced, sterile and uniform places are created at the expense of a true public access and vitality of street life which encompasses all classes, ethnic and racial origins (Zukin, 1995; Minton, 2006; Peyroux, Putz & Glasze, 2012).

In response to equity criticisms, BID advocates defend their actions by demonstrating that they are using their funding, which are mostly gained from self-assessments, for basic service requirements like sanity, security in the whole neighbourhood which is not provided adequately by local authorities (Mithchell, 2001; Levy, 2001). They also plead that, all the investments raised for BIDs are spent for local needs and keeping the local area in the competitive business market. From this point of view, the BID organizers justify the inequality issues in local service provision to an acceptable degree as the DNA of market oriented nature of BIDs. Another justification by BID defenders, on excluding poor and homeless, is creating social services, shelters and outplacement programs in addition to creating job opportunities to unskilled members of society (Levy, 2001; Steel & Symes, 2003; Hoyt & Glopal-Agge, 2007).

Critics also argue the BID effect which sabotages the characteristic of public spaces and result in privatized and over-regulated spaces (Mallett, 1994; Hoyt & Galopal-Agge, 2007; Morcol, Hoyt, Meek & Zimmerman, 2008). It has been suggested that around the world the private sector has become more powerful in the governance of many cities; while the state has gained more control, contrary to claims about its withdrawal. In this respect, BID implementation is the product of neoliberalism, which causes the identification of public and private spaces to become blurred. Neoliberalism has changed the meaning of “public interest”, and under market forces may have redefined it as the “interests of the private sector” (Ward, 2006, p.68). As Marquardt an Fuller stated, BIDs started to play an important role on this new governmentalizing concept of space and bodies, which tries to normalize market and competition approach and commodification of public spaces (Marquardt & Fuller, 2012).

BIDs are trying to be the cultural and entertainment centres of the cities. For this mission they are serving only the interests of high income groups, as new luxury shopping centres replace smaller retailers. However, Steel and Symes (2005) warn against this conception for the simple reason that although shopping centres have the right of turning down proposed tenants and controlling customer access when they want to, BIDs do not because they operate in public spaces, and they do not have opening and closing times. BIDs are also becoming the inexpressive faces of the cities with too much makeup. Similarly Minton (2006) claims that the BID managements perceive urban space as a ‘consumer product’; and therefore, through the BID implementation areas are branded, marketed, sold to the customers and it is turned into a place, ‘a location destination’, which will ‘experienced’. Furthermore this type of transformation or “disneyfication” creates non-place areas, which lose the real authenticity and create a fake and elitist authenticity instead (Minton, 2006; Hoyt, 2007; Zukin, 1995).

In contrast to mentioned critiques, BID practioners say that BIDs can’t be classified as shopping malls because unlike these private properties, BIDs are under the jurisdiction of municipalities and democratic activities like free speech and demonstration are not limited in BIDs border (Warner, Quazi, More, Cattan, Bellen & Odekon, 2002). They also suggest marketing strategies like uniformation and beatification of streets are very important and essential for the nature of doing business for attracting people and reaching the quality. Additionally, BID advocates call “disneyfication” or “loosing authenticity” as poor critics and defend the model by saying: “Were our city centers more authentic when they were abandoned at night with graffiti and plagued by crime?” (Levy, 2001) Although it is a reality that BIDs can be a tool for improving the conditions of urban space; the compatibility of the political activism or expression for all groups of community with the unwritten rules of privately managed or consumption spaces is still questionable (Warner, Quazi, More, Cattan, Bellen & Odekon, 2002; Mac Donald, 1996).

3. Talimhane: an Informal Business Improvement District in Beyoglu, Istanbul

Istanbul is the largest city of Turkey with unique historical and cultural heritage and 14 million people living on it. The continuous growth of Istanbul since 1950s accelerated after 1980s by the impact of neo-liberal policies. In order to promote the city as a “Global City” a series of laws and projects, in the context of “tourism law” were adapted. Whereas in the period after 2000, new laws, prepared within the framework of the process of harmonization to European Union, and related legislation amendments, ensured the legal basis for bringing urban regeneration projects into the agenda of local administrations (Keyder & Öncü, 1994).

So as to reach “World City” level, the current government set the visions of Istanbul for 2023 as tourism, finance and knowledge. In this context, many large scale projects, including water front developments, luxury hotels, and urban revitalization projects have been implemented. These transformations and changes were observed in the Historical Peninsula, Haliç and Beyoğlu district. Istiklal Street in Taksim area is located in the Beyoğlu district, where entertainment, tourism and cultural activities are clustered. The district hosts many local and foreigner visitors and tourists. In this context, Talimhane area, situated next to Istiklal Street and Taksim, has entered into a process of transformation, starting from the 1990s (Berköz, 1991, 2000; Özdemir, 2000; Tokatlı & Boyacı, 1999).

Positioned on an intersection area between Mecidiyeköy, the Historical Peninsula, the Golden Horn, Beşiktaş and Bakırköy,Talimhane in Beyoglu, close to Taksim Gezi Park,a former military parade ground in the Ottoman era, is located to the north of Taksim Avenue, at the point where Cumhuriyet Avenue and Tarlabaşı (Refik Saydam Avenue) intersect. Talimhane, seen principally as a residential area during the post-war period, experienced economic and social changes similar to other central Istanbul districts until the 1990s. The area has a very central and well-connected location, due to its historical and transportation links. Despite having been subject to numerous physical changes, Talimhane remains within the borders of the Beyoğlu district, an area of great architectural importance, particularly for Art Deco and early modernist buildings (Akin, 2005; Polat & Polat, 2006).

The social composition of Talimhane has changed over time as a consequence of political incidents and the change in land use and socio-economic condition of the area. The first residents of the area who were mostly non – Muslims, had to leave Turkey due to 6-7 September incidents. After 6-7 September events, the low-income population from Turkish rural area, started to move into the abandoned residences from 1950s (Polvan & Yönet, 2010). After 1970, due to unwanted activities around neighbourhood like car repair shops, increasing crime rates, the residents of the area sold their properties and moved to Şişli, Nişantaşı or to the Anatolian side. This migration led to another immigration flux to the area. According to Talimahane Mukhtar Metin Sönmez, who was interviewed on 18 June 2009, residents, who are living in residential zone of mostly migrated from Eastern and South-eastern part of Anatolia. Sönmez also indicated that the current residents of the area low income and uneducated groups. These families, with many children, which are struggling with unemployment, live together in a house that has 90-150 euro rent price. Moreover, as a result of financial difficulties, many children often in the area cannot attend school and instead they try to find employment by working at informal jobs like selling water or flowers on the street.

In order to explore the transformation of the area and the establishment of “informal BID” in Talimhane, I employed a mixed methodology, using census data, participant and nonparticipant observation, and in-depth, semi structured interviews with hotel managers, mukthar of Talimhane and the director of Talimhane Hotels & Investors Association. Since it is impossible to find data on current population and because of the informal relationship between Talimhane Hotels & Investors Association and local government, in-depth, semi-structured interviews are the backbone of this research. Such conversations provide insights into the socio-economic transformation and the establishment and structure of “informal BID” in Talimhane neighbourhood.

3.1 The Transformation of Talimhane

Important changes which took place after 1990 were to transform Talimhane, and effectively detach it from its previous urban role as a residential area. In 1988 the opening of Tarlabaşı Boulevard, which connected Istanbul's historic peninsula with Talimhane and the central traffic hub of Taksim Square, cut off the adjacent Tarlabaşı district and its surroundings from commercial districts north and south of Taksim. In the newly-separated Tarlabaşı district drug dealing and crime were to flourish. On the other side of the new boulevard however, a pedestrianization project for Istiklal Avenue, implemented in 1990, was to lead to greatly increased activity, both social and commercial (Enlil, 2000; IBB, 1990; Tekeli, 1994).

Located next to Taksim, at the northern end of the new boulevard, Talimhane was an area of decline, both in terms of physical and social structures. Due to its key location Talimhane nevertheless aroused the attention of the municipality and led to planned improvements to develop a more attractive environment for commerce, and in particular tourism infrastructure. The first initiative involved its designation as a "tourism district" by the Cabinet and the Ministry of Tourism in 1994. Talimhane was also declared as an "urban protected area" in decision number 11437 (7 July 1993) by the Cultural and Natural Heritage Conservation Board No.1 of Istanbul. Later, for the 12 housing blocks comprising the Talimhane area which had started to lose their functional and architectural identity, another decision was taken in 1999 by the same Conservation Board to register the area at a city block and street scale, to ensure integrity before taking decisions on any single parcel scale, and to designate and protect selected "buildings of the early Republic period", as defined in decision number 663 (Polat, 2006; Ozden, 2008; Kizildere, 2010).

The designation of Talimhane as a tourist zone by the central government triggered the process of transformation and started to change the residential identity of the area. Housing was replaced with hotels, commercial units, and offices, which not only changed the identity of the area but also changed its social structure in the long run. With the aim of preventing the deterioration of individual buildings, eliminating illegal and informal parking lots and ensuring safety and increased perceptibility, the "Beyoğlu Talimhane Area Front Rehabilitation Urban Design Implementation Project" was subsequently realized through cooperation between the Istanbul-Metropolitan and Beyoğlu Municipalities, and was put into practice in 2004 (Kizildere, 2010; IBB, 2004).

3.1.1 Beyoğlu Talimhane Area Front Rehabilitation Urban Design Implementation Project

Anticipating the accommodation needs of the Istanbul NATO Summit in 2005, the Area Front Rehabilitation and Urban Design Implementation Project was intensified in Talimhane, not least because of its convenient location close to Taksim, the 'Congress Valley' international hotel district and the expensive shopping district of Nişantası. Formulated with a disregard for social consequences however, and planned as only as a series of physical changes involving urban furniture, facade renovation and pedestrianization (Kizildere, 2010)

The "Beyoğlu Talimhane Area Front Rehabilitation Urban Design Implementation Project" began with a pedestrianization programme, in order to increase security, accessibility, and to provide space for festivals and outdoor activities. In this pedestrianization programme certain hours were allocated for access by service vehicles, with passage of vehicles free between the hours 06:00-10:00 while card access became obligatory at other hours. Entrance into the area is made at two points, and the exit is a controlled passage where Abdülhakhamit and Topçu avenues intersect. Urban furniture and pavements have also been renovated, with the former positioned to avoid inhibiting pedestrian circulation throughout the district (Kizildere, 2010; IBB, 2004).

The project did respond to problems of security and physical deterioration, but failed to offer any solution to the social challenges faced in the low-income and deprived residential sections of Talimhane. After the completion of the project, user profiles and the demand for services in Talimhane have changed. Car mechanics, other small workshops, and cargo companies operating in Talimhane since the pre-1990 period have had to leave the area due to rent increases, the pedestrianization project, and changes in demand (Table 1).These premises were subsequently replaced by cafés, restaurants and souvenir shops used by tourists and people working in the area. Interviews made with hotel managers after the project indicate that business establishments located in the area are very satisfied with Talimhane's development, the reclamation of its prestigious image, and the better use of its central location. Hotels can now offer not only accommodation facilities, but also congress and meetings functions, having many high capacity meeting rooms after re-structuring themselves in conformity with the strategic plan of the central administration (Polat, 2006; Kizildere, 2010).

3.2 Creating the "Informal BID": The Establishment of Talimhane Touristic Hotels & Investors Association

After the complementation of the rehabilitation project, in 2005, to enforce the tourism based transformation and to prevent the re-emergence of security and social problems, hotel owners got together and established "Talimhane Touristic Hotels & Investors Association" which also began to create a type of business improvement district. As mentioned before although there is no legal framework or any legal contract between the Association and Beyoglu Municipality, Talimhane Touristic Hotels & Investors Associations articles of association gives us detailed information about the associations structure, its aim, working principles and forms of work. The prerequisite to be a member of the association is to be an owner of a hotel or commercial enterprise in Talimhane. The decision making system is based on voting system and to make a decision absolute majority vote is needed (TTHIA Article of Association, 2005; Kizildere, 2010).

As stated in articles of association, Talimhane Touristic Hotels & Investors Association is a non-profit organization and its source of income is based on membership fee and donations. Membership fee is composed by two types of fees. First one is entry fee which is equivalent to 500 TL (180 Euro), the other one is annual fee that is 200 TL (70 Euro). Their budget differentiates according to needs of the area but it is reported that their expenditure for 8 years was around 6.6 million Euros. For 2014, the Association's budget is around 720.000 Euros. As can be seen from the numbers, the economic sustainability of the association is based on voluntary assessments by hotel and commercial enterprise owners. The biggest part of expenditure is the security. Mediterranean Security Company which is responsible for areas security, receives payment, which is equivalent to 864.000 Turkish Liras (304.000 Euros) for a year, for its services from the Talimhane Touristic Hotels & Investors Association every month. The amount paid by 32 hotels is divided according to each hotel's number of stars and rooms. The district's infrastructure and repair costs are also covered by the Hotels & Investors Association (TTHIA Article of Association, 2005; Esmer, 2009, 2013).

According to articles of association (2005), apart from hotel needs, the Association is responsible for the district's management including infrastructure, security, repair and most importantly, socio-economic and cultural improvement of Talimhane area in addition to establish partnership with governments, NGOs and public/private institutions to run projects. Emerging from this, it is possible to organize the association's activities in three main groups: 1. Place management of the public environment 2. Production of special events 3. Planning and political advocacy.

The first category of functions which includes security, improving and repairing infrastructure and landscape like lighting, sidewalks, urban furnitures. Talimhane has been protected by the Akdeniz Güvenlik (Mediterranean Security) Company since 2005, even though private security units are not allowed to operate freely in public spaces. Nevertheless, 32 employees of this company have worked with the municipal police since then, but due to lack of authority to apply any penalties, they require close support and monitoring, in addition to this troublesome situation, an interview held in January, 2014 with Security Bureau of Beyoglu Police, showed the broken connection between Akdeniz Guvenlik and Beyoglu Police. In the interview, Security Bureau, which is responsible for private securities, claimed that there can be no security forces other than police at the public spaces which creates contradiction with current situation (Esmer, 2009).

Apart from management of public space, Talimhane is used for place-promotion activities by the association and Beyoglu Municipality. As it is the one few pedestrianized areas in the city centre, activities like opening and closing concerts of festivals, free public concerts take place in the area. Association is also responsible for free accommodation for artists during festivals and organizing free Ramadan Iftar dinners in the area in the name of Beyoglu Municipality (Esmer, 2009, 2013).

Planning and political advocacy is another important responsibility of Talimhane Hotels & Investors Association, including development of site plans, land uses and also to work as a bridge between hotels and municipality on legal issues. In 2009, a land use plan with tourism function designation for Talimhane was issued by municipality. The conservation board approved the plan in 2010 and also documented the buildings with height and façade violations. Although illegally built floors of hotels must be destroyed, no legal action has been pursued. The other crucial point is the legal status of the potential projects. As the area is protected, the new hotel and commercial projects must have the board's approval but as conservation board informed, there are no hotel projects completed or pending at the moment so the legal basis of current projects is questionable and mainly depend on licence or assurance of Beyoglu Municipality (Solano, Geambazu, Soltanzadeh, Swangpol and Mohyeldin, 2013) Talimhane Hotels & Investors Association is aware of the situation and to solve the problematic legal status, they initiated both with Beyoglu Municipality and Tourism to cooperate and reach an agreement. Although, declaration Talimhane as a tourism center by the ministry of tourism and with this declaration transferring the planning authority from the municipal government to the cabinet or central government could solve the legal problems, the Beyoglu Municipality refuses this solution and want to keep the area in their authority. According to Esmer (2013), Beyoglu Municipality doesn't want to lose control on an area like Talimhane which is self-funded and also the associations economic and social support.

Another critic subject in this category is whether the Hotels & Investors Association's efforts are improving the local people's socio-economic statuses including the job training and employment services for the unskilled and poor population living in the area or not. Esmer (2013) stated that although they have plans with local authorities on educating and providing jobs to local people, currently, people working at hotels are not resident of Talimhane and live mostly in the suburbs.

3.3 Outcomes- Impacts and Similarities with BID model

As mentioned before, BIDs are quite successful as a "travelling concept"; it is spreated around the world. Talimhane Hotels & Investors Associations implementation, which is very similar to other BIDs around the world because of its self-imposed and voting system and also service provider mission, however this differs from the other BIDs because of its legal status. As mentioned before, there is no legalized framework for BIDs by local governments in Turkey. This status makes us to declare the implementation as an “informal BID” (TTHIA Article of Association, 2005; Peyroux, 2012).

Like most of the BIDs around the world, the Association activities and concerns are concentrated on “creating safe and clean environment” which includes improvement on physical conditions of properties, the management of buildings and public spaces and also safety and security issues. And again like many BIDs, their assessment criteria is based on improving “physical decline of inner city infrastructure”, “empty building and vacant shops”, “disinvestment from the city centre”, “unmanaged informal trade”; “congested pavement”, “continued corporate exodus” (Peyroux, 2012; Esmer 2013)

With the help of both Urban Design Project and “informal BID” Implementation, Talimhane continued to develop rapidly as a tourist area. During the interview held with the director of the Talimhane Hotels & Investors Association in June 2013, informed that Talimhane is still serving for the affluent tourists and customers, in the line with this concept, the land prices are still continuing to increase with an average square meter of 6.000 Euros. As in the UK (Cook, 2008), the BID model in Talimhane is described as both successful and appropriate due to the improvement of physical conditions and services. Talimhane launched as the “new Shanzelize” by Istanbul Greater Municipality Mayor also used in Beyoglu Municipality commercials as an example of perfect transformation (http://www.ibb.gov.tr/tr TR/Pages/Haber.aspx?NewsID=8062#.U6v5z7FAAqI; Kizildere, 2010; Esmer, 2013).

Although it is impossible to deny the physical improvement and glamorous image of the area, like in mnay BIDs, issues about BIDs on regulations, democratization, accountability and inequalities are questionable for Talimhane as well. Firstly, Esmer (2013) stated their discontent about the street beggars who are mostly from Syria. He claimed that these beggars do not even hesitate from entering the hotels, and damaging the ‘glamorous’ image of the area. The Association acted on the street baggers by photographing and reporting them to the Beyoglu police and Beyoglu Municipality, but in return the authorities informed the Association that they can only impose 86 Turkish Lira (30 Euro) penalty and have no authority on keeping the beggars away from Talimhane. Anoher important point is that the improvement of the conditions has not involved the west part of the neighbourhood, a residential area for poor and unskilled group. Besides the security problems appeared again in Talimhane. Although looseness of security measures played a part in the re-surfacing the security problems in the area, the emergence of unsafe areas where crime becomes widespread would be inevitable in cases where poor, excluded and marginal groups in city centers are not empowered economically and are deprived of social aid and public support, as in the case of Talimhane. It is very likely that these groups will move from one neighbourhood of the city center to less central neighbourhood, as per the changing conditions like transformation process of the poor residential area into boutique hotels (Kizildere, 2010).

4. Conclusion

As Brenner and Theodere (2002) stated, “cities became increasingly important geographical targets and institutional laboratories for a variety of neoliberal policy experiments.” (Brenner & Theodere, 2002, p.21). Business Improvement District concept is one of those policies which goes beyond “clean and safe” environments and as our case study Talimhane indicates BIDs, as a new “urban revitalization” tool, act like a transformative force for the culture, social and physical improvement, still a conflict on academic literature that the ‘revitalized’ areas should be admired rather than avoided or for whom it is made (Mallett, 1994; Hoyt, 2006; Peyroux, 2012)

Even though, the legal framework of implementations such as BIDs has not been set up yet in Turkey, Talimhane Touristic Hotels & Investors Associations efforts, with keeping the area safe and well-maintained, are very parallel to BID implementations in foreign countries. For example, security and maintenance / repair services being paid by the private sector, according to the logic of who pays the piper calls the tune, are only for the areas which are close to the hotels, not for residential areas. As central and local government are incapable of solving the social and economic problems of residents, it is inevitable for the private sector to create its own well-maintained and protected areas. Although, the security company in Talimhane does not discriminate towards the residents living next to the hotels when using the hotel district, these people have no such demand to use or come to this area, which is socially and economically different and whose lifestyles are incompatible with the luxury eating and drinking places. They live as if the hotels area does not exist.

BIDs play a central role in attempts to governmentalize bodies and space (Peyroux, 2012). In our case study Talimhane is one of the most important districts of Beyoglu. Due to its economic importance, influence and unique legal status, Talimhane Touristic Hotels & Investors Associations has a strong relationship with Beyoglu Municipality, which in turn results in actions like lobbying of the hotel owners for a new tourism plan, request for the pedestrianisation of Talimhane or providing free accommodation for Municipality activities. Although interplay activities between interest groups can be useful sometimes like solving time and political obstacles, it does not always reflect the interests of the society. In this respect, although association's decision making process is based on voting system, monotype membership system of the association limits the voice of “others” and also the Beyoglu Municipalitiy's top down planning approach and strong tie with Talimhane Touristic Hotels & Investors Association increase the concern for the well-being of “other” groups living in the area.

Debate on BIDs is very controversial and the same can be said for this case study. Some defend the urban revitalization tools like BIDs in view of increasing financial capacity, stabilization of collapsed areas and improvement of physical and social qualities. But on the other side, these processes contain risks and should be sensitive to the social context which needs to be considered very carefully, to avoid the negative consequences like displacement, loss of social diversity, creating gentrified spaces. It is important to realize that the “informal BID” implementation in Talimhane created the “clean and safe” area, intensified growth, enhanced competition and increased the profits of business and hotel owners. But also unfortunately, the last implementations in Talimhane intensified the problems in terms social aspect of disadvantaged groups. Hence as the gap deepens between Talimhane and its inner circle, as if corroborating the critics, there has been an increase in urban environment structures which are physically near but segregated socially and institutionally.

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Analysis of transformation of urban planning practice by mapping changes in economic, social, cultural and built environment of the Neighborhood Level Urban Communities (NLUC): Case study of Kolkata, India

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Synopsis

The study analyses the transformation of urban planning practice through mapping changes in economic, social, cultural and built environment of the selected NLUCs. The study then explores how entrepreneurial urbanism and neoliberalism has dominated planning practice leading to erosion of the cultural patina of Kolkata.

Keywords: urban planning, neighbourhood level urban communities, cultural

1 Introduction

Kolkata has experienced an explosive population growth leading to rapid urbanization. Population is found to be stagnating in the core city as the wards 1 to 100 shows a low growth rate for the last two decades, but the newly added wards, especially from 101 to 110 adjoining to Eastern Metropolitan Bypass, abutting the East Kolkata Wetland is growing at an alarming rate hence the natural growth of the city is higher. This noticeable contrasting urban growth is accounted mainly for the increase in city size, expansion of tertiary and service sector activities especially the IT boom, and the improved transit facilities along the eastern fringe. This population explosion has resulted in an unprecedented boom in the real estate sector imposing verticalization subsequently changing the city skyline and thereby reimaging a large part of Kolkata. The eastern fringes of the city have experienced an incremental growth in population which has helped the architectural profession to thrive but many a time-defying planning norms. An increase in land value and property price along the Eastern Metropolitan Bypass have resulted in an uncontrolled urban sprawl, bringing with it a myriad of Economic, Social, Cultural and subsequent planning challenges. The professions of architecture and urban planning are being largely dominated by driving forces of entrepreneurial urbanism making preservation of built heritage and culture a difficult proposition. This has often resulted in the demolition of historic buildings and subsequent erosion of the cultural patina of Kolkata (Bose, 2016). This urban explosion has started encroaching the eco-fragile areas of the East Kolkata Wetlands, a RAMSAR site resulting in an uncontrolled sprawl. The present paper explores the transformation in urban planning approach of Kolkata based on a timeline of historical events since its inception as an Indian colonial port city to today's IT-driven city.

2 The onset of entrepreneurial urbanism and neoliberal policies in Kolkata

The authors have tried to explore how economic liberalization has instigated the onset of neoliberal policies which has paved the path for entrepreneurial urbanism, responsible for restructuring the spatial urban landscape of Kolkata.

Neoliberalization in India has contributed towards highly polarizing consequences with respect to social welfare and environmental sustainability (Chattopadhyay, 2017). The essence of neoliberal policies is to encourage open competitive and unregulated market logic to pursue large urban development projects in quest of transforming Indian cities into 'world-class city' (Peck et al. 2009) (Ghertner, 2011). As a consequence of the implementation of the Neoliberal policies, the urban development plan was being reshaped and developed by the complex dynamic interplay of global ideals and local factors. Neoliberalization has interacted with the local forces for managing the city and pursuing growth and development which is often termed as 'glocalization'. Swyngedouw (2003) has described 'glocalization' as dichotomous global and local entities which actually complement each other to generate economic prosperity.

The economic liberalization of the 1990s has brought about significant reforms which have changed the lifestyle of Kolkata's middle class and promoted new 'neoliberal policies across Kolkata. The economic liberalization of the 1990s and the issue of foreign investment has brought about reforms which have benefitted the 'new 'middle class and increased the disparity, widened the inequality gap between the urban poor and the middle class. From 1977 onwards, the ruling political party was disregarding the needs of urbanites in favor of their rural vote banks. From 1990 onwards, in order to accommodate the needs of the consumeristic middle-class citizens, the state government began to invest heavily in urban infrastructure intending to gain the support of the middle class who were now interested in state politics in order to stay in power.

The change of reform in policies such as encouraging foreign investment, in the private sector, export-oriented business, the emergence of the bourgeoning IT sector led to the embracement of the global consumerist culture. Consequently, this led to the drastic consequences of 'regeneration' and 'urban restructuring' in Kolkata (Fernandes, 2004). The metros such as Kolkata and Delhi were reshaped and reordered in order to support the needs and demands of the growing urban elite (Donner, 2012). Construction of highways, bridges, malls business parks, suburban housing indicated the changing era. The neoliberal policies began to reshape the imagination of the public and consequently, the city and urban spaces began to be looked upon as economic resources. In order to realize the vision of the middle-class Calcutta of identifying themselves as the future IT hub at par with Bangalore and Hyderabad, Kolkata had to expand beyond its boundaries. The planners and bureaucrats of the entire political landscape were dominated by the hegemonic left front and their appeasement policies for the vote bank to stay in power linked the fate of the city to its hinterland (Donner, 2012). This led to the emergence of luxury residential apartments catering to the needs of the global lifestyles where basic infrastructural facilities were also not available. The government started investing biasedly to develop these new areas while the city core stood neglected.

Few Government policies are explicitly biased towards the interest of the elite by encouraging property development. It has provided investment opportunities in real estate with attempts to include the middle-class to claim their stake in the wealth generated by the new economic order (Shatkin, 2014). Neve and Donner in their article of Revisiting urban property in India has highlighted that the unregulated market values and the influence of neoliberal ethics didn't lessen the role of social aspects during the development of the property regimes but they have endangered transformation in the way property plays a key role in driving contemporary social life (De Neve & Donner, 2015). Entrepreneurial urbanism is largely responsible for changing the urban spatial landscape at the local level (Smitha, 2016) which will eventually erode the intrinsic characteristics of the metropolitan cities of India.

There has been a wave of real estate development of luxury condominiums on the fringes of Indian Metropolitan city of Kolkata. These housing projects are being developed solely to imbibe the status of Global India. This real estate market is mainly targeted to attract overseas Indian communities and local elites who want to acquire the "international" identity (Bose, 2007). Such massive development has not only altered the skyline of Kolkata but also has exerted a significant impact on the social, economic and ecological environment of the city. Such rapid urbanization triggered by the real estate industry is endangering the ecologically sensitive East Kolkata Wetland a wastewater-fed aquaculture (Bunting et al., 2010) constituting an ingenious waste management system of Kolkata which has been also recognized as a Ramsar site since 2002 (Bunting et al., 2002) (Bose, 2007). Moreover, this also affects the livelihood of the workforce who are directly working in co-operative or private fisheries in this wastewater-fed aquaculture including rice fields and vegetable farming on garbage (Chaudhuri, 1990). Thus such development not only did adopt the international aesthetics to attract NRIs which is in contrast to the intrinsic identity of Bengal but also negatively affected the socio-economic structure and displaced population interwoven in this physical space (Bose, 2007).

3 Urban planning transformation in Kolkata

The authors have identified that the spatial planning of Kolkata has been hugely influenced by four incidents which were direct consequences of the rapid urbanization of Kolkata leading to an uncontrolled sprawl. Firstly, colonization by the British in the 18th century, Job Charnock an agent of British East India has laid the foundation of modern Kolkata by consolidating three economically potential villages namely Sutanuty, Gobindapur and Kalikata. It was during the 18th century a white town was built exclusively for the British people in and around old Fort William. The indigenous people were given compensatory lands in the north of the city (Sutanuty) which was referred to as the Native town. In between the white town and the native town, other European, as well as foreign communities started to settle down in the Grey town. Urban growth varied significantly across the White Town and Native Town. The city played an elemental role in extending the 19th-century globalization and imperialist policies of the British empire. In fact, the city has been the pivotal site for resisting and revolting during the anti-colonial and nationalist movement against the British(Chaudhuri, 1990; Chattopadhyay, 2005).

Secondly, the partition of India in the year 1947 led to a huge influx of refugees from East Pakistan to West Bengal. Thirdly the Bangladesh Liberation war in the year 1971 resulted in a huge influx of refugees of Bangladesh in West Bengal, Assam, and Tripura. Kolkata was the capital of India during the British East India Company rule until 1911 (Fazal, 2013), and later became the state capital of West Bengal after independence in 1947. Kolkata had suffered sharp economic decline due to political instability during 1947 and 1971 when the city level infrastructure almost collapsed due to the huge influx of refugees. Fourthly the economic liberalization has changed the Left front hegemony which consequently changed the approach of the planning of Kolkata. Policy makers and urban planners have tried to condemn the colonial arrangement of the city and refugee influx after the liberation war. They have tried to implement urban planning to change the physical layouts of the city which is not yet properly implemented as a result of which the urban growth varies distinctly across various municipalities (Mukherjee, 2011).

After Independence, efforts were made by policymakers to introduce proper planning in Kolkata like many other Indian cities, but till date, the city has failed to achieve uniform urban growth and undergo a well-planned spatial transformation. KMDA has tried to regulate the unprecedented urban growth in Kolkata by introducing a bi-polar strategy of urban growth in Basic Development Plan (1966-86) which was planned (Mukherjee, 2011) by Ford Foundation to promote Kalyani-Bansberia as a counter magnet to Kolkata-Howrah twin city (Nyqvist J. et al., 2013). The bi-polar strategy in 1966 was a complete failure in curbing the unplanned population growth in the City since Ford Foundation tried to apply western systems in developing the city with no consideration of regional context and specificity in Kolkata's case (Mukherjee, 2011).

In 1976 CMDA prepared a development perspective plan which rejected the bi-polarity proposed by Ford Foundation a decade ago and contrastingly they recommended a polycentric strategy. Their main aim was to distribute the population and work in a balanced way for boosting the regional economy. This perspective plan was called into action because of the huge refugee influx after Partition in1971. Kalyani, Saltlake, and Dum Dum are examples of implemented plans (Nyqvist J. et al., 2013). Then in 2001, KMDA launched their perspective plan ‘Vision 2025’ which also adopted a multi-nodal growth strategy (Majumdar & Kait, 2014) in which new urban centers near Kolkata were given stimulus for growth (Mukherjee, 2011). In this perspective vision plan Metro center, Metro Sub Centre and Trans Metro system were given utmost importance. New settlements and New Townships, existing industrial Parks and industries were also identified and proposed (Nyqvist J. et al., 2013).

4 Neighbourhood level urban communities (NLUC)

For the purpose of neighbourhood level assessments, it has been observed that often components at the level of an individual building or certain city level infrastructure are considered thereby neglecting issues at the intermediate levels (Blum, 2007). Along with the built fabric, this study has taken into consideration the diverse social and cultural aspects of the communities residing within them. Hence the authors have used the term neighbourhood level urban communities (NLUC) implying communities or group of people residing within a tangible space i.e. neighbourhood which is well-defined by physical boundaries such as large roads or other manmade structures referring to the built environment which is more or less homogenous in character (Blum, 2007).

4.1 Selected NLUCs

The authors have selected five NLUCs which are spread across the city and each of them is representative of the different periods of development of Kolkata during its transition from a traditional colonial city to an IT-driven metropolis. Three urban NLUCs have been identified within older parts of Kolkata and one urban NLUC from Saltlake, and one gated township named Sukhobrishti from Newtown Rajarhat, a satellite residential town to Kolkata. The selection has been made in order to compare between older and newer NLUCs and also to understand how the later set is different from the former located in the core of Kolkata. The study also tries to understand whether Kolkata has been able to sustain its past cultural glory and whether the older NLUCs are still efficient and sustainable. Administrative unit and well-defined physical and manmade edges have been considered as parameters for defining the boundaries of the neighborhoods.

4.2 Delineation of the NLUCs

The authors have selected three NLUCs differing in socio-economic character. Dhakuria is mostly inhabited by upper-middle-class people whereas Saltlake has a combination of middle to higher income groups and Sukhobrishti is a community designed to accommodate lower and middle-income people with facilities befitting high-end residential complexes. Dhakuria is the most densely populated NLUC followed by Bhowanipore and Saltlake whereas Sukhobrishti is least populated. All the selected NLUCs are diverse in terms of their population density, pattern, grain and texture. The authors have tabulated the demographic details in the following Table 1(Chakraborty and Deb, 2010; KMC, 2018; BMC, 2018; Humayun, 2014)**.**

Table 1: Showing the brief details of each of the selected neighborhoods

SL. No	Neighborhood Level Urban community	Details	Predominant Socio-economic profile
1.	Bhowanipore	Falls within Ward – 70, KMC (Kolkata Municipal Corporation)	Middle-income group (MIG)- High income group (HIG)
		Neighbourhood Area – 205 acres	
		Population density-22367 people per Sq. km	

SL. No	**Neighborhood Level Urban community**	**Details**	**Predominant Socio-economic profile**
2.	Dhakuria	Falls within Ward – 92, KMC (Kolkata Municipal Corporation)	Middle-income group(MIG)
		Neighbourhood Area –160 acres	
		Population density-23143 people per Sq.km	
3.	New Garia	Falls within Ward – 110, KMC (Kolkata Municipal Corporation)	Lower-income group(LIG)-Middle-income group(MIG)
		Area - 130 acres	
		Population density- 15698 people per Sq.km	
4.	Sector, Saltlake	BA, CA blocks falls within Sector 1, BMC(Biddhanagar Municipal Corporation) Ward no 39	Middle-income group(MIG)-High income group (HIG)
		Neighbourhood Area 140 acres	
		Population density – 16062 people per Sq.km	
5.	Sukhobrishti, Rajarhat	Falls within action area III, Rajarhat NKDA (New Town Kolkata, Development Authority)	Low-income group(LIG)-Middle-income group(MIG)
		Neighbourhood area- 150 acres	
		Population density-11532 people per Sq.km	

4.3 Bhowanipore

Bhowanipore is a well-established posh NLUC of Kolkata which is thriving with vibrancy even today after 150 years. The place is bounded by Acharaya Jagdish Chandra Road on its north, Sarat Bose road on its east, Ashutosh Mukherjee Road on its west and Gour Ghosh Road on its south. This is a mixed-use NLUC where residences coherently exist with school, colleges, markets, and hospitals. Many significant shopping markets are located here such as Forum, Brand factory etc. Bhowanipore was part of the white town and it has always shown a positive growth rate since its inception (Mukherjee 2012). This NLUC houses mostly high-income people and few low-income people living in slums. Middle-income people cannot afford to stay in this posh NLUC hence they commute to this place only for work which is well connected to the rest of the city (Guha & Ferreira 2009).

4.4 Dhakuria

Dhakuria is a well-recognized, vibrant, middle-income NLUC of South Kolkata. Dhakuria is bounded by railway lines on its North, Raja Subodh Mullick Road on its West, Prince Anwar Shah Road on its South and Dhakuria Road on its East. The cultural activities hosted throughout the year in a vibrant open type shopping centre named Dakshinapan, keep the neighbourhood bubbling. It's been surrounded by a posh NLUC of Jodhpur park having a strong cultural background.

Durga Puja is the most celebrated annual festival of Hindus especially Bengalis (*Bengali is the native language of West Bengal*) where prayers are offered to Goddesses Durga and the festivity continues for 10 days during Autumn season. Dhakuria hosts quintessential Durga Puja's of Kolkata, at Babubagan and Selimpur and flanked by the surrounding Jodhpur Park, Gariahat Goplark Durga Puja committee. The successful execution of the Durga Puja implies existing harmony and community participation within the neighbourhood. It is significantly inhabited by people having an inclination towards honing their cultural skills.

4.5 New Garia

New Garia is one of the fastest developing NLUCs of Kolkata, situated in Garia. It is bounded to the North and West by Eastern Metropolitan Bypass, to the south by Briji Road and East by Kavi Subhas Metro Station and New Garia railway station. It is also surrounded by the Baishnabghata Patuli Township on its north side. New Garia is situated in the southern tip of the Eastern Metropolitan Bypass and is often referred to as the next 'Chowringhee' of Kolkata. The EM Bypass connects the northern parts of the city to the extended Kolkata, Salt Lake City, and Rajarhat and provides access easy to the airport. The enhanced accessibility facilities have triggered commercialization in the area. Garia became the transport and commercial hub for the region with two major bus terminus, metro stations, and railway stations.

4.6 Saltlake Sector 1, BA & CA blocks

Bidhanagar or Saltlake as it is popularly called is a planned satellite town of Kolkata to accommodate the burgeoning population of Kolkata between 1958-1968. The authors have selected two blocks within Sector 1 for the concerned neighbourhood study.

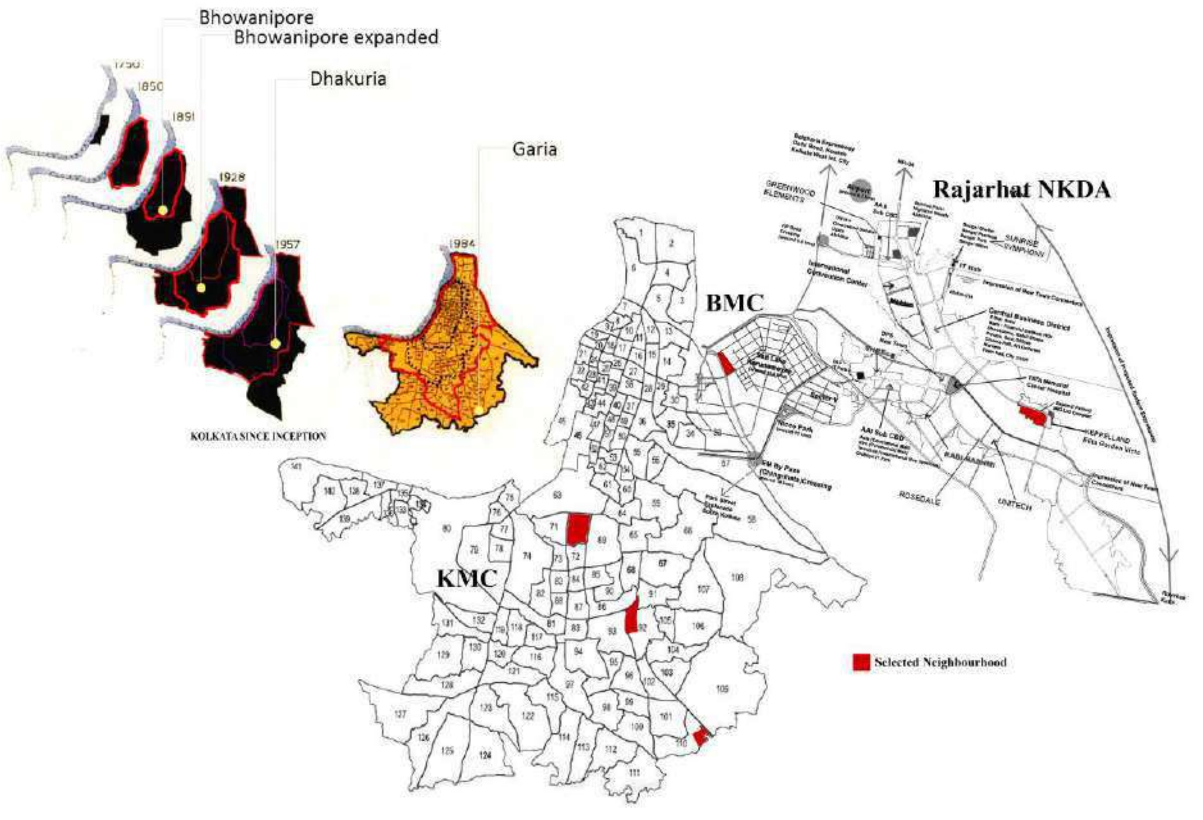

Figure 1: *Showing the evolution of the physical extents of Kolkata and the selected NLUCs*, *Source*: Author, (Guha and Ferreira, 2009; KMC, 2018; Elita Garden Vista, 2018)

The selected CA & BA block NLUC is bounded by Eastern Metropolitan bypass on its North and East, 1stCross road on its East and Manicktala main road, fourth avenue on its South. Saltlake blocks actually exhibit examples of a planned neighborhood in Kolkata although it has been criticized for being associated with a feeling of seclusion. The research will reveal how the planned NLUC in the urban areas of Kolkata are performing compared to the vibrant old organic NLUCs and new NLUC within KMC.

4.7 Rajarhat - Sukhobrishti

"Sukhobrishti" or "showers of happiness" is a township representative of the trend of high rise gated townships which is mushrooming all over Kolkata. It is located in New Town, Rajarhat and has been designed for 1 lakh population. It is predominantly inhabited by MIG group low – upper middle class although it has been designed for LIG and MIG population with facilities amenities associated with high-end residential apartments. It has been developed by Bengal Shapoorji Housing Development Pvt. Ltd. and is considered to be the largest mass housing project in India. It is built on 150 acres and house 20000 apartments. It actually fulfills Clarence Perry's definition of neighborhood in a modern context.

5 Imageability and visual survey

The authors have conducted Imageability and Visual survey of the selected NLUC to get a better understanding of the existing condition of the five elements of Kevin Lynch viz path, edge, district, node and landmark along with the pattern, texture, grain, and density, (Spreiregen, 1965), were considered during the survey. Age, condition of the existing building fabric and land use were also noted.

The observations have been listed down below (refer to Table 2), for a comparative analysis of the same which revealed that these NLUCs s exhibit different architectural, socio-cultural and socio-economic characteristics.

- Bhowanipore is a busy NLUC with significantly less amount of interaction within its communities as compared to Dhakuria. The lanes of Saltlake CA blocks and Sukhobrishti are empty most of the time with not much activity on the streets. Saltlake and Sukhobrishti have a feeling of seclusion associated with them. Dhakuria and Bhowanipore, are very vibrant and bustling with activities and have a significant number of people on the streets which leads to vehicular and pedestrian movement conflicts.
- Saltlake and Sukhobrishti have comparatively lesser traffic and are sparsely populated compared to the other selected NLUCs but both of them are very well maintained compared to Dhakuria and New Garia. Moreover, Bhowanipore is dominated by commercial land use, while the remaining four communities are mostly residential in nature. Bhowanipore mostly contains city level activities.
- The architectural style of Bhowanipore on the other cannot be generalized. It has contemporary buildings along with colonial buildings. Most of the buildings in Saltlake are aesthetically pleasing and are of contemporary in style with few buildings exhibiting traditional embellishments. In fact, ethnically Bhowanipore is very different from other NLUCs. Dhakuria, New Garia, Saltlake blocks and Sukhobrishti are majorly inhabited by Bengali population, but Bhowanipore has a significant number of non-Bengali population.
- Saltlake blocks and Sukhobrishti is considered to be inhabited by upper-middle-class to high-income group population. Dhakuria is predominantly inhabited by middle-income population, New Garia has lower-middle income group population and Bhowanipore is a rich NLUC and the middle-class population cannot afford it, but interestingly lower income group people commute to work in Bhowanipore.
- The quintessential essence of 'para' *(it is a Bengali word for neighbourhood implying a strong sense of community*) culture is lacking in Saltlake and Sukhobrishti, while Dhakuria and Bhowanipore have a strong predominant para culture.

The authors have conducted a pilot survey and asked the residents to give a score on a Likert scale. Observations and perceptions about the neighbourhoods were marked on a five-point Likert scale (from "1=very low" to "5=very high").

Table 2: Showing the imageability analysis of the NLUCs

Neighborhood	Historical inception	Imageability elements								Built Fabric			Predominant land use	Urban Landscape		
		Paths	Edges	Nodes	Landmarks	Density	Pattern	Grain	Texture	Building facade	Average condition of the buildings	Average Building age		Street Furniture	Foliage	Public realm – public space
BHOWANIPORE	Part of the white town	Lee Road Elgin Road Chakraberia Road	Acharya Jagadish Chandra Bose Road –North Sarat Bose Road – East Ashutosh Mukherjee Road- West Gaur Ghosh Road	Ashutosh Mukherjee road	Forum courtyard Notable malls such as Brand factory, forum Bhowanipore education society, Nizam's palace	Mixed use, Medium Density	Organic, irregular street layout, Sheet	Coarse grain	Uneven	Architectural embellishments in some of the of the buildings	Well maintained	Minimum 50 years	Residential, commercial, mix use	Signage No benches	Streetside foliage	Northern Park-Subhas udyan
DHAKURIA	Refugee settlement s	Maharaja Road, Selimpur Road Dhakuria Kali Bari Lane Babubagan Road	Raja Subodh Chandra Mullick Road, It seamlessly blends with the surrounding neighborhood Haltu	Gariahat road towards Gariahat 'more'(crossing)	Dakhinapan Dhakuria railway station,	Mostly Residential, High Density	Organic, irregular street layout, sheet	Fine grain	Uneven	Concrete masses with very few building having embellishments and architectural treatments	Moderately maintained	Minimum 30 years with many new building construction	Residential, Mixed use	Nil	Sparse	Rabindra Sarovar Dakhinapan
GARIA	Refugee settlement s	Internal Baishnabghat a Patuli Township roads	EM Bypass Garia station Road	New Garia station Kavi shubhash Metro station		Residential, Medium Density	Organic, irregular street layout, branching	Fine grain	Uneven	Concrete masses without any embellishments and architectural treatment	Moderately maintained	Mostly new construction. Minimum 15 years.	Residential, ground floor commercial	Nil	Sparse	No designated public space, but abundant open space
SALKTLAKE	Reclamatio n of Saltlakes	Internal roads within the blocks	2nd Avenue –North 2nd cross road- East 1st Cross road- West side 4th Avenue - South	City Centre	City centre, CA park	Residential, Medium Density	Grid Iron, regular street layout, rectilinear	Fine grain, uniform building sizes	Even	Architectural, Aesthetically pleasing	Well maintained	25 years	Residential	Nil	Street side foliage	City centre, central park, CA park
RAJARHAT-SUKHOBRISTI	LIG-MIG mass housing	Internal campus roads	Gated community	Shapoorji cricket association ground	Shapoorji cricket association ground	Residential, Low density	Regular street layout, Linear	Coarse grain, Tall, bulky building blocks	Even	Architectural, aesthetically pleasing	Well maintained	5 years	Residential	No signage	Street side foliage along with playgrounds and open spaces	On campus playgrounds and open spaces, OAT

Table 3: Showing the score matrix based on observations

	Observations	**Bhowanipore**	**Dhakuria**	**New Garia**	**Saltlake**	**Rajarhat-Sukhobristi**
1.	Perceived density/ crowdedness	3	4	2	2	1
2.	Maintenance and upkeep(overall image like clean or dirty)	3	3	2	4	5
3.	Activity on street across the day	4	5	3	3	2
4.	Illumination	4	4	3	3	3
5.	Road signage	4	4	3	4	4
6.	Age-friendly and Universal design	3	3	3	4	5
7.	Are there people seen on street	5	5	4	4	3
8.	Road Approachability	2	4	4	3	2
9.	The occurrence of luxury condominiums buildings	4	2	2	3	5
10.	Hawkers on street	2	3	4	1	1
11.	Presence of wall graffiti and political posters on property walls	3	3	3	2	1
12.	Availability of corner teashops and snacks	4	4	4	1	1
13.	Gathering of people on street for casual conversations	3	4	4	1	1
14.	Perception of approachability towards the residents	3	5	5	2	2
15.	Noise on the streets	4	5	5	1	1

New Garia is the least maintained with respect to the rest of the selected NLUCs and it is still a developing NLUC lacking basic infrastructural facilities. Some areas within New Garia are densely populated while others are sparsely populated. Saltalke blocks and Bhowanipore are well established NLUCs, whereas Sukhobrishti is an isolated NLUC with all facilities available within its boundaries and not blended well with its surroundings. Its interactions and activities are only limited within its closed campus.

Table 4: Showing the score matrix based on perception

	Perception	**Bhowanipore**	**Dhakuria**	**New Garia**	**Salt lake**	**Sukhobristi**
1.	Community engagement in various cultural activities	3	5	3	3	2
2.	The sense of belongingness to the neighbourhood	4	5	3	4	3
3.	Interaction with neighbours	3	4	3	3	2
4.	Location preference	5	5	5	3	2
5.	Coexistence of different types of housing	4	3	4	4	3
6.	Housing affordability	3	4	4	3	3

7.	Access to basic neighbourhood amenities	4	4	2	4	4
8.	Access to city level amenities	5	5	3	3	2
9.	Access to quality &affordable transit facilities	5	5	4	2	2
10.	The perceived sense of security	5	5	3	3	4
	Total	41	45	34	32	27

Dhakuria has scored really well with respect to the aspects of neighbourhood cohesion, location accessibility, and affordability. Some of the residents of Saltlake and Sukhobrishti have expressed that they have faced connectivity issues of their neighbourhood with the city core. New Garia is not at all performing well in the physical infrastructure aspect. They have acute drainage issues.

6 Recommendations

The neoliberal urbanism has brought about a significant change in the urban planning scenario of these NLUCs which has eventually affected their social and cultural strata. The authors have observed that the main reason for the declining social interaction among the residents of the new NLUCs is due to a lack of proper public realm leading to degenerating public life Moreover, the middle-income population is burdened with aspirations of attaining the global identity and threatened with job insecurities This observation is supported by similar research done on public realm and streetscape done by LGA in 2014 and Daley in 2003 respectively.

The authors have observed that among the selected NLUCs, Saltlake and Sukhobrishti lack social cohesion and identity, while Bhowanipore, Dhakuria and New Garia are not pedestrian friendly. The narrow sidewalks in these localities act as a major obstacle to lively street life. The following recommendations have been made by the authors with an idea to restore the essence of the Kolkata ‘para’ culture and enhance neighbourhood cohesion and involvement.

- Encourage community engagement and involvement with the help of local clubs and residence welfare associations. They should organize several activities including cleanliness drives, cultural activities, awareness programmes on social and health related issues.
- Ensure a sense of safety through active vigilance and CPTED(Crime Prevention Through Environmental Design) (LGA 2014).
- Enhance the image of the NLUCs and inculcate a sense of belongingness among the residents. by adequate branding. Building bye-laws, urban design guidelines and development control regulations can be instrumental in this process of image building.
- Improve visual quality through proper illumination, installation of outdoor furniture and art elements. This would aid in increasing legibility and comprehensibility of the neighborhood.
- Revamp the sidewalks with three defined zones. The amenity zone will have all the utilities such as the streetlamps, benches, and trees placed at regular intervals. Walking zone will refer to the unobstructed pedestrian zone. While the merchant zone refers to the frontage of the stores, cafes and can also be used as regulated hawking spaces. Local government should enforce strict rules to prevent occupants of any one of these zones from encroaching any other zone. A first cut implementation of this

design may be introduced in Dhakuria and New Garia which are in dire need of such redesign.

- Restore all natural assets within the NLUCs and connect the communities to those.
- Increase awareness regarding the use of alternate energy, grey water recycling, waste segregation at source and rainwater harvesting at building and at neighbourhood levels. Installation of solar panels in public areas such as local clubs, transit stops, ‘adda’ (a native word used for a particular place where people gather for conversation) zones should be encouraged by the local government with cooperation from the local clubs.

7 Conclusion

The paper confers that the prevailing hegemony of the dominant neoliberal urbanism is neglecting the place making characteristics of the public realm of Kolkata which is eventually eroding the cultural fabric of Kolkata NLUCs. In fact, the newly developed NLUCs have failed to incorporate the cultural aspects in its quest to attain the International identity. The authors strongly opine the redevelopment of the public realm so as to reinvigorate the fading cultural patina of the neighbourhoods and enhance the neighbourhood cohesion.

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Plan making in delivering intensification in Auckland, New Zealand: Issues and Challenges

(Plan making in delivering intensification: a case study of Auckland, New Zealand)

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Abstract

Urban growth policies that promote housing intensification and higher density development have been widely embraced in development strategies of many cities in Australia and New Zealand, part of the Europe, and the North America. Typically, this takes the form of intensification development in and around the defined transit nodes and city centres spread across the metropolitan regions. The local government council for the Auckland region (the Auckland Council) also seeks to implement a compact city model, after the amalgamation of the previous regional council and seven territorial authorities into a unitary authority in 2010. It aims to encourage most of its future growth and developments in and around, existing and proposed town and transit centres, with the goal of achieving the 'most liveable city'. However, there are growing concerns that urban planning approaches currently used are not effectively delivering intensification outcomes aspired. The uncertainties on what the future might hold in practice and whether the plan can realise the anticipated outcomes remain as one of the significant challenges both policy makers and planning practitioners are facing.

Drawing on the Auckland experience, this article adds to a relatively small but growing number of studies investigating on the efficacy of urban planning systems to deliver outcomes that are well aligned with the goals of urban growth management strategies. This paper critically reviews and discusses the Auckland case on the delivery of policy outcomes, with particular attention to delivering residential intensification and higher density housing policy outcomes. Connecting with ongoing researches, we contribute to the understanding of the local government land use and its plan making to deliver the anticipated policy goals. We suggest that the land use planning should be accompanied by a more thorough discussion and review of planning tasks and goals, and a deeper understanding on the role of plan regulation and its actual implementation under a market driven planning system.

Keywords: Plan making and implementation evaluation; Land use plan; Plan methods; Policy outcomes; Residential intensification; Rational comprehensive model

1. Introduction

The urban growth strategy of Auckland is aligned with many international planning strategies, such as 'Metro Vancouver 2040: Shaping our Future', 'Melbourne 2030', and 'City of Cities: A Plan for Sydney's Future'. The central goal in each of these policies is the containment of low density, peripheral growth. Although the compact city model may have a wide range of merits ((Neuman, 2005; Breheny, 1997), the extent to which these are actualized largely rely on how intensification actually is delivered. Common to the broad range of literature on urban growth management, the 'gap' between strategic planning and what has been achieved is evident in the argument for the 'compact' urban form (Woodcock et al., 2010). The transformation of the rhetoric of the residential intensification model into reality is of profound influence yet has enjoyed limited empirical analysis. In Auckland's recent metropolitan strategies, the more prominent of the challenges have been concerns on the plan objectives for delivering intensified built environment and the efficacy of planning tools for attaining these associated plan objectives.

As New Zealand's largest city and fastest growing region, Auckland is home to about a third of the population of the country (around 1.5 million people in 2017). It is the principal commercial centre of the country and has a diverse economic base. Historically, development in Auckland urban housing market has been dominated by low density suburban housing built on comparatively large plots (Dixon and Dupuis, 2002; Haarhoff et al., 2012; Beattie, 2010). In Auckland, the compact city model is seen by planners as a key to containing urban growth largely within an urban boundary, through a combination of infill within city boundaries, limited peripheral development, and higher density subdivisions. However, since the adoption of urban growth strategies from 1990s, the new dwelling development in Auckland still focused on standalone dwellings, predominantly in green field space (Berke et al., 2006; Beattie, 2013).

In 2007, under the pressing disputation on the Auckland's governance, the government assembled a Royal Commission to explore the potential to assure long-term sustainable development for Auckland (Salmon, Bazley and Shand, 2009). The Royal Commission concluded in its 2009 report that the Auckland's planning process were complex, lack of integrity and community engagement, and the regional relationship was fragmented and weak (Royal Commission, 2009). The Royal Commission's recommendations included replacement of the previous regional council and seven local authorities with a single unitary Auckland Council, and establishing one integrated planning framework with one new spatial plan (the Auckland Plan, the AP) and one statutory development control plan (the Auckland Unitary Plan, the AUP), to provide the strategic direction creating the basis for integrated and aligned decision making and planning functions (Beattie, 2011). After two weeks, the national government accepted the Royal Commission's recommendations to create a unitary council by publishing 'Making Auckland Greater', aims to make Auckland a 'super city' under one single local authority, and introduced the 'spatial plan' as a new planning approach in Auckland. The establishment of the new 'spatial plan' - Auckland Plan set up the strategies to deliver intensification into diversified arenas, including economic, environment, transport and sustainable developments (Auckland Council, 2012). Turning these visions into reality is operatised through the new statutory land use plan, the Auckland Unitary Plan.

Taking Auckland as an example, this article aims to investigate the efficacy plan making and implementation directed towards higher density development in traditionally sprawl cities. In drawing on the plan-making process and content of the plans, this article critically discusses the plans' capability, issues and challenges to deliver residential intensification. The next section briefly outlines the relevant literature of plan making towards intensification and delivery of intensification strategies. The third section describes the development process of the Auckland Plan and Auckland Unitary Plan, it also critically examines the efficacy of plan making and content of the plans, identifying the issues and barriers of plans to achieve the intended intensification outcomes. The discussions and conclusions on the issues and challenges of the plan making and content to deliver intensification outcomes in Auckland are presented at the end of the article.

2. Plan making and implementation towards intensification

Movement towards the achievement of intensification as a means of improving urban sustainability and enhanced liveability is "a complex process that requires action by both the public and private sectors" (Boon, 2010). Many factors apply in the delivery of housing intensification policies. The exact location, form, pace, and pattern of implementation rely on a combination of specific elements. These elements include, but are not limited to, planning policy, market response, technological tools, and community engagement (Liu et al., 2018; Adams and Tiesdell, 2005; Haarhoff et al., 2012). Managing the process of housing intensification involves balancing the multiple and often conflicting interests of the established and prospective stakeholders, while simultaneously engaging in the pursuit of broader policy objectives when facing contemporary changes (Ruming, 2014). Planning policies and regulations are essential determinants of the effectiveness and implementation of intensification. However, researchers have pointed out that there is a lack of a delineator of the extent to which plans are being implemented after they are adopted ((Liu et al., 2018; Brody and Highfield, 2005).

Therefore, researchers have raised the issues of searching for the means to evaluate planning outcomes (Brody and Highfield, 2005; Berke et al., 2006; Searle and Filion, 2011; Beattie, 2010), and the evaluation of plan implementation (Tian and Shen, 2011; Filion and Mcspurren, 2007). New evaluation models and methods have been applied to examine the effects and results, and also the capacity and effectiveness of planning activities (Brody and Highfield, 2005; Chapin, Deyle and Baker, 2008; Alexander, 2009; Laurian et al., 2010). Khakee (2003), Alexander (2006), Oliveira and Pinho (2009, 2011) articulate the evolution of evaluation methods from three different perspectives: (i) a program policy perspective, (ii) a welfare economics perspective, and (iii) a planning theory perspective. These evaluation approaches provided the foundation for the subsequent improvement in the quality of plans and planning systems.

The existing researches on plan implementation evaluation in New Zealand mainly employed a conformance-based approach, which is concerned with the alignment between the outcomes and the goals of plans (Laurian et al., 2004a, 2006; Beattie and Haarhoff, 2011). Some academics have begun to ask how much influence a plan can have over the urban planning process in New Zealand (Berke et al., 2006; Laurian et al., 2004a). The findings of Laurian et al. (2004a) demonstrate the implementation of plans varies greatly. Laurian et al. (2004b) raised the question of whether the plan quality can influence its implementation. They found that plan implementation is largely driven by the quality of the plan and the resources of the planning agencies. The academics increasingly recognised the quality and strength of the adopted plans are not necessarily correlated with implementation of their contents and rules (Brody and Highfield, 2005).

In order to reflect existing problems and contradictions, some works have attempted to link intensification theory to the local planning innovations (Buxton and Scheurer, 2007; Haarhoff et al., 2012; Janssen-Jansen, 2013), the planning implications (Williams, 1999; Randolph, 2006), as well as the capacities and achieved degree of intensification growth (Woodcock et al., 2010). However, government and urban planners still have difficulty linking the implementation knowledge to actual intensification projects (Berke et al., 2006, Beattie, 2013). There seems to be a gap between policy intention and implementation practice. Also, the mainstream of research on plan implementation has been focused on measurement of land use development patterns, and performance assessment of comprehensive plans (Brody and Highfield, 2005), while a few of them have provided policy improvement for planning performance at the local level (Waldner, 2009). In the Auckland context, “the link between plans and outcomes is at the heart of the urban planning process, that is, it is assumed that the plan will deliver a means of action to achieve its intended outcomes on the ground” (Haarhoff et al., 2012).

3. Issues and challenges of plan making to deliver intensification in Auckland

3.1 The ambition and reality of the Auckland Plan

With the aspirations to make Auckland the most liveable city through ‘quality compact’, the first ever spatial plan in the region – the Auckland Plan was developed to provide a 30-year vision to better “align its internal operations, actions and investments” (Auckland Council, 2012). Auckland Council drafted its first ever spatial plan in the September of 2011, with the public submissions and consultation from 20 September to 31 October of 2011 (Auckland Council, 2011). The vision of the Auckland Plan aims to achieve the ‘most liveable city’ through ‘quality compact’, to achieve its envisaged regional development through aligning its investments and operations (Auckland Council, 2012). In the March of 2012, the Auckland Plan was officially adopted.

The Auckland Plan (2012) is a non-statutory urban growth strategy which aims to implement a compact city model for Auckland so that it can become ‘the most liveable city in the world’ (Auckland Council, 2012). The plan delineates a series of tools to promote urban intensification within the proposed Rural Urban Boundary (RUB) so as to discourage urban expansion at the urban fringe (Auckland Council, 2012). Based on population projections, Auckland needs to accommodate an additional one million inhabitants by 2040, and the Auckland Plan proposes that 60 to 70 per cent of the new dwellings will be located within the existing urban areas and 30 to 40 per cent in new green field and existing rural areas and coastal settlements (Auckland Council, 2012; Duguid and Chan, 2013).

Turning this vision into reality requires the use of a broad range of growth management strategies and planning policies. The delivery mechanisms of the Auckland Plan include the Unitary Plan as one of main tools to define land use activities and zoning to achieve high quality spatial development, “the Long Term Plan (LTP) (which sets out the activities, services and investments planned for the next 10 years) to deliver the outcomes of the Auckland Plan”, and to provide the budget for the implementation of the projects and actions. Local board plans and agreements would emphasize the priorities and projects identified by each local board and community. A range of core strategies and place-based plans are important tools for implementing the Auckland Plan, also in achieving design, social and environmental outcomes (Figure 1) (Auckland Council, 2012). The Auckland Unitary Plan is the major tool to implement the directions of the Auckland Plan. It developed objectives, policies and methods (including rules) which set different goals and provisions to achieve quality urban growth in Auckland (Auckland Council, 2013).

Figure 1: Implementation framework of The Auckland Plan
Source: The Auckland Plan (2012), Auckland Council

However, close analysis of the Auckland Plan’s measures suggests a rather different reality. Firstly, due to the lack of civic participation and limited timeframe for plan making, the plan content and quality is insufficient to deliver high quality intensification strategies. Developed in September 2011, the first Auckland Plan was then officially adopted in the March of 2012, less than 18 months after Auckland Council was established (Auckland Council, 2012). The limited timeframe for plan making raised concerns on how the plan can be delivered in meaningful way in such a limited timeframe, as the plan is dealing with a range of complex transitional issues (Beattie, 2011). The international experience from Vancouver and Stockholm revealed the necessity of the process for civic participation and long timeframe to ensure the quality of policies. As described by Imran and Pearce (2015), a comparatively small proportion of communities engaged in the development of the Auckland Plan.

Secondly, the undeliverable visions in the Auckland Plan and the limited mechanisms and tools for plan implementation make the effectiveness and deliverability of the planning content questionable (Rowe, 2012). A number of academics raised the concerns on whether the planning content of the Auckland Plan is achievable. For example, Gunder (2014) questions that part of the visions in the Auckland Plan consist ‘a range of impossible fantasy outcomes”. He points out the proposition of 5 percent annual GDP growth rate over 30-year period is an example of the fantasy. The effectiveness of the Auckland Plan is also questioned by Imran and Pearce (2015), they claim that the flaws of Auckland Plan include its “plan ownership, lack of civic participation, and the imbalance of transport strategy and institutional inertia” (pp. 25).

Thirdly, the plan content and implementation tools and processes to deliver the spatial planning, in part, are deficient. Due to the lack of government commitment and inadequate funding strategy, the implications of the Auckland Plan and its capacity to achieve intended outcomes are contentious (Beattie, 2011). This raises the question of how an untested planning approach work in practice if there are quality and implementation issues with the existing statutory based plans in the region (Rowe, 2012). Furthermore, the issues of urban amenities, parking zone, and design quality in the developments are questioned in terms of whether the envisaged high-quality outcomes are attainable (Haarhoff et al., 2012).

Lastly, the flaws of plan implementation partly lie in the quality of urban planning practice and the quality of the plans themselves. There was no guiding for the Auckland Plan provided in the Resource Management Act 1991 (RMA), which is the national legislation which outlines the processes of “resource consent, council plans and designations, proposals of national significance” (Ministry for the Environment, 2018). The delivery of an effective infrastructure network will be difficult if there is no a clear, coherent strategic direction. Moreover, the new local governance still has to fund through central government contributions, in particular, for the regional infrastructure programmes, which would potentially make the plans ineluctable to political intervention (Imran and Pearce, 2015).

In sum, the content and implementation of the Auckland Plan remain contentious for the effectiveness of its plan content, lack of citizen participation, the challenges of policy achievement in practices, and the potential political intervention due to the heavily reliant on central government funding. The flaws of plan implementation partly lie in the quality of urban planning practice and the quality of the plans themselves.

3.2 The challenges of the Auckland Unitary Plan to deliver intensification

The AUP has experienced a number of variations in the whole plan making process. The draft Unitary Plan was released in March 2013 to receive 11-week informal feedback from March to May 2013. This was held in seeking to encouraging community engagement to assist in improving the Proposed Auckland Unitary Plan (the PAUP), which was notified on 30 September 2013—18-month time for developing the Plan for notification. The Plan combines provisions associated with management of coastal, air, land and water resources, intending to deliver a quality compact city in the region (Liu et al., 2018).

The Auckland Council then proposed to the national government that it recommend an Independent Hearing Panel (the IHP) to hear and consider submissions on the notified Plan and make recommendations on the final plan. The central government agreed with this proposed change of process, and this notably shortened the timeframe to put the Unitary Plan in place. Between September 2013 to February 2014, over 13,000 submissions from the public, government, developers, planning professionals and community groups are made. The notification of Summary of Decisions Requested report and further submissions were made from 11 June to 22 July 2014 (Liu et al., 2018).

Beginning from the September 2014 to May 2016, the IHP held 249 days of hearings across 60 topics. On the 22nd July of 2016, the Auckland Council received all the recommendations on the Plan from the IHP. The Council decisions and its decision version of the Plan are notified on 19 August 2016. On 8 November 2016, the Council released its annotated decisions version to show the parts that are under appeal and the parts that can now be ‘treated as operative’ (Liu et al., 2018; Auckland Council, 2016) (Figure 2).

The delivery mechanisms of the Auckland Plan include the AUP as the main tools to implement the directions of the Auckland Plan and provide zonings to integrate and prioritize spatial development. The AUP aims to give legal effect to the Auckland Plan, through developing objectives, policies and methods (including rules) which set different goals and provisions to enable quality, sustainable, compact development in Auckland.

Indeed, the AUP is a combined regional policy statement, regional coastal plan, regional plan and district plan (Auckland Council, 2013). The plan tries to provide guidance and serves as the primary document which will be capable of meeting the obligations of the unitary authority and find a new balance between fostering positive natural environment effects and protecting community health and wellbeing. The concept of the plan is the ‘quality compact’, which aims to provide for development both up and out, based on up to 70% of future population growth being located within the existing urban area (Auckland Council, 2013).

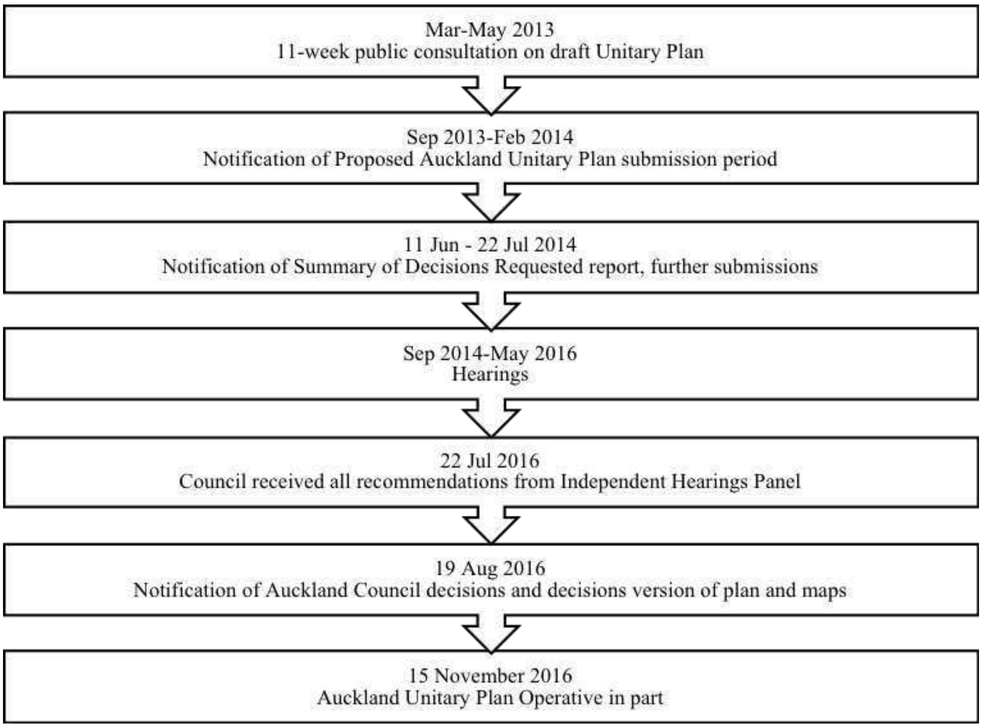

Figure 2: The history and earlier versions of the AUP (Auckland Council, 2016).

Vague and weak objectives and policies

The Auckland Unitary Plan, as a statutory plan, shall provide direct legal effects for land use development, rather than stipulating vague or weak policies for future urban development. However, the objectives and policies of the PAUP are overall inexplicit and weak to present a proposed development and estimate a potential scheme. Some of the objectives and policies are either unclear or non-specific to guide and regulate the development and some of them lack of clear definitions and assessment methods to evaluate whether the proposed development achieve the articulated policy outcomes.

For example, Terrace Housing and Apartment Buildings (THAB zone) in the PAUP is defined as “a high-intensity zone enabling a greater intensity of development than previously provided for”. One objective of the THAB zone is to “achieve development is of a density that is appropriate for the physical attributes of the site, any infrastructure constraints, and the planned urban residential character of the neighbourhood” (Auckland Council, 2013). This is ambiguous to predict the development envisioned by the plan making authority on what is ‘appropriate’. Also, the plan does not provide definition or assessment methods on ‘urban residential character of neighbourhood’.

Another example of unclear objectives and policies in the PAUP is the mixed-use zone. The PAUP does not explicitly put forward that it has to have a mix of residential and business, therefore, developers could have all business or have all residential, or have a mix of business and residential. Further, the plan does not really deal well with how to get that mix. On one hand, it can potentially provide more flexibility, but it relies on the provisions of clear and strong objectives and policies to minimise the interpretation differentials. On the other hand, it raises issues of the possible complexity in assessing in terms of balance and weight.

This altogether leaves uncertainty for development sector and may result in difficulties in understanding among plan users, for example, inconsistent interpretations between developers and their planning consultants, and between planning consultants and planning officials. This could further bring about delay the consenting process due to the difficulties and longer timeframe required for solving different interpretations and discussions on what are acceptable and correct, causing the delivery of residential intensification uncertain. The existing objectives and policies are overall generic and put greater emphasis on development rules rather than policy outcomes, which misaligns with the planning theory and framework in Auckland that adopts a conformance-based plan making model (Beattie, 2010).

Regulations for intensification are weak

In order to achieve intensification, it is essential that stronger regulations and policies that constrain low density developments are developed in the Plan. Nevertheless, in the PAUP, there is no minimum density control or maximum unit size for two or more than two-bedroom units, which means the larger size apartments can still be built in the (zone) areas designated to provide intensified buildings. This is contrary to the plan goals of the PAUP to deliver intensification and higher density housing.

In addition, there is no guarantee to achieve higher densities with a variety of housing types. The direct responding method for building height variations supporting public transport, social infrastructure and the vitality of the adjoining centre are also missing in the PAUP. It seems the local planning authority (Auckland Council in this case) is timid in putting forward strong regulations that need to rely on collaborations and efforts from other sectors and agencies.

It is also worth noting that the PAUP standards concern on the site-specific development rules, other than from the regional and neighbouring scale. For instance, the PAUP sets up rules to protect on-site amenities, however, there is no regulation to protect and enhance the neighbouring amenities. This observation reiterates the central message of the inefficiency of plan making in the PAUP to undertake the entire region and the previous plan and development into plan making process.

Misalignment with the market practice

The historical problem of insufficient provision of intensive housing in Auckland highlights the importance of paying more attention on those responsible for implementing planning policies on the ground: the development sector. The complicated interplays between planning officials, property developers and potential consumers can significantly affect the implementation of the targeted higher density developments, leading to a situation where "different stakeholders had different views on what might constitute 'good' medium density housing" (Haarhoff et al., 2012; Dupuis and Dixon, 2002).

The commitment of urban land developers to planning objectives, and their capacity to meet the objectives of intensified development in practice, can directly affect the plan implementation (Ruming, 2010; Berke et al., 2006; Laurian, 2004a). However, change can be difficult, as the developers may not always comply with the conditions and obligations stipulated by the zoning context and the consumer preferences (Gunter, 2013; Bowman and Thompson, 2009).

It is also critical to recognise that other regulations and policies may be needed to fill in the gaps where plan methods fall short for achieving intensification outcomes, with the minimum density control was not clearly regulated. The flexibility provided to developers through claiming the objectives are achieved leaves them too many chances. The planning authorities shall establish clear and well-defined standards to provide a regulatory option for interested developers as a mechanism for fostering intensification. The complexity of interacting developers and planning system under the rational plan making framework underscores the importance of setting out clear and well-regulated development standards to guide the activities of development sector.

Requires plan evaluation and review

Despite the apparent benefits of plan evaluation on facilitating more effective implementation, better communicating the intentions of decision makers, and ensuring plans include accurate information and reflect community values, the planning professions have been ineffective in applying evaluation methods, particularly the evaluation of achieving the plan outcomes (Guyadeen and Seasons, 2016; Brody et al., 2006). Evaluation in planning has yet generally concentrated on plan development process with limited attention on plan outcomes (Guyadeen and Seasons, 2016; Oliveira and Pinho, 2011).

The urban planning policies in New Zealand context are facing the challenges that issues arise through implementation phase but not through the development of plans. The literature suggests the limited guidance on gauging the success or failure of plans are largely resulted from disagreements on how to evaluate the outcomes of plans (Oliveira and Pinho, 2011). This research reinstates the significance to develop and implement evaluation frameworks that urge plan making department to continually evaluate their efforts.

4. Conclusion and Discussion

This article critically reviews the plan development process, plan content and implementation adopted or proposed by the Auckland Plan and the Auckland Unitary Plan. Delivering on the aims of these urban growth strategies “has been difficult and controversial” in Auckland (Haarhoff et al., 2012). The content of the first ever spatial plan – the Auckland Plan has been pointed out being ambitious and bold (Imran and Pearce, 2015), and its implementation has been questioned for several reasons, including the effectiveness and quality of the plan content, lack of citizen participation, the challenges of policy achievement in practices, and the potential political intervention due to the heavily reliant on central government funding (for examples, Gunder, 2014; Imran and Pearce, 2015; Beattie, 2010).

This research also demonstrates that the plan making and implementation tools and processes to deliver the planning outcomes, in part, are deficient. This research gives rise to three core issues in the plan making and implementation of the Auckland Plan and the Auckland Unitary Plan. Firstly, the plan content and quality of the Auckland Plan is insufficient to deliver high quality intensification strategies. Secondly, the possible fantasies in the Auckland Plan and the inexplicit, weak objectives and policies of the PAUP can potentially lead to the misalignment between the outcomes and plan objectives. This affirms that the plan making processes and tools need to be more clear, flexible and strong to ensure its delivery of plan visions. A more thorough review of planning tasks and goals is required for local planning department (Auckland Council) to implement the intended plan objectives and goals. Thirdly, a deeper understanding on the role of plan regulation and its actual implementation under a market driven planning system are required to ensure the alignment between the Auckland Unitary Plan and the market viable developments in both locations and housing types.

In terms of the connections and mechanisms between the Auckland Plan and the Auckland Unitary Plan, under the political pressure and other factors, there is a risk that some of the policy intervention in the Auckland Plan would be reversed during the preparation process of the PAUP. The potential remains for political pressures for the decisions on the final Auckland Unitary Plan to be inconsistent with the Auckland Plan. Even though the current planning frameworks and their methods are responsible for giving effect to the higher-level strategic policy, however, less clear from this research is that the alignment between the Auckland Plan and its main implementation tool – the Unitary Plan, which would remain as a key field for future research.

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Impact of large-scale urban interventions on contemporary city centers

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1. Introduction

Large scale urban interventions have become a common development practice in cotemporary cities, allowing achieving rapid changes in their urban structure [Markowski, 2004]. They can be analyzed taking into account various perspectives. Some of them include planning and development models, types of sites transformed (brownfields, greeenfields, densification of urban structures as well as transformation of other types of distressed urban areas) as well as consequences and results of their implementation in existing urban structures.

There is a vast literature on how these transformations are planned, developed and implemented, although there is still not much discussion on the consequences and evaluation of their implementation. Among others, one can mention here works by Swyngedouw and Salet, to name just a few of the key authors. In addition, most of the analysis of these cases was focused on spatial consequences of their development[1].

Therefore, the main aim of this paper is to discuss this issue in the wider context, taking into account also social, legal, economic and infrastructural consequences of these projects, with a special focus on the ones located in city centers and generating major changes in their functional and spatial structure. Within the paper the following issues are discussed:

- Typology of contemporary large-scale urban interventions, located within the city centers;
- Scope of the spatial, social, economic, infrastructural and legal issues associated with contemporary large-scale urban interventions;
- Discussion of the consequences associated with implementation of large-scale interventions within the structure of contemporary urban centers on the basis of the analysis of selected case studies from Gdansk Metropolitan Area (Poland);
- Conclusions regarding future of planning and development of such projects.

On this basis the more in-depth analysis of the cases from Gdańsk, Poland, including the newly created “Forum Gdansk” along with “Olivia Business Center” and “New train station complex in Sopot” projects are discussed. All these are brand new interventions, located within the structure of Gdańsk Metropolitan Area – one of the most important metropolitan areas in the country and in the entire Baltic region.

The locations of these project include distressed site as well as reclaimed area above the existing railway tracks, urbanization of the urban voids and transformation of the distress railway-side area. In addition, each of these are complex urban interventions, meeting the criteria set in definition of the large scale urban interventions, later on referred to as LSUI-s.

2. Characteristics of the large scale urban interventions

Types of intervention within the urban areas may vary and can be described differently due to their size and type of the site, type of the degradation or characteristics of the site as well as functional and morphological composition. But in every case the level of complexity of urban intervention required asks for the comprehensive approach regarding planning and development processes. In case there is a need for more complex functional and implementation solutions, the intervention can meet the criteria described in the definition of the large scale urban interventions (LSUI-s). [Lorens, 2011]

2.1. Definition of the large-scale urban interventions

Large scale urban interventions are not characterized only by the size of the site dealt with or by its location. In fact, what makes these different, is the complexity of intervention. Therefore, the following definition can be applied to the LSUI-s:

"*Complex redevelopment programs associated with introduction of new, substantial portions of urban program or transportation infrastructure, which are planned and implemented in the integrated way by one, clearly defined, entity*".

On that basis one can draw the following characteristics of the LSUI-s:

– Diversified types of land uses

– New, substantial portions of urban program

– Morphological complexity, including various types of structures

– Infrastructure improvements

– Integrated mode of implementation

– Presence of one, clearly identified, „implementation entity"

2.2. Typology of large-scale urban interventions

On the basis of the above mentioned, one could draw a typology of the LSUI-s. This could include:

- Key transportation hubs (associated with railway, road and air transportation) along with other uses (commercial, business and multi-use complexes) including the „railway station complexes"
- Housing complexes along with the basic social infrastructure
- Commercial complexes, which include shopping and other service centers as well as entertainment complexes
- Business and industrial parks, including „airport cities"

Above mentioned typology reflects the contemporary tendencies regarding LSUI-s within European cities and may be further developed in case the new types of issues emerge [Lorens, 2004].

2.3. Role of the large-scale urban interventions in the process of shaping the urban structure

LSUI-s are frequently employed as the vehicles allowing comprehensive transformation of cities. This is due to a number of reasons, which include the facts that LSUIs:

- contribute to focusing the investment efforts in the designated zones;
- can become the trigger for further development processes in its vicinity;
- become locations of the new urban program of over-local importance – including types not yet present in the given city / region;
- allow substantial acceleration of the spatial development processes of both the entire metropolitan area as well as its key parts.

In result, in many cases LSUI-s are understood as key triggers of urban change. This is due to the fact that development of LSUI-s may:

- influence the decisions of other investors / developers / site owners;
- lead to creation of the new spatial development poles – which especially relates to the sites especially attractive for investors;
- contribute to changing the geography of spatial and functional connections and networks within the city and entire metropolitan areas;
- prevent the disordered, spontaneous development – which is due to their ordered structure.

In addition, LSUI-s may also play an important role of shaping the investment strategies both of the public and private stakeholders. This comes from the fact that LSUI-s:

- allow coordinated and carefully planned realization of the extensive investment program;
- provide investment stabilization for both „leading entity" (i.e. land developer, key developer) and other entities/partners (small-scale developers);
- allow creation of the urban space of predictable quality – which contributes to the stabilization of the land market.

2.4. Obstacles for planning and implementation of the large-scale urban interventions

Planning and implementing the LSUI-s is not always an easy task. In many cases it is associated with a number of obstacles and issues that have to be taken into account while considering these as a viable vehicle for urban change [Markowski, 2004]. Among many, one should mention the following key ones:

- lack of interest in undertaking more complex urban undertakings on the side of local/public administration („who does nothing, never makes any mistakes");

- lack of trust in private entities and their activities on the side of the public sector;
- dislike – in many cases due to lack of clear legal framework – in undertaking the public-private partnership schemes;
- lack of highly skilled administration clerks/officials able to initiate/implement/monitor the development of the LSUIs.

Of course, above mentioned obstacles are not always present. In many cases these are considered as one and only type of vehicle able to deliver the major urban transformation projects. The key example here is Hamburg HafenCity project, which since late 1990-ies is successfully implemented[2]. This major waterfront transformation project allowed not only regeneration of the distressed urban area but also retaining by Hamburg its prominent position as key business centre of Europe. In this case it was necessary not only to develop a masterplan itself (see fig. 1), but also to conceptualize a comprehensive implementation scheme based on public-private partnership.

Fig. 1. Visualization of the HafenCity masterplan. Source: *HafenCity Hamburg. Der Masterplan.* Hamburg 2000.

But at the same time one have to note that not always planned interventions are actually fully implemented and not in each case they provide an immediate effect of urban regeneration. In case some of the “success factors” are absent, instead of the comprehensive implementation once can observe partial development of the isolated urban structures, not allowing the fundamental change of the entire site. One of the good examples of such a situation is Glasgow waterfront, which – despite numerous planning and implementation efforts undertaken since late 1990-ties – is still a fragmented urban structure awaiting comprehensive rejuvenation and implementation of the coherent urban structure (see fig. 2). Of course, in each of these cases the reason of partial implementation or even failure may vary, but some of them are associated with not always positive consequences of the planned intervention.

Fig. 2. Image of the Glasgow waterfront (2016) – where newly developed structure are still neighboured by distressed sites awaiting new comprehensive transformation despite the fact that the regeneration process was originated over 20 years earlier. Photo credit: P. Lorens

3. Selected aspects and contexts associated with planning and implementing the large scale urban interventions

As discussed before, the LSUI-s may bring various effects and be associated with numerous types of consequences to the urban structure. Among these one should name the spatial and infrastructural contexts as well as social, legal and economic issues associated with their implementation. Many of them may be considered of negative character to the existing urban structures and local communities.

3.1. Spatial contexts

LSUI-s, due to their scale, may bring significant changes to the urban structure. Despite the regeneration effect for the site itself, it may at the same time cause **disintegration of the existing urban structure and networks**. And this means not only their transformation and creation of the new poles of growth, but also elimination of the existing vibrant urban centers. In many cases, this is also associated with **substituting the "old" centers of urban life with the new ones**, which may also cause substituting the diverse functional structure of those with the facilities focused i.e. on tourism and mass entertainment. The good examples of such the situation is construction of the CentrO center in Oberhausen, Germany (developed in the late 1990-ties) which caused serious functional decay of the neighboring urban centers[3]. To some extend the similar cases can be found in many other European cities like Barcelona, which centers are over-dominated by the tourism industry. In result, the daily needs of the citizens of these areas (associated i.e. with grocery shopping) have to be fulfilled in alternative ways. Another issue is associated with **transformation of the urban landscape** which may include creation of the new landmarks, which in some cases may dominate the historic townscapes and influence the perception of the heritage areas. Moreover, in some cases one can observe the significant **environmental changes**, which may include reshaping the green and blue infrastructures of the site. Finally, in many cases LSUIs are associated with **capturing the vast portions of land** and transforming them into the commercial structures, which may make further spatial improvements leading towards creation of the more human structures impossible.

3.2. Social issues

Although LSUI-s are rarely located within the already inhabited areas, they may also be associated with numerous social issues. The key one is based on impact of the LSUI-s on the local community, with a special focus on these parts of it inhabiting the sites in close vicinity of the intervention. In many cases **members of these communities are not very much welcomed** within the borders of the newly development areas while – at the same time – the redeveloped space gets opened for incomers from more distant places or even from other cities. The good example is Lyon Confluence, which has become a truly international district and a new hub of urban activities while the local community was – to some extend – left behind[4]. At the same time this newly transformed space is – in many cases – much more dense than before which makes it **less friendly for the existing local community**. But at the same time – in many cases – implementation of LSUI-s may effect in **creation of the high quality public spaces,** open and accessible for all citizens and allowing organization of numerous public events – like open-air exhibitions etc. Also, **development of the new cultural offers as well as shopping and entertainment environments** make the surrounding living environments more attractive. But – at the same time – since the urban environments within which the LSUI-s are located get more commercially and touristically attractive, the **real estate prices within their vicinity may rise** and the living environments – gentrified. In result, some of the previous citizens may will to move out from the districts affected. Although at the same time development of the LSUI-s may be associated with **creation of new social housing**, which could be financed from the **fees and taxes** coming from using for the investment purposes the municipal grounds.

3.3. Legal aspects

Development of the LSUI-s is usually associated with numerous legal aspects. Some of them are related to the **changes in land ownership patterns**. In these cases the expropriation and compulsory purchase of land can be executed, although not each of the legal systems allow for such the action. Also, selling **and leasing publically owned land to the private investors** is usually executed. This may take also the form of creation of the public-private partnership scheme, within which each of the partners is contributing with different type of assets. On the public side this is usually publically owned land, which may be in hands of both municipalities, state and other public companies (like i.e. airport or railway companies). In addition, issuing the planning permits allowing development of LSUI-s may be dependent on **making the special development agreements**, within which the private partners may be obliged to develop elements and systems of public and technical infrastructure of the over-local importance. Among others, one can identify here new public transportation networks, public roads and walkways as well as new or rejuvenated public spaces. On the contrary, development of LSUI-s – due to their high commercial attractiveness – may be associated with **increased crime rates**. Finally, in many cases the **environmental standards may be challenged** and the development of LSUI-s may be associated with eliminating some of the environmental values and elements. Of course, in these cases usually the compensation mechanisms are introduced, but in reality these rarely pay back the environmental harms created by i.e. elimination of mature trees or semi-natural creeks or ponds. In these cases, even if the water bodies themselves are preserved, they usually are transformed into some sort of pleasure areas and lose their environmental potentials.

3.4. Economic issues

Also the economic consequences associated with development of LSUI-s are massive. One of the major thing that has to be mentioned here is **development of the commercial offer** within the city and **increase in the number of jobs**. In many cases the new types of urban program that have not been present before in the city or in the vicinity of the site are introduced, which additionally increases the attractiveness of this type of the development. But – on the contrary – this can have also negative effect on the local economy as a number of previously existing local enterprises, small shops as well as service points may go **bankrupt**. Of course one may argue that this effect can be considered real only in part, as the creation of new jobs can compensate elimination of the previously existing ones, but what counts is that usually within this process the locally developed and sustained businesses are specially endangered. So what counts is not just the amount of jobs but their importance to local communities. Another key issue associated with development of LSUI-s is connected with the **increased attractiveness** of both the city and – in some cases – the entire metropolitan area. This has to be considered in three perspectives: attractiveness for tourists, migrants (willing to get permanently relocated) and other investors. All of them are important for local economy as this may further spur economic growth and increased income to municipal budget. Finally, when discussing the economic issues associated with location of LSUI-s, one has to mention the risk of **gentrification and manhattanization**[5] of entire cities, but – predominantly – of the sites in the close vicinity of these interventions. This comes along with **increase of the real estate prices**, both for sale and – predominantly – for rent. It is necessary to mention that this increase in case of the analyzed sites is much higher than in other parts of cities.

3.5. Infrastructure contexts

Finally, implementation of LSUI-s is usually associated with **massive infrastructure improvements**, both on-site and in its vicinity. This process may include creation of new public transportation hubs and multi-story parking lots, which offer **new transportation options** both for the residents and customers of the analyzed developments and for all other city inhabitants and visitors. In many cases these components of the projects are negotiated within the agreements, mentioned in one of the previous parts of this article. On the other hand, increase transportation demands associated with LSUI-s may result in **increased traffic demands**, both in terms of requests for more efficient, safe and reliable public transport and in relation to the demand for parking. The last part is especially visible in case there is a shortage of parking spaces within the planned structure and the system of public transportation is not efficient enough to cater for the increased demand. Also, in many cases there is much greater **demand for supply of media**, like water, electricity etc. Finally, development of LSUI-s may result in **increased pollution**, which include both solid waste, waste water, noise as well as light pollution[6].

All groups of aspects mentioned in this chapter May be further analyzed according to a number of criteria. Also, one has to remember that some of these issues and consequences may be regarded as positive and others as negative to the local economy, society and space.

4. Selected case studies of large-scale urban interventions in Gdańsk Metropolitan Area

In order to present the above mentioned issues three case studies from the Gdansk Metropolitan Area were selected. Each of them has different nature and scale, which make this group and interesting set allowing further comparisons.

4.1. Forum Gdańsk

The project was conceptualized as both retail, entertainment and transportation hub, allowing reorganization of the mobility and land-use patterns in the entire city center. In addition, development of this project extensively influences the future of the city and its central part, changing the development chances of other post-industrial and other brownfield areas. In addition, its scale and level of complexity allows using it as the good case study, on example of which the entire scope of issues associated with contemporary large scale urban developments can be discussed.

Fig. 3. General view of the Forum Gdansk complex (2018). Photo credit: M. Habier

In addition to these general features of the project, this new development created a new city landmark, although perceived in the local scale (as no high-rise building was built within it). The key entrance plaza to the entire complex – a brand new part of public space (although privately owned and operated) – has also immediately become a focal point for the citizens and visitors of the city. This was also a result of the decision to combine the commercial part of the project with the public transportation hub (including new suburban train station and key bus and tram stops) of regional importance. Therefore, the entire complex may be now regarded as not only the huge shopping center (the area of it is over 6ha) but a true sub-center of the entire Gdańsk. Also, what has to be mentioned is the fact that within this project a railway corridor was included, and the existing tracks were covered by the platform on top of which part of the complex was developed. Therefore, also from the landscape point of view this project has a huge importance for the entire city. In result it is possible to conclude that this development contributed to the spatial reorientation of the entire city center.

But the project Has also negative aspects which have to be discussed. First of all, construction of the extensive parking complex in addition to the commercial part has generated a huge increase in car traffic in this part of Gdańsk. Also, since so many public transportation routes were connected to this development, one can observe a rapid decrease of the volume of passengers using the previous hub – associated with Gdańsk main train station. Also, some of the architectural solutions adopted (like incorporating the existing Radunia river in the structure of the complex including rebuilding the historic river bed) generated the extensive discussion on the limits of possible intervention within the historic and natural structures. One has to mention that this part of the project was developed despite the fact that developer in fact did not have a valid permit for this part of works. And the decision of doing this was taken with full understanding of possible consequences, including the extensive fees which developer had to pay.

Despite these, development of the Forum Gdańsk complex definitely contributed towards perceiving Gdańsk as the major Polish metropolis.

Fig. 4. Main entrance to the Forum Gdansk complex (2018). Photo credit: M. Habier

4.2. New railway station complex in Sopot

The new railway station complex in Sopot (a city constituting the Gdańsk Metropolitan Area, located just 10 km to the north from Gdańsk city center) was completed in 2016. This is one of the largest projects in Poland developed within the framework of the public – private partnership. It is also perceived as key example of combining the public and private funds, assets and experience. Within the project the large-scale multi-use complex was developed, combining the new building of the railway station, shopping and gastronomic center as well as culture facilities.

Despite its size, this project has not affected heavily the natural and cultural environments, as well as has not generated major transportation hassle. What is important is that no major increase in traffic was observed after its completion. In addition, its architecture is regarded to be compatible with the surrounding area. In result, this project is perceived as one of the two key hubs of the Sopot center (the other one is so-called Haffner Center near Sopot Pier on the waterfront). It also contributes towards building the image of Sopot as the modern city (and not only nostalgic XIX-century summer resort), which – in conjunction with the fact that Sopot is perceived as one of the top three cities in Poland regarding the cost of life and of high quality of urban environment – makes justified its nickname as "Monte Carlo of the North".

Fig. 5. General view of the new Sopot Railway Station complex (2018). Photo credit: M. Habier

4.3. Olivia Business Center (OBC)

Olivia Business Center is currently the largest office park within the Gdańsk Metropolitan Area, combining seven building of total floor area of 120.000m2 occupying the 3,5ha plot. Its main part is the high-rise building „Olivia Star" – 35-stories high class A office building, scheduled for completion in the end of 2018, which is already perceived as the tallest building within the Gdańsk Metropolitan Area and the new city landmark. Development of the project contributed extensively to the rapid change of the part of the city it is located within, both in terms of architectural and functional criteria. Moreover, Olivia Business Center Has become a seat for many both local and international companies, which contributed towards creation of truly international image of this site. In addition, location of the complex in close vicinity of suburban train station allowed many of the commuting employees to use public transportation as the basic way of getting to their offices.

Despite these features of the project, the key issue associated with its development is jamming the Grunwaldzka Avenue (the main spine of the Tri-City area, in close vicinity of which the OBC complex was located). In addition, extensive usage of private cars by OBC employees led to the situation that every piece of vacant land located in the walking distance from OBC was converted into parking. This resulted in measures undertaken by other site owners in the area – and the largest one is Gdańsk University – aimed at protecting their land from being used as unofficial parking. In this case the university authorities decided to fence its area, which was associated with a very negative response from the academic community. Also, other office park owners in the vicinity of the OBC had to deal with issues coming from increased traffic in the area as well as with heavily increased demand for public transportation. These issues are still to be solved. Another problem is associated with the tallest building of the OBC complex – "Olivia Star". Its extensive illumination caused discussion on how this is polluting the neighboring areas with unwanted lights as – due of its height – it was affecting pretty large part of the city, including the historic districts and heritage areas. This could potentially lead to the court cases put through by unhappy citizens. In addition, the large density of the project (FAR) may cause in future environmental issues (lack of green spaces, no opportunity for the rain water to be retained within the site etc.). Finally, despite its quite central location in close proximity of key transportation hubs as well as other local centers OBC is still perceived as a white-collar workers area, lacking the public space – which in fact is untrue as within the complex a vast public areas were developed and OBC management is trying to bring to this site many public events.

Fig. 6. General view of the Olivia Business Center complex (2018). Photo credit: M. Habier

5. Conclusions

As argued, large scale urban interventions have become a common development practice in cotemporary cities, allowing achieving rapid changes in their urban structure. But at the same time their implementation is associated with numerous issues and consequences, which were outlined in the article. One can identify both social, legal, economic and infrastructural consequences of the development of LSUI-s. Of course, the scope of these depends on the nature, location and character of the particular project, therefore its peculiarities shall be taken in the account in case of the more detailed analysis. And although these interventions are frequently associated with a number of negative influences, still their implementation can help in spurring urban development and making cities more attractive. In many cases these are also the only chance for undertaking the complex regeneration programs for distressed sites, which otherwise would either never be transformed or – in some cases – might have been developed in an accidental way.

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[1] See – among others – works by Pancewicz and Lorens
[2] More on this: www.hafencity.com
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[5] Referred to in literature as „corporate gentrification".
[6] This term refers to the situation whennNew buildings and structures are extensively illuminated, which may be troublesome to the other users of space. For more on this refer to: Martyniuk – Pęczek, Justyna (2014) Światła miasta, Wrocław: Wydawnictwo Marina

Research On the Planning of Community Life Circle in New Town Based on an Evaluation Approach ——A Case Study of Ningbo Eastern New Town in China

(Smart and Quality – a Technical Discussion for Community Life Circle Planning)

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Abstract: Community life circle (CLC) planning has gradually become an important part of urban space creation in China. This paper focuses on the real project in Ningbo Eastern New Town, aiming to achieve a CLC planning method and a design model, through an evaluation approach. Begin by defining the concept of CLC, relevant planning practices and researches were summarized. Secondly, this research assesses the current life circle from two aspects: social demand aspect and physical space aspect. For social demand aspect, the problems in current living space is obtained through residents' survey. For physical space aspect, a habitable evaluation model was used to refine and summarize the spatial characteristics of high-scoring community among the selected seven residential groups. Finally, four spatial models of CLC are constructed, which are new residential area, old town, business area, and current residential area. In addition, targeted planning strategies are proposed to complement the short boards of new town development, and to achieve the goal of livability.

Key Words: Community, Community Life Circle, Habitable Evaluation, Social Demand, Place Creation

1. Introduction

With the diversified development of urban areas, the research and planning of communities has gradually shifted from treating residents as a homogeneous group to focusing on varied needs of different social groups. Standing on the point of residents' living space, CLC research and planning were gradually becoming a vital tool to meet the needs of residents, to balance resource allocation, and to maintain local life. The Eastern New Town located in Ningbo, China, which is the future political and economic center here, has undergone ten years of construction and development. As a typical case of new city construction in China, the creation of its CLC is representative.

2. Concept definition and Status overview

2.1 The concept of CLC

The concept of "life circle" began in Japan (Xiao, 2014) . It mainly refers to the maturity activities of shopping, leisure, friendship, education, medical care, and culture in mature cities or regions. The concept of "Daily Life Circle", which is correlated with the scale of CLC, refers to the spatial or behavioral space involved in daily activities such as shopping, leisure, commuting, social interaction and medical care (Xiao, 2014). Based on the consensus, the definition of CLC could be refined into three keywords: residents, daily activities, and spatial scope.

The concept of CLC in this research discusses the spatial form and structural system, that covering various daily activities of residents around their living space. Its supporting subsystem includes five areas: living space, employment space, road system, service facilities and public space.

2.2 Planning practice of CLC in Asia

The research and planning of life circle could be traced back to Japan, and then spread to South Korea, Singapore, Taiwan and other countries and regions. Table 1 summarizes the CLC content within each planning practice.

Country or region	Name of Community life circle	Service	Travel time	service radius	Circle range	Population
Japan	Residential Area	basic services, focusing on the facilities used around the residential area	15 minutes walking	Within 1000 meters	1-2 km²	10,000 to 2 0,000
Korea	Middle Life Circle	primary school, daily shopping (neighborhood center)	15 minutes walking	1000-2000 meters	5-6 km²	30,000 to 6 0,000
Singapore	Neighborho od Living Circle	primary school, neighborhood center, daily service	5-10 minutes walking	500 meters	1-2 km²	10,000 to 2 0,000
Shanghai, China	15 Minutes Community Life Circle	Basic service and public event space required for life	15 minutes walking	500-1000 meters	about 3 km²	50,000 to 1 00,000

Table 1 Summary of CLC practices in Asia
Source: Author's summary based on different cases

According to these planning cases, the size of the CLC was supposed to match the street scale and population size, and it is mainly configured to meet the social demand of service facilities and public spaces.

2.3 Overview of research site

The Eastern New City is the geometric center in Ningbo's future urban structure, and it has a total land of 15.85 km². Most of the new city construction in core areas have been completed, while the eastern part is where resettlement area, old town area and farmland located.

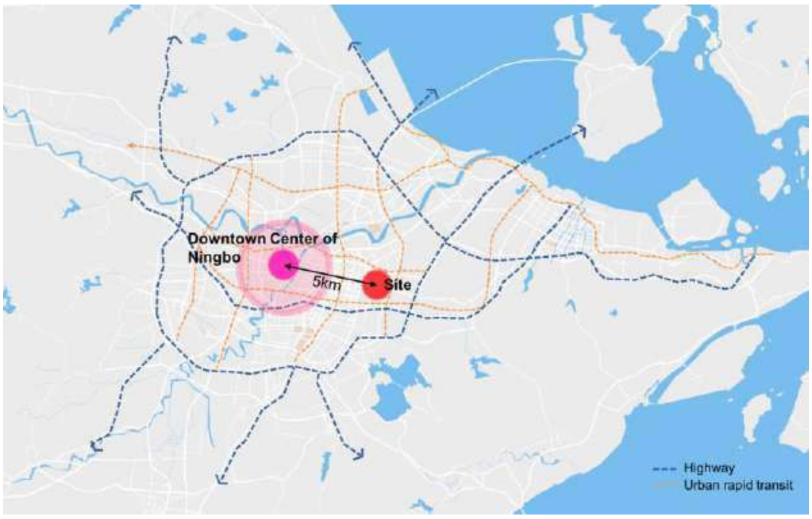

Figure1: Location of Eastern New Town in Ningbo, China
Source: Author's self-drawn, base map from https://www.mapbox.com/studio/styles

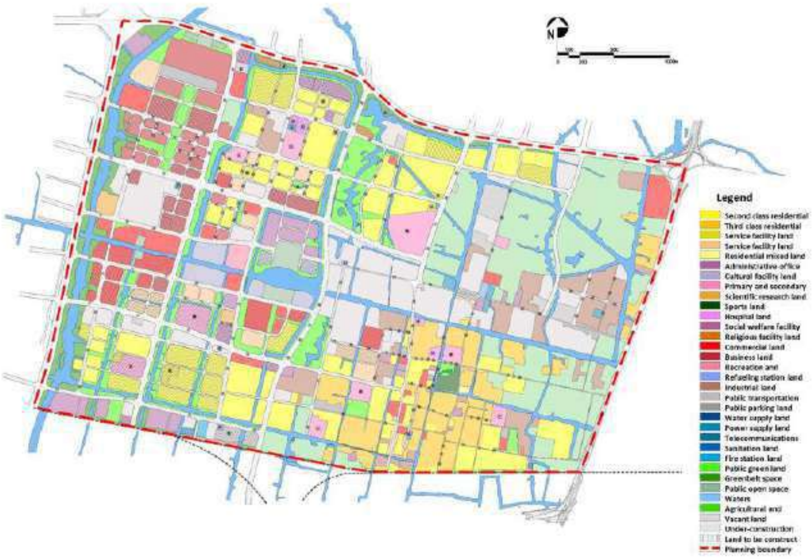

Figure 2: current land use of Eastern New City
Source: Author's self-drawn

2.4 The scale of CLC

The CLC constructed in the Ningbo Eastern New Town includes community-level facilities and open spaces, with a service radius of 500 to 600 meters within 15 minutes walking distance. It serves a population of 10,000 to 20,000 people.

3. Social demands survey and analysis

3.1 Core requirements of each supporting subsystem

Based on questionnaires and interviews (The total number of issued questionnaires were 282, of which 220 were valid), this research analyzes the residents' evaluation on the living space in the Eastern New Town, and different demands that corresponding each subsystem.

(1) Living Space. The focusing facts in living space are high-quality facilities, convenient transportation and a healthy and pleasant community environment. High-quality facilities should concern a whole life cycle services through different products for diverse groups, for example: senior apartments, commercial apartments, and elite apartments. At the same time, environmental friendly housing, renovation of old houses and villages also received highly attention.

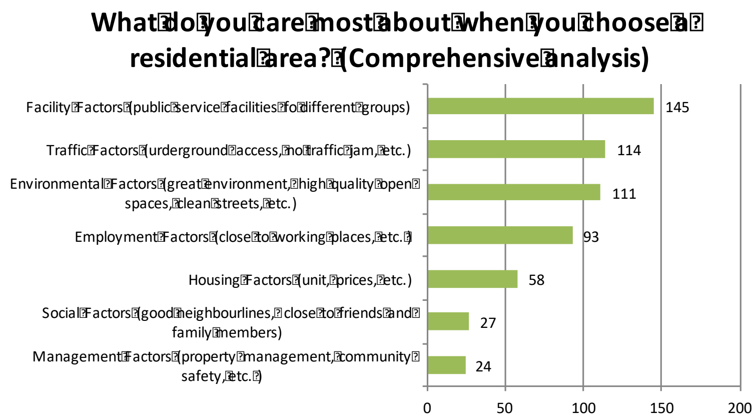

Figure 3: Factors when people choosing a residential area
Source: Author's self-drawn, data collected by survey

(2) Employment space. The most urgent requirements here are parking facilities, and catering services. It is considered that office space in new city is relatively independent and lacks communication with the surrounding environment. This interview also suggests more diversified office space blending surrounding amenities, like makers space, functional composite office and low-cost enterprise communities, to provide a more creative work environment.

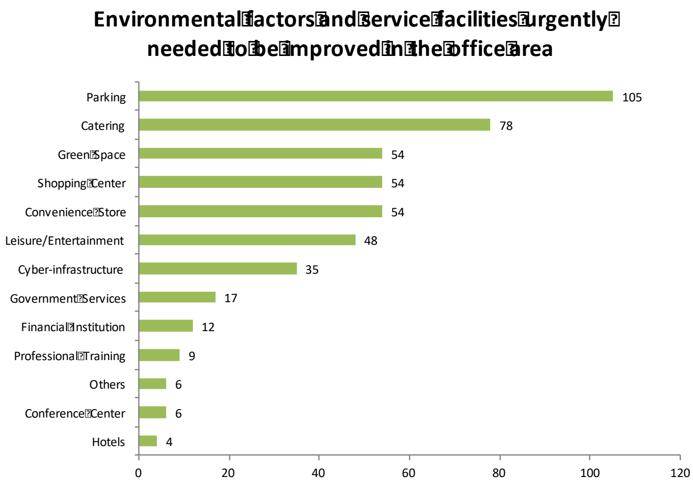

Figure 4: Environmental factors and service facilities needed to be improved in office area
Source: Author's self-drawn, data collected by survey

(3) Road system. The primarily concerned field of residents were walking environment, parking problems and public transportation, which includes limited bus routes, congestion, and traffic transfer. During the interview, residents expressed their desire to provide running path and leisure facilities. As a new type of public transportation, shared bicycles were also highly recommended in the new city. Bus intelligent system is also concerned.

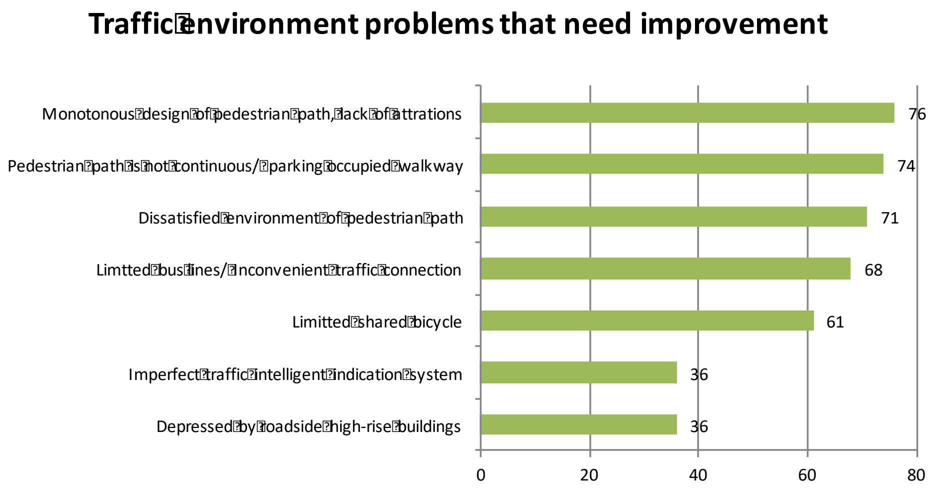

Figure 5: Problems of current traffic environment
Source: Author's self-drawn, data collected by survey

(4) Amenities. The highest demand is to increase fitness and leisure facilities, daily shopping and living service facilities. According to the interview, residents especially require for more flexible service facilities, such as shared facilities, childcare facilities near office and unmanned convenience stores in community, small cafes, etc. Residents also suggest to reuse old buildings as neighborhood activity spaces.

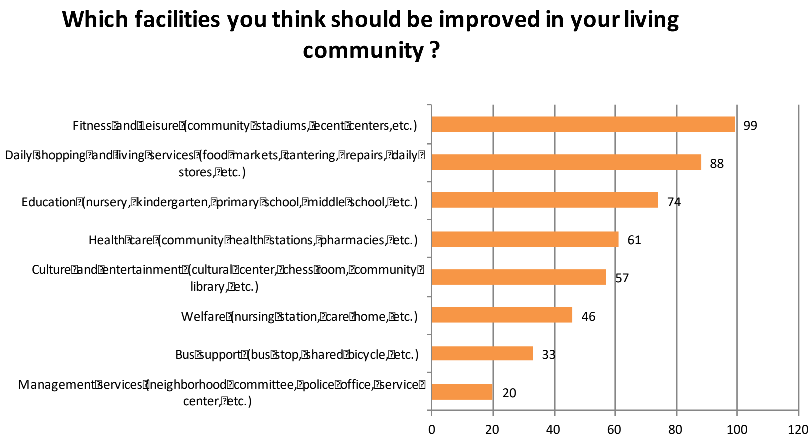

Figure 6: Facilities should be improved in community
Source: Author's self-drawn, data collected by survey

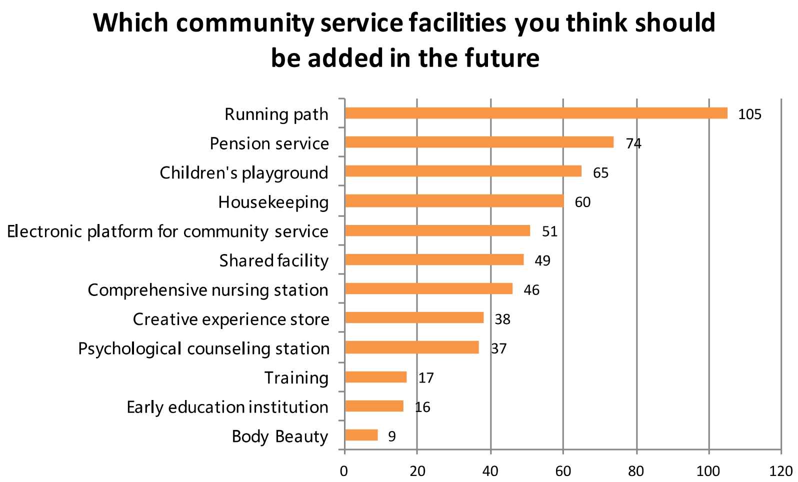

Figure 7: Facilities should be added in community
Source: Author's self-drawn, data collected by survey

(5) Public Space. The principal problem here is the accessibility of green spaces. Most of open spaces lacks recreational facilities and unique characteristics. Thematic public spaces were required while the quantity of green places should be added. At the same time, residents mentioned that private closed space should be shared in the future by breaking the wall-type community mode.

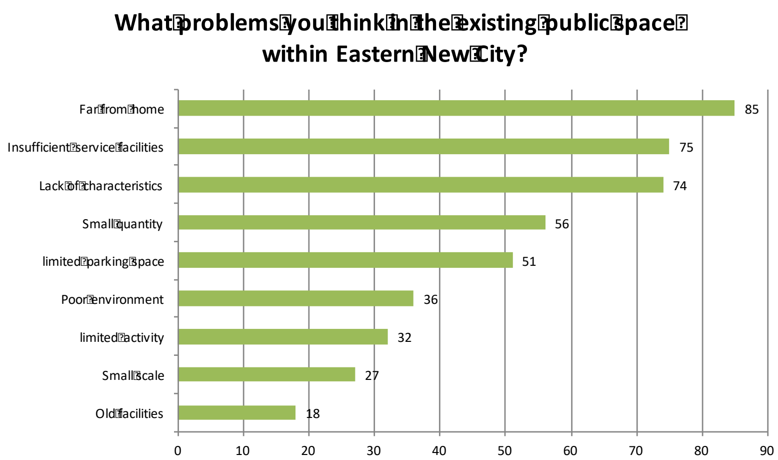

Figure 8: problems of open spaces in Eastern New City
Source: Author's self-drawn, data collected by survey

3.2 Summary of social demands survey

Analysis shows that the main contradiction on existing living space in the Eastern New Town is the top-down resource allocation mode and the residents' high-level requirement. The demands of residents include two major themes: first, to improve basic needs, and second, to increase existing quality of life.

4. Habitable evaluation of community life circle

4.1 Construction of evaluation index system

Corresponding to the five supporting systems of community life circle, the factors were extracted to evaluate the habitability of current life circle (Figure 9). Firstly, based on the living space and employment space, 7 residential groups with different properties were selected. Secondly, 9 evaluation index factors were extracted from the service facilities and public space. At last, accessibility analysis was carried out based on the road system as the path through ArcGIS.

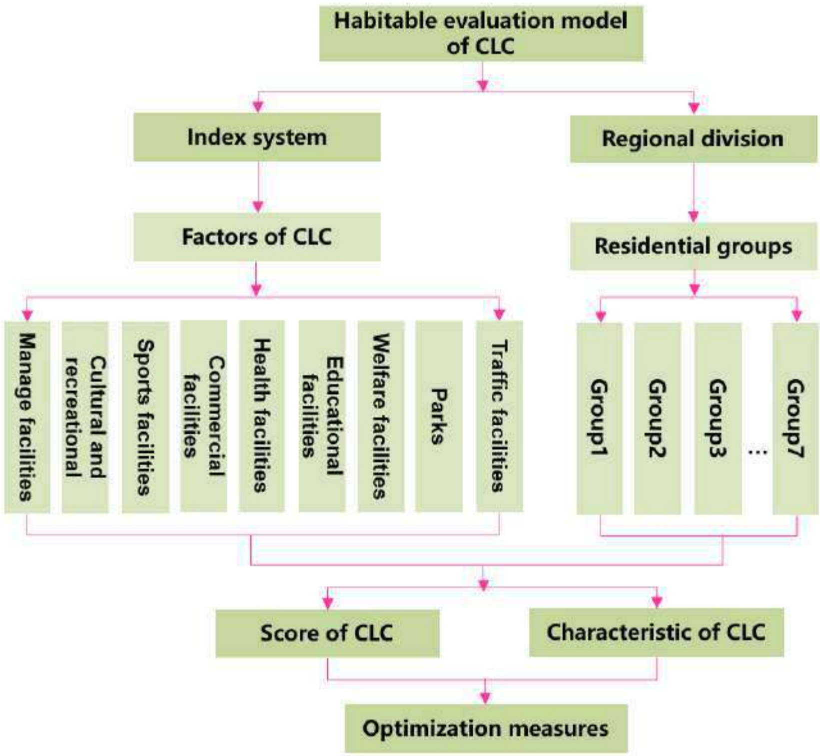

Figure 9: Habitable evaluation model of current CLC
Source: Author's self-drawn

4.2 Evaluation method and process

4.2.1 Selection of index factors

Based on the analysis of current situation and the needs of local residents, nine factors were selected as the main components, which are manage facilities, cultural and recreational facilities, sports facilities, commercial facilities, health facilities, educational facilities, welfare facilities, parks and traffic facilities. Each main factor corresponds to the subdivision factors (Table 2).

4.2.2 Weight assignment

Selected indices were endowed with weights by means of Delphi Method and Analytical Hierarchy Process (AHP). 8 Experts scored the important degree through pairwise comparison. The weight judgment matrix was constructed to get the final weight of each factor. (Comparative evaluation was divided into seven levels: 1=equal importance, 2=weak importance, 3=fair importance, 4=essential importance, 5=very importance, 6=particular importance, 7=absolute importance. Consistency inspection was conducted for each weight judgment matrix.) The result of the weight of each factor is shown in Table 2.

Factor	Weight	Subdivision factor	Weight
Manage facilities	0.34	Community police office	0.06
		Community service center (property service, neighborhood committee)	0.28
Cultural and recreational facilities	0.53	Community cultural activity center	0.53
Sports facilities	0.82	Gym	0.26
		Sport field	0.56
Commercial facilities	**1.53**	Food market	0.45
		Supermarket	0.53
		Restaurant	0.16
		Service facility (bank, barbershop, laundry, etc.)	0.08
		Community shopping (convenience store, groceries, clothing shop etc.)	0.31
Health facilities	0.88	Community health station	0.59
		Drugstore	0.29
Educational facilities	**1.53**	Kindergarten	0.48
		Primary school	0.75
		Middle school	0.30
Welfare facilities	0.67	Care station	0.67
Parks	1.20	Neighborhood green space and square	0.60
		Small parks, Street park	0.60
Traffic facilities	**2.50**	Bus stop	2.50

Table 2: index system and weight for the evaluation on the habitability of community life circle
Source: Author's self-drawn, calculation result of the weight

4.2.3 Selection of residential groups

According to the spatial distribution and different characteristic of living space, four types of residential clusters were selected (Table 3, Figure 10), which are upscale community (group 1), business-living community (group 2, 3), intermediate community (group 4, 5) and rural community (group 6, 7).

Residential group	Name of the community	Land use	Plot ratio	Type of community
Group 1	Jinxiu Dongcheng, Oriental Yipin	R2	2.2	Upscale community
Group 2	Lan Garden	RB	2.79	Business-living community
Group 3	Jiaheng Plaza	RB	4.5	Business-living community
Group 4	Qianshuiwan Urban	R2	1.6	Intermediate community

	Garden I, II			
Group 5	Shuxiang Jingyuan I, II, III, IV	R2	2.0	Intermediate community with resettlement housing
Group 6	Fangzhuang	R2	1.1	Rural community
Group 7	Yinfeng	R2	1.5	Rural community with resettlement housing

Table 3：Properties of different residential groups
Source: Author's self-drawn

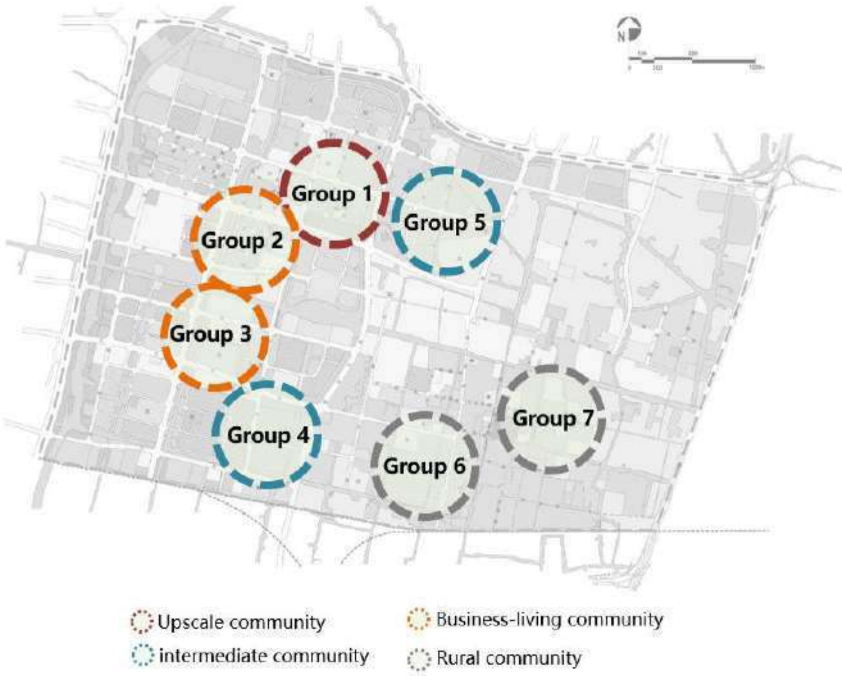

Figure 10: Classification and distribution of residential groups
Source: Author's self-drawn

4.2.4 Scores of the habitable evaluation

Entrances and exits of the residential groups were selected as the starting points. The spatial accessibility map was formed by GIS-based measures. The score was determined by whether the factor could be found in 15 minutes' walk distance or not. Score 1 means yes, while score 0 means no. The result is multiplied by the factor weight, and the total point of each group is the sum of all the factor scores. The calculation model of evaluation is:

$$Q_i = \sum_{j=1}^{n} W_j * X_j$$

Q_i is the total score of ith residential group. W_j is the accessibility score of the factor of the jth residential group (be accessible=1, be inaccessible=0). And X_j is the weight of the jth factor.

The facilities and spatial accessibility distribution are shown in Figure 11. And Table 4 illustrates the habitable scores of evaluation of each factor.

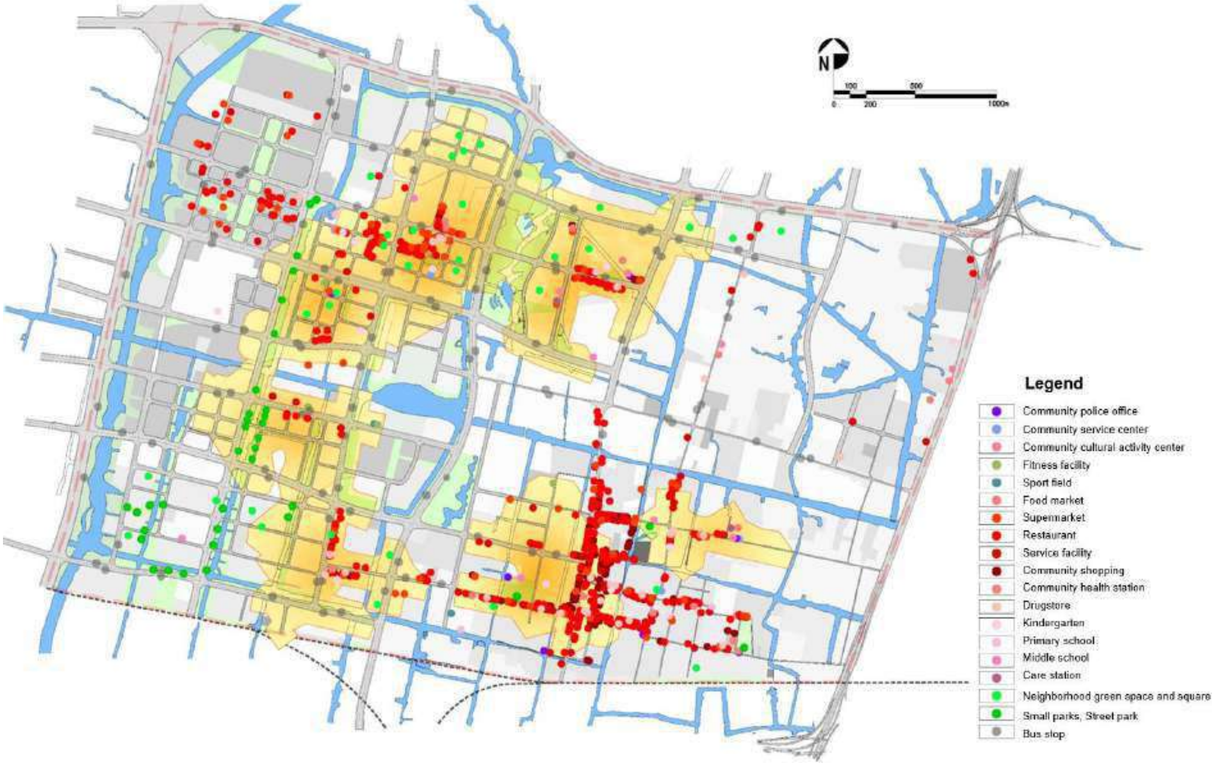

Figure 11: Facilities and spatial accessibility distribution map
Source: Author's self-drawn, according to the accessibility analysis through ArcGIS

Residential group	Manage facilities		Cultural and recreational facilities	Sports facilities		Cultural and recreational facilities					Health facilities		Educational facilities			Welfare facilities	Parks		Traffic facilities	Total score
	Community police office	Community service center	Community cultural activity center	Gym	Sport field	Food market	Supermarket	Restaurant	Service facility	Community shopping	Community health station	Drugstore	Kindergarten	Primary school	Middle school	Care station	Neighborhood green space and square	Small parks, Street park	Bus stop	
Group 1	0.06	0.28	0.00	0.00	0.56	0.00	0.53	0.16	0.08	0.31	0.59	0.29	0.48	0.75	0.30	0.00	0.60	0.00	2.50	7.49
Group 2	0.06	0.28	0.00	0.26	0.00	0.00	0.53	0.16	0.08	0.00	0.00	0.00	0.48	0.75	0.00	0.00	0.60	0.60	2.50	6.30
Group 3	0.00	0.00	0.00	0.26	0.56	0.00	0.00	0.16	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60	2.50	4.16
Group 4	0.00	0.00	0.00	0.00	0.00	0.00	0.53	0.16	0.08	0.31	0.59	0.29	0.48	0.00	0.00	0.00	0.60	0.60	2.50	6.14
Group 5	0.06	0.28	0.53	0.00	0.00	0.45	0.53	0.16	0.08	0.31	0.59	0.29	0.48	0.00	0.00	0.67	0.60	0.00	2.50	7.53
Group 6	0.00	0.00	0.00	0.26	0.56	0.45	0.53	0.16	0.08	0.31	0.59	0.29	0.48	0.00	0.30	0.00	0.00	0.60	2.50	7.11
Group 7	0.06	0.28	0.53	0.00	0.00	0.45	0.53	0.16	0.08	0.31	0.59	0.29	0.48	0.00	0.30	0.67	0.00	0.60	0.00	5.33

Table 4：Habitable scores of evaluation of each factor
Source: Author's self-drawn

4.3 Analysis of the evaluation

The evaluation scores of current CLC and spatial characteristics of different residential groups are shown in Figure 12.

Group 5 gets the highest score (7.53), which has large scale communities of enclosed-type with a big community service center (including health station, recreational center, old-age service facilities etc.). And some of the commercial facilities are along the streets.

Group 1 (7.49) ranks second. It is an open community, which has the spatial characteristic of small block and dense network. Most of the service facilities are distributed along the streets. While compared to the gated community of group 4 (6.14), the habitability of group 1 is better.

The rural community (group 6) is close to the center of the old town, ranking the third (7.11). The community is open, and various facilities are distributed along the main street.

The business-living communities (group 2, group 3) have high quality. However, they are located in the newly developed area, which is close to the office area, lacking all kinds of facilities. The overall habitability score of community life circle is relatively low.

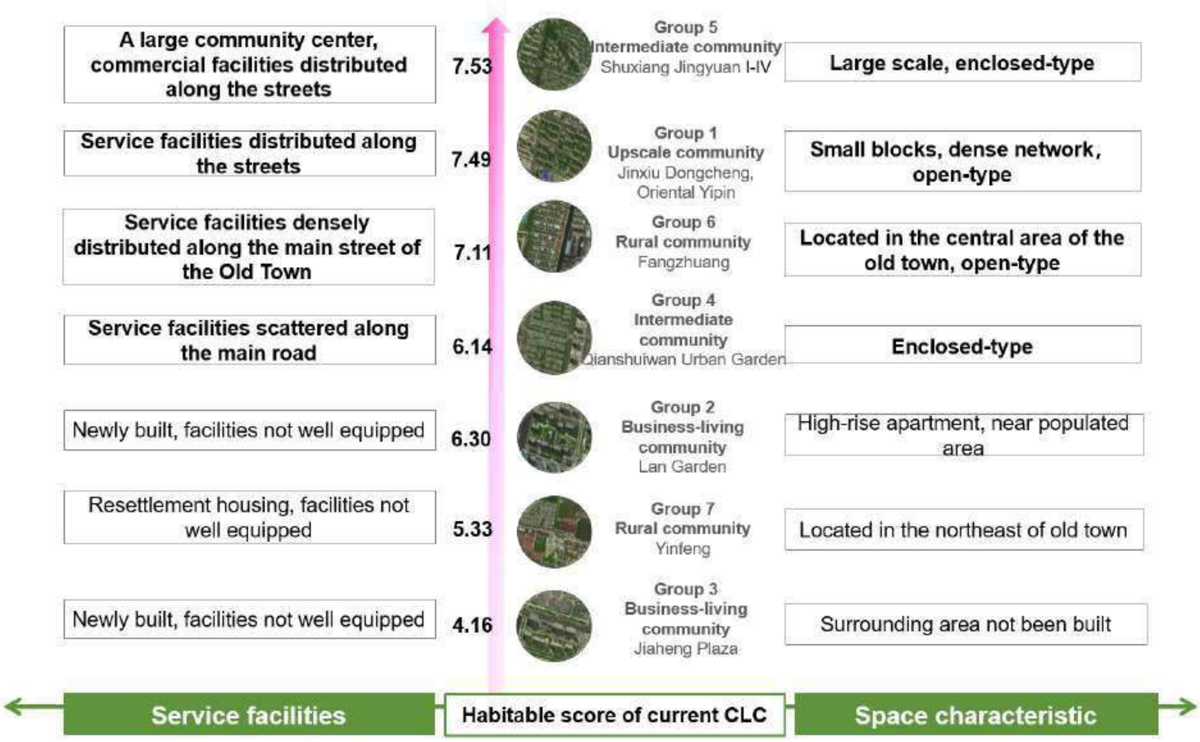

Figure 12：Evaluation scores of current CLC and spatial characteristics of residential groups
Source: Author's summary

4.4 Conclusion of the evaluation

The evaluation conclusion includes two points. First, there is a large gap between each factor, which requires targeted supplement and improvement. Second, the habitability of current life circle differs among different residential groups, which need to be improved separately according to the spatial characteristics.

5. Construction of Community Life Circle

According to the characteristics of the residential group, the eastern new town is divided into four types of districts, business areas, current residential areas, new residential areas and old town. The spatial characteristics of high score groups in the habitability evaluation are extracted for building the spatial models and putting forward the key requirements of each area.

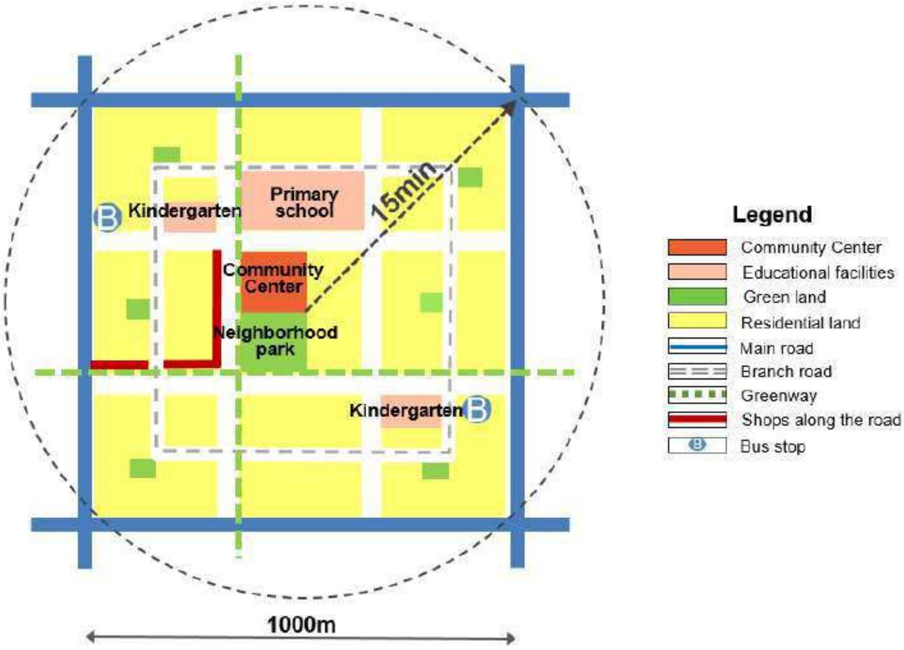

Figure 13: 15-minute community life cycle model
Source: Author's self-drawn

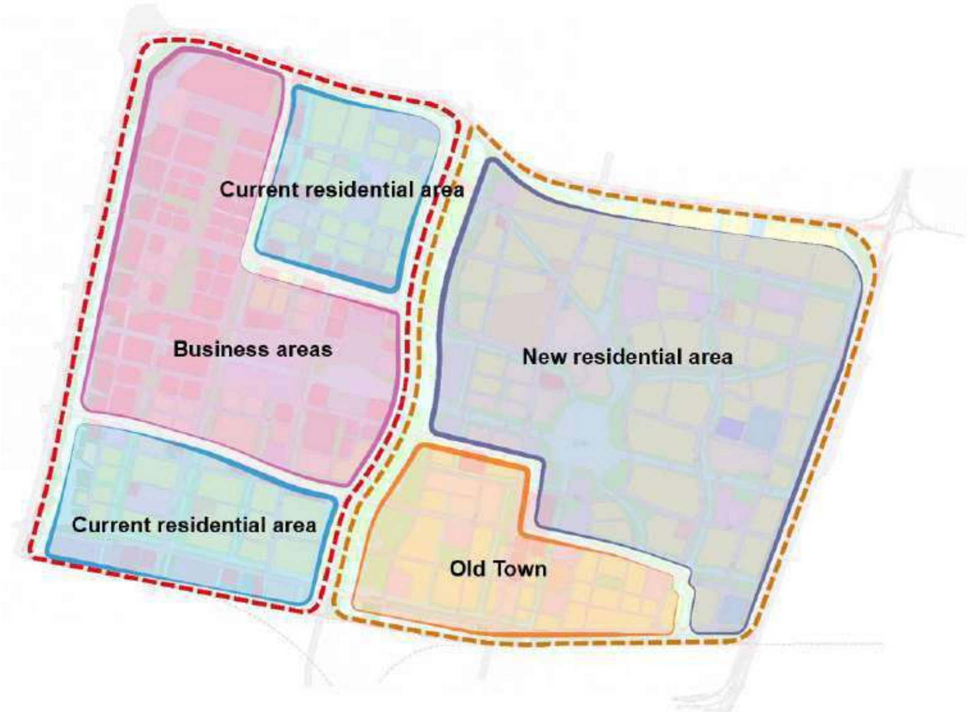

Figure 14: Area classification of Ningbo Eastern New Town
Source: Author's self-drawn

5.1 New residential area

For the new planning areas, the construction of community life circle is goal-oriented, especially focusing on service facilities and road system.

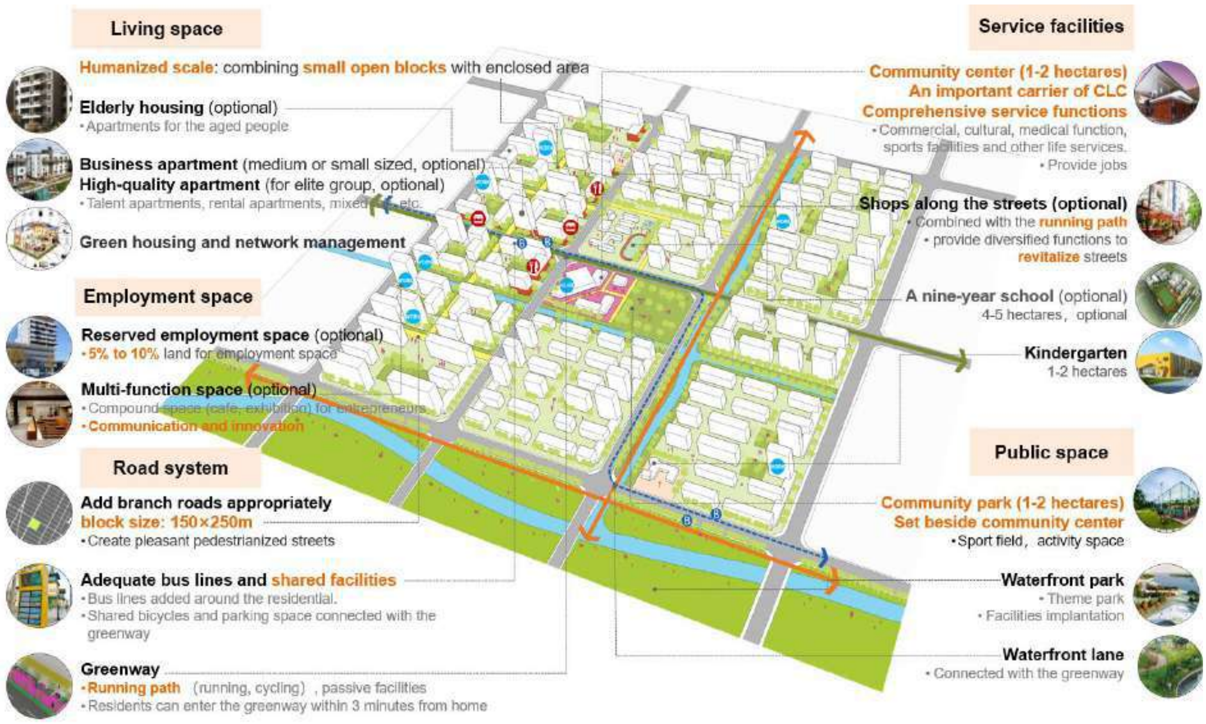

Figure 15: 15-minute community life cycle model of new residential area
Source: Author's self-drawn

For service facilities, the first aspect is spatial distribution. The community center (1-2 hectares) acts as an important carrier of 15-minute CLC with comprehensive service functions, including commercial, cultural, medical function, sports facilities and other life services. Simultaneously, shops along the streets are designed to supplement diverse service function and achieve street vigor. The second focus is the classification of the facilities. Based on the service radius of CLC, a hierarchical facility system is established to eliminate the blind area for pedestrian and to improve the coverage ratio of facilities. In order to meet the different needs of people, not only the basic facilities are provided, but also the ones with high quality and innovative features are considered, such as shared bikes, intelligent management facilities and electronic service platform.

In terms of road system, it is recommended to combine the small block with the traditional enclosed community. Branch roads are encouraged to be added appropriately, and the block size is suggested to be about 150 X 250 meters. As residents have a great need for fitness trails, a greenway system is introduced to the life circle, which provides running path and leisure facilities.

The other supporting systems include living space, employment space and public space. For living space, according to the needs of residents, attention should be paid to the provision of different housing types, such as elderly housing and talent apartments. In terms of employment space, it is suggested to reserve the land (about 5%-10%) for working space in new residential areas. The aim is to create a mixed space for innovation and startups. As for public space, a community park (1-2 hectares) with sport field is planned beside the community center. Parks should be humanized design with service facilities and full of local features with different theme. Cultural activities are introduced to increase the vitality of public space. In addition, attention should also be paid to the utilization and development of waterfront space.

5.2 Old Town

The construction of community life circle in old town keeps the characteristics of high score residential groups, and focuses on organic renewal.

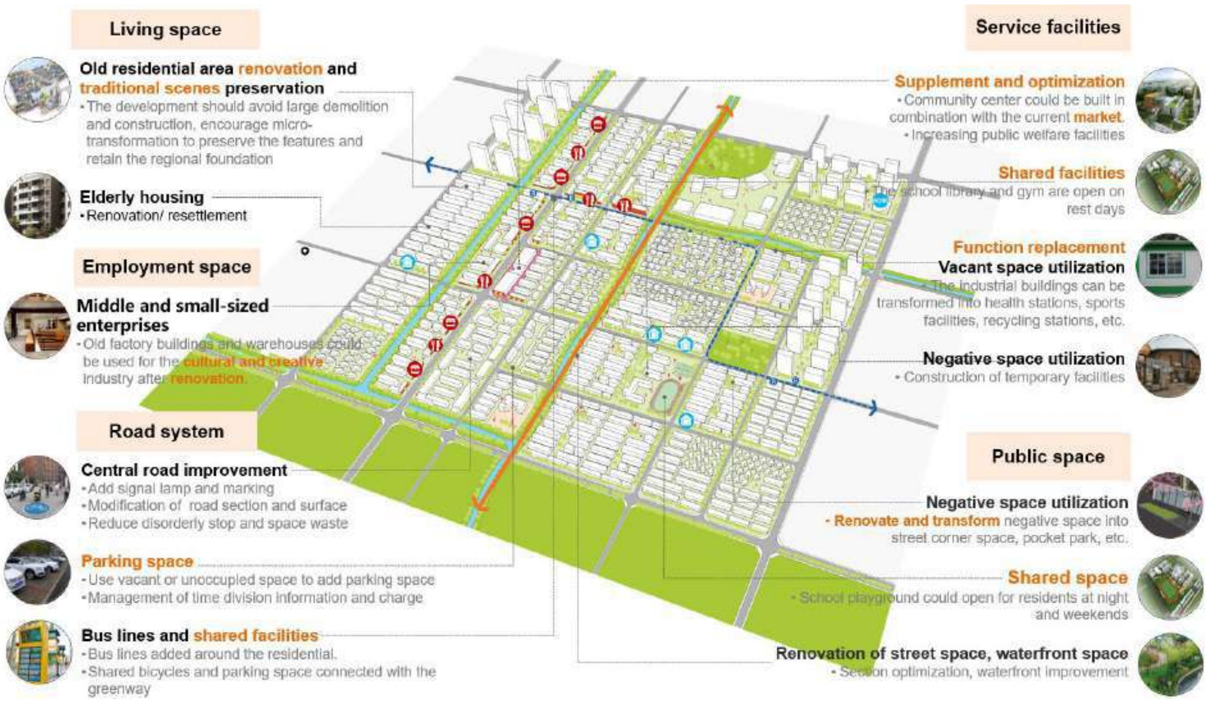

Figure 16: 15-minute community life cycle model of old town
Source: Author's self-drawn

The living areas are restored to preserve the traditional features. The old factory buildings and warehouses could be used for the cultural and creative industry after renovation. In terms of service facilities, it is suggested to transform the market into a compound facility acting as the community center. Roads are being improved and bus lines are being added. As public spaces are limited, negative spaces are encouraged to be used and waterfront should be improved.

5.3 Business area

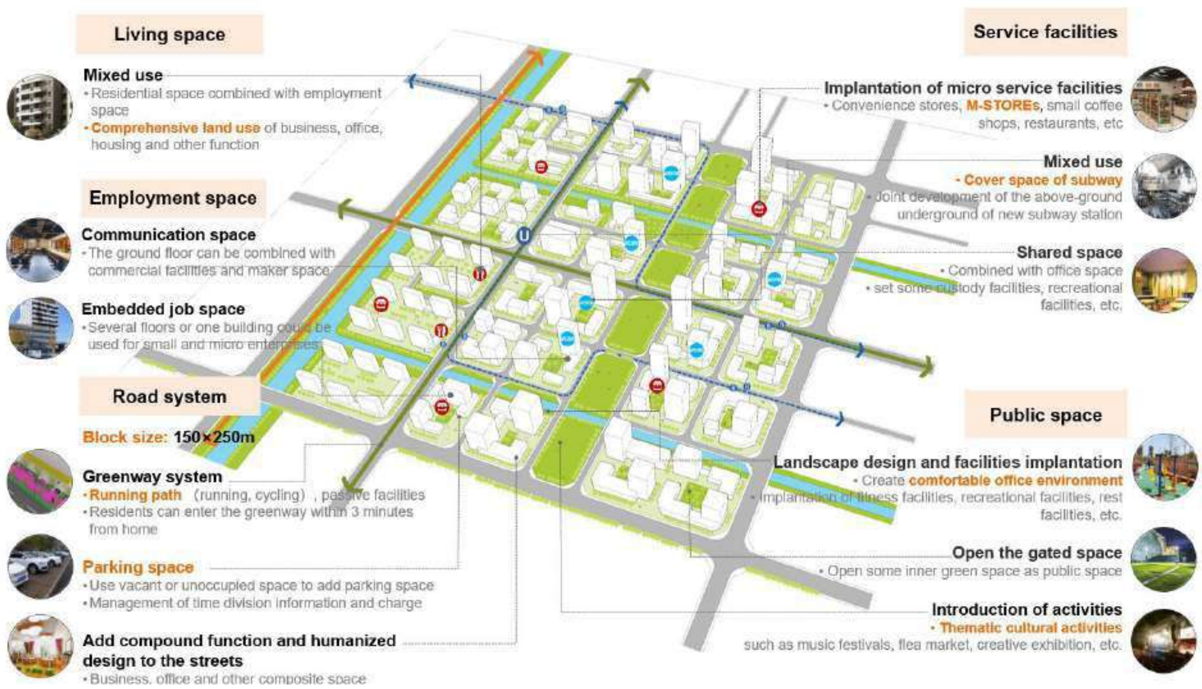

Figure 17: 15-minute community life cycle model of business area
Source: Author's self-drawn

Business areas have basically completed the construction, and the CLC is mainly constructed by micro-renewal.

Scores of the business-living communities are relatively low. The main reason is lack of facilities. Composite use could be implanted into the existing buildings. Daily service facilities could be put in the ground floor, such as convenience stores, coffee shops, newsstands and so on. Meanwhile, the joint development of new subway stations should be planned ahead, which combines the space of the ground and underground. It is recommended to open and share some gated space.

5.4 Current residential area

For residential areas that have already been built, the CLC is mainly constructed by micro-renewal.

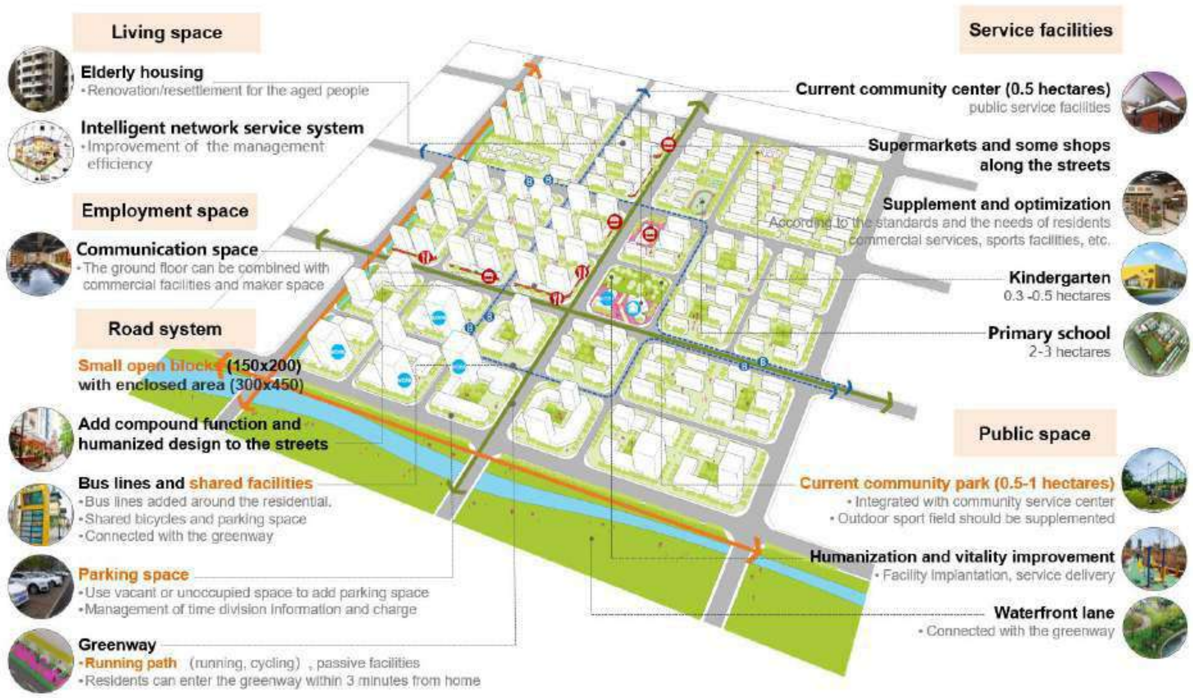

Figure 13: 15-minute community life cycle model of current residential area
Source: Author's self-drawn

In terms of road system, bus lines should be added and shared transportation facilities for shared buses and bicycles should be set up. Parking facilities need to be optimized. Special attention should be paid to adding flexible parking space and popularizing intelligent street management. As for service facilities, the missing types need to supplement, and the quality of facilities needs to be improved to meet residents' high-level requirement. Space along the street floor can be used. In terms of public space, the outdoor sports ground should be supplemented. In addition, waterfront slow lane could be built for leisure and exercise, which could also connect to the CLC greenway.

6. Conclusion

This project focuses on the implementation of residents' living demands via social surveys. It breaks the traditional single model of top-down planning in new city development. This research also builds a spatial model based on the adaptive evaluation of current life circle, and the daily activities of residents. Corresponding planning strategies are proposed as well, which could not only guide the CLC construction for this area, but also interface with control detailed planning, urban design and community planning.

However, the limitations of this research are the acquisition of big data and the characteristics of crowd activity in a larger base. The CLC model should be adjusted in the future with more combination research methods.

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How Do Universities React with Cities: the Case Study of Wuhan, China

(Interpretation of the “Univercity” and its spatial Policy in the Case of Wuhan)

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Abstract

Cities and universities have been reacting with each other in a complex conflicting way not only in urban morphology but also in economic, social and culture networks. This paper takes Wuhan for an example to explore the relations between universities and cities not only because Wuhan is famous for college education and has the most graduates all over the world， but also because Wuhan has been positioned as the national innovation center by making it as a “univercity”. Comparison studies on the historic evolvements how universities react with cities are made between the western countries and China. In this way, efforts are made to interpret the meaning of the “university” in aspects of absorbing talents, promoting industries and developing cities. Then the index system of the “univercity” towards the three dimensions mentioned above has been established. Last but not least, the spatial strategies of making a “univercity” have been given accordingly.

1. Introduction

As major spaces to produce local knowledge, universities have become important public facilities to promote regional innovations, so as to make the cities more competitive globally. For examples, cities like Santa Clara, Boston, Cambridge and Oxford have become key nodes of the global innovation network due to their interaction with local universities with top rankings in the world. As the global innovation resources shifting to Asia, Shanghai, Beijing and other cities have put forward urban strategies of making global innovation centers so as to improve their roles in the innovation network worldwide by developing knowledge-based districts such as Yangpu Areas and Zhongguan Village.

As an important educational and technological base in China, Wuhan has long been attempting to transfer its own strength into regional innovation competitiveness. In 2016, To Make it as a “Univercity” has been put forward as one of the ten strategies of Wuhan innovation, which can be illustrated to make universities integrated with the city as a national technological and industrial innovation center. Among all the administrative divisions in Wuhan, Hongshan district has been listed as the core of the “univercity” with the densest resources of key universities, national labs and undergraduates[1] (see Figure 1). However, the district has been confronted with series of problems such as low contribution of universities to industries and isolation between universities with cities leading to traffic jams and facility shortages. Based on this, how do universities react with cities has long been bothering Wuhan especially Hongshan district. This paper attempts to analyze the histories of the interactions between universities and cities, illustrate the meaning of “univercity” and propose exploratory strategies on physical environment.

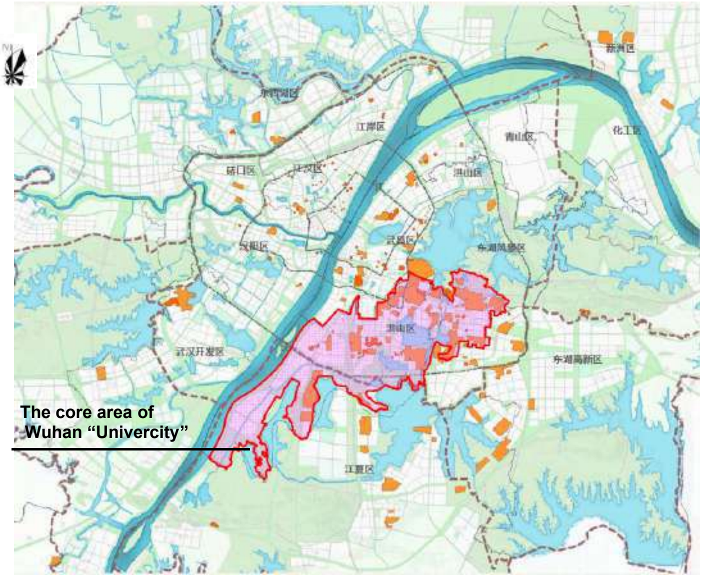

Figure 1: Range of the Core Area of Wuhan “Univercity”

2. The Interaction between Universities with Cities in Historical Perspectives

As the products of western modern civilization, universities can be rooted from the word universus with the meaning of universal, whole, world and universe, which determines that the reactions between universities and cities in China and abroad quite different.

2.1 Experiences in Western Countries

The histories of the reaction between universities and cities in western countries can be divided into the following three stages.

The first stage from the 12th century to the 18th century can be characterized as comparative isolation under the influences of religions. At the beginning of the 12th century, universities have come into being as a new kind of high education facilities especially for government staffs, reverends, noblemen and other elites. Influenced by the Christians, university campuses were almost integrated with churches, which were located besides small towns as enclosures, like the King College of Cambridge University.

Then it was the stage of open public facilities in the ideas of equality and freedom from the 18th century to the 20th century. After the first Industrial revolution, the new emerging business has led to large demands for scientific professionals. As the raise of expenses on high education, universities have expanded themselves for technicians. Greatly influenced by the famous Germany education revolutionist Wilhelm Von Humboldt who advocated the combination of education and research, scientific research has become the responsibility of universities for the first time. As a result, universities which used to be isolated with cities have become open to people especially in the aspects of public facilities. For example, Cambridge University in Britain has torn down the old monasteries and colleges, and instead built a conference center, a library and a museum open to the public. Massachusetts Institute of Technology has set up an opera, a hospital, a gymnasium, parking lots as well as some research centers around the campus.

From the 20th century till Now, it was the third stage characterized as the integration of universities and industries driven by regional innovation. After the third technology revolution, innovation has become the major driven force promoting regional economic developments. With the improving role of scientific research to urban productiveness, the research functions have gradually reached out of campuses and penetrated into the neighboring research institutions. For example, there were more than 8000 technique companies surrounding

Stanford University, Santa Clara University and San Jose University, which has formed a ring of research centers, communities and retail stores (see Figure 2). Under the influences of productivity revolutions and freedom ideologies, the universities in the western countries has transformed from isolated blocks to open neighborhoods sharing public facilities and research institutions, which has not only improved the service efficiency, economic powers and regional innovation competitiveness.

Figure2: Function Analysis of Stanford University and its surrounding areas

2.2 Experiences in China

The histories of the interaction between universities and cities in China can be divided into the following four stages.

The first stage can be characterized as enclosure academies in the ideas of elitism education, which was from the 9th Century to the 19th Century. The oldest universities originated from the academies especially for the gentries, scholars and government staffs in the feudal society. Influenced by the naturism of Taoism and Confucianism, the universities were mostly located in the forest on the outskirts such as Changsha Yuelu Academy. Then to improve the convenience of administration, universities were mostly located in the cities such as Beijing Jingtai Academy. There were one or multiple courtyards in the academies with the functions of teaching, studying and resting.

From the early 19th century to 1949 was the second stage of open campuses under the influences of western education. As the revolutionary change in the traditional education driven by the Westernization Movement, the academies were gradually transferred into schools influenced by the western education thoughts. Later on, campuses become more open to cities, which can be considered as the early forms of the "univercity" in China.

It was the third stage from 1949 to 1978 under the influences of western education, which can be characterized as self-contained compounds. From the foundation of the People's Republic of China to the Reform and Open-up, universities were mostly located on the outskirts which were usually planned as the educational areas in the city master plans. There were multiple defined and connected functional areas such as education, research, libraries and living quarters, which composed the unique self-contained compounds. On one hand, the state encouraged universities to share their gymnasiums and auditoriums with the public. On the other hand, factories and warehouses were built in the campuses to make use of every bit of space, which has led to the disorder of land use. As a result, the self-contained compound model has set back the integration of universities and cities in China.

From 1978 till now was the fourth stage of function overflows under the influences of high education revolutionary movements. After the Reform and Open-up, the high education revolutionary movements have not only inspired the commercialization of research but also promoted the overflows of adjunctive functions to cities. Based on the self-contained compound model, some functions including caterings and retails were gradually shifting outside of campuses where assembled innovative research institutes spontaneously in correspondence to the famous disciplines. After 1998, continuous expansion of universities have led to the popularization of high education with low input and fast speeds. Local governments began to set up new colleges or expand existing universities which also demonstrated different kinds of spatial features. For example, some were located in new towns with abundant land resources as university towns like the Guangzhou University Town or as featured industrial parks like the Hangzhou Eastlake Creative Valley. Some were located in the main cities, like the central Intellectual Area around Shanghai Tongji University and Fudan University with multiple functions of business, retails, leisure and entertainments.

Greatly influenced by western education thoughts, the interactions between universities and cities have transformed from isolation, gradual openness to sharing services and contributing to industries. However, the traditional academies and self-contained compound models have exerted deep influences which demonstrated themselves as fences to keep isolations both physically and mentally. Taking the core area of the “univercity” in Wuhan as an example, most universities were located along the mountains and lakes like compounds or as clusters. Although the expansion of universities in the 1980s have promoted their interaction with research companies, isolation has been still clear both in the functions and forms. On one hand, there was a lack of commercialization of research leading to the massive demands but limited supply of innovation spaces outside campuses. On the other hand, enclosure campuses have not only led to the failure of sharing public services, roads and open spaces with the public, but also resulted into the big city diseases such as traffic jams and service shortages.

3. Interpretation of the “Univercity”

From the historical experiences how universities reacted with cities, the “univercity” should be illustrated as a sustainable mechanism of talents, industries and cities, which operates by transforming the education resources into industry competitiveness and sharing the service facilities with the public. To interpret the idea of “univercity” more concisely, an index system can be established from the dimensions of talents, industries and cites(see Table 1). Based on the *Guidelines of Developing Innovative Cities*[2] issued by the Ministry of Science and Technology and the National Development and Reform Commission, nine categories were made out of the basic index base by learning from the advanced areas and following principles of easy to compare and implement. For every category, two to five indexes were set up to demonstrate the features, goals and processes of making the “univercity”. By the method of type research and comparative studies, quantitative analysis has been made for every index also learned from the references.

Table 1
Key Indexes of the "Univercity"

Dimensions	Categories	Indexes	Types		
			Features -related	**Goals -related**	**Processes -related**
Talents	Input on Education Expenses	Percentage of Technology Input to Public Finance(%)	√		√
		Percentage of R&D Expenditure to GDP（%）	√		√
		Percentage of Basic Research to R&D Expenditure(%)	√		√
		Number of Labs with Nobel Prizes	√	√	√
	key disciplinary &interdisciplinary platforms	Number of World-famous Leading Universities	√	√	
		Number of World-famous Leading Disciplines	√	√	
		Number of National Key Technological Facilities	√	√	
		Number of Research Platforms between Universities	√	√	√
	Personnel Recruitment	Percentage of Graduates to Local Employments(%)	√	√	
		Number of High-level Talents		√	
Industries	R&D Expenditure	Percentage of Enterprise Input to University Research Expenses (%)	√		√
		Number of Key Disciplines Transformed to Industries	√	√	
	Innovation Facility Platform	Number of Innovation Facility Platforms	√		√
		Contribution rate of technology to economy increase(%)	√	√	√
	High-tech enterprises	Number Percentage of High-tech Enterprises to Enterprises(%)	√	√	
		Revenue Percentage of High-tech Enterprises to Enterprises(%)	√	√	
Cities	Urban Quality	Number of Projects for National Garden City	√	√	
		Coverage of Metro Station with a Radius of 500m to Universities (%)	√		√
		Number of Talent Apartments Per Year	√		√
		Number of International Schools	√		√
	Open Campuses	Sharing Rate of Facilities (%)	√	√	√
		Number of Landscape Projects Funded by Governments	√		√
		Network Density(km/km^2)	√	√	
	Urban Regeneration	Percentage of Land used for Innovation (%)	√	√	√
		Percentage of Revenues for R&D (%)	√		√
		Areas of Key Facilities or Labs（m^2)		√	√
		Rewards for New-built Research Facilities			√
		Rewards for New-built Talent Apartments			√

3.1 The Dimension of Talents

Universities were essentially the cradle of talents output to cities. On one hand, the basic interpretation of the "univercity" is to cultivate and raise leading talents especially by nurturing key disciplines of universities and promoting interdisciplinary construction and international corporations , so as to improve the strengths of city human resources. As a result, more talents will be attracted into the city once the competitiveness has been improved. Therefore, the indexes in the dimension of talents include input on education expenses, key disciplinary and interdisciplinary platforms as well as personnel recruitment. For example, key indexes like world-famous leading universities, world-famous leading disciplines and national key technological facilities were chosen for the sub-category of key disciplinary and interdisciplinary platforms. In a goal-oriented way, these indexes can not only represent the overall features in the domain, but also focus on both the qualities and quantities.

Taking the core area of Wuhan "Univercity" as an example, the goal of two world-famous leading universities with twenty first leading disciplines has been proposed based on the resources of current universities and disciplines. According to *the Mid-and-long Term Plan of National Key Technological Facilities(2012-2030)*[3], there will be about fifty facilities nationwide. Based on this, Wuhan "Univercity" has been proposed to establish two national key technological facilities according to the current situations and comparisons with other cities.

3.2 The Dimension of Industries

As an important way to transform the educational resources into urban innovation competitiveness, fostering industries is the foundation of the "univercity". On one hand, key disciplines should be focused on boosting the process of incubation so as to play the leading role in regional innovation network. On the other hand, cooperation between universities and enterprises should be promoted based on the dominant industries, so as to exert backward forces from demands to supplies and improve the effectiveness of commercialization and appliance of research. Therefore, the indexes in the dimension of industries focus on the whole process of innovation and include spending R&D expenditures, building innovation facility platforms and nurturing high-tech enterprises. As an important part of cultivating innovation, building innovation facility platforms can by evaluated by methods of goal-oriented quantification, which can be indexed as the number of public service platforms and contribution rate of technology to economy increases.

As the most potentially innovative area in Wuhan, the core area of Wuhan "Univercity" has been proposed to meet the demands of leading universities and institutes by paying attention to building the platform of innovation facilities so as to keep up with the international levels. According to the *Thirteenth Five Years' Plan of National Technology Innovation*[4], the contribution rate of technology progresses to economy increases has reached an average level of 55.3% in 2015 and proposed to achieve the goal of 60% in 2020. Learning from experiences of other cities home and abroad, the goal of the core area of Wuhan "Univercity" has been set as 70%.

3.3 The Dimension of Cities

If the aspect of industries is only the economic dimension of the "univercity", the aspect of cities can be considered as a comprehensive dimension. On one hand, sharing all kinds of public facilities of universities with cities so as to promote the overflow of adjunctive functions, make most use of the facilities and improve urban living qualities. On the other hand, featured service functions can be set specially surrounding campuses not only to meet the diverse needs of college students and teachers but also improve the efficiency of urban public service facilities. Accordingly, the aspect of cities can be indexed including both improving urban qualities and promoting university openness. Not only the number of international schools which can be comparable to other areas has been listed, but also the sharing rate of college facilities and road network densities which can be used to evaluate the achievement of goals have been included. Besides, the subcategory of urban regeneration has also been proposed to add especially for the built areas surrounding colleges, which does not only focus on controlling indexes like the land use percentages for innovations in urban regenerations and also include improving indexes like FAR bonuses on new built incubators.

As the model of the Wuhan “Univercity”, the core area has been proposed to focus on the improvement of urban qualities so as to increase the attraction for talents. Learning from the references that there are from 2.3 to 3.3 international schools per billion persons in Beijing, Shanghai and Guangzhou, it has been estimated that there should be at least 3 international schools in the core area according to the population. Besides, as the current road network density is less than 2.5 km/km^2 due to the “compound” model of universities, the goal has been set as 5.5km/km^2 after opening campuses based on the national standards and implementation difficulties.

4. Spatial Strategies to React Universities with Cities

No matter the concepts of university towns and university parks proposed by Chinese scholars long ago or the “univercity” are essentially to react or integrate universities with cities. For the spatial elements, there are studies about university educational units and urban expansion units (Duan and Lu,2003), also discussion about the educational districts, adjunctive function districts and creative function districts(Wang, Chen, Yu, Feng and Zheng, 2016). Based on the theories of regional innovation systems[5], the physical spaces of the “univercity” should include universities to output innovating subjects, incubators to provide spaces for innovation activities and all kinds of facilities to cultivate innovation environments(see Figure 3).To achieve the goals in dimensions of talents, industries and cities, three connections should be made between universities, industries and cities.

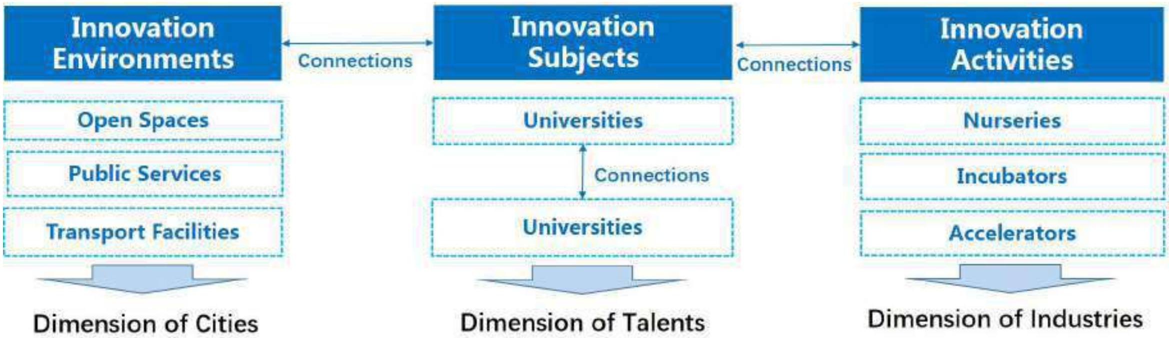

Figure3:Analysis of the Spatial Elements of the “univercity”

4.1 Connecting universities with universities to make use of inner spaces

As the cradle to nurture innovative talents, universities as well as research institutes are in the upper stream of innovation chains, which supply the platform for building disciplines, undertaking research and promoting international academic cooperation. Therefore, adequate spaces should be provided by optimizing inner spaces of campuses to make close connections between universities. For example, residents for teachers and staff, dormitories, cafeterias as well as other logistic service spaces can gradually evacuate their functions out of campuses with the socialization reform of university, so as to provide spaces for key technology facilities and research platforms between universities. With the renovations of classroom, schoolhouses and warehouses, research functions could be added on. Meanwhile, the intensities and densities are encouraged to be improved when educational lands are transformed into key technological facilities so as to promote the intensive utilization of land use(see Figure 4).

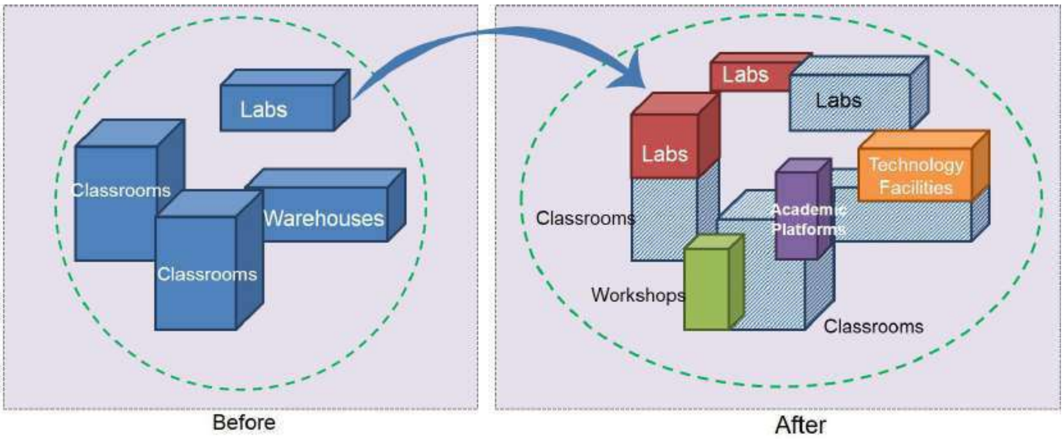

Figure4: Function Analysis of University Inner Spaces

To solve the problems of lacking platforms for key technological facilities such as laboratories, and research platforms in the core area of Wuhan "Univercity", it has been proposed to reconstruct the logistic service facilities with inefficient land use, which can be remade as national key technological facilities and academic platforms between universities. Besides, encouragement has also been proposed to make FAR rewards ranging from 1.1 to 1.2 so as to promote the reconstruction of inner spaces(see Figure 5).

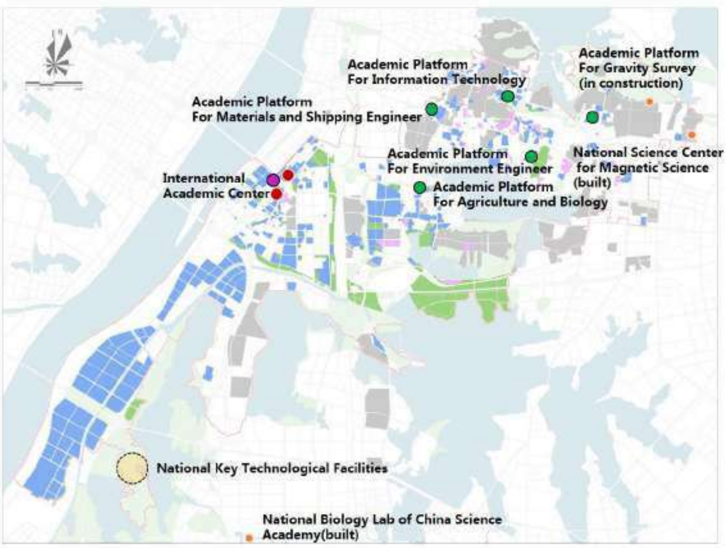

Figure5: Layouts of the Research Facilities in the Core Area of Wuhan "Univercity"

4.2 Connecting Universities with Industries to Set up the Whole Chain of Innovation

As the major physical spaces for innovation activities, incubators will play the determinant role of transforming educational resources into urban innovation competitiveness. Based on the key disciplines of universities and dominant industries of cities, corresponding innovation spaces will need to be provided to complete the whole chain of innovation.

Learning form experiences of innovation spaces home and abroad, it has been proposed that the whole chain of innovation including nurseries, incubators and accelerators needs to be built. On one hand, innovation nurseries especially for new-born start-ups are suggested to be located surrounding old residential areas, commercial facilities and offices, to which it will take 10 to 30 minutes from universities(see Figure 6). One the other hand, incubators for growing start-ups would be better to be located on the lands planned as industries and business with easy access. Accelerators for grown-up start-ups will be suggested to be located in industrial parks with abundant lands. Especially the scales and locations of platforms for innovation activities should be regulated so provide sufficient physical spaces to start-ups(see Figure 7). For the universities with key disciplines of human and social sciences, facilities of culture innovation, creative productions, creative consumption and entertainments should also be established surrounding the current historical districts and open spaces(see Figure 8). Creative industry clusters neighboring universities will be formed so as to provide spaces for the conversion of human and social science to creative industries and also redefine the culture identities of cities.

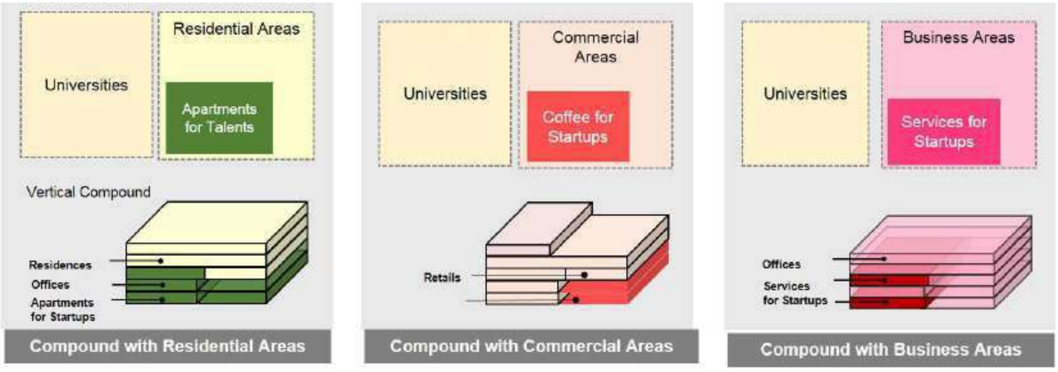

Figure6: Location Analysis of the Nurseries for New-born Start-ups

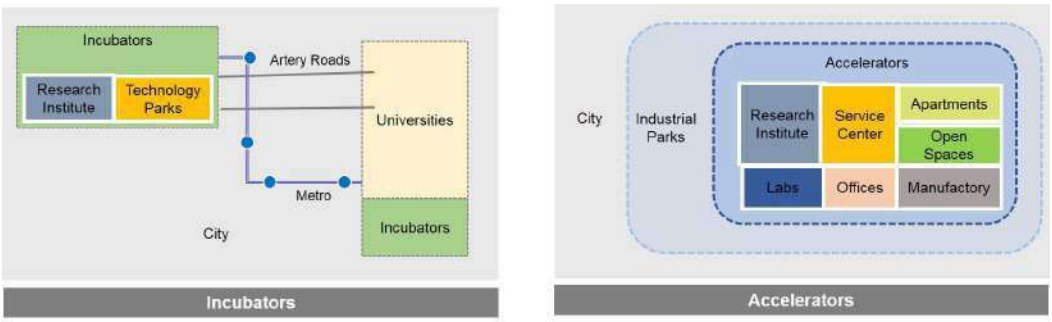

Figure7: Location Analysis of the Incubators and Accelerators

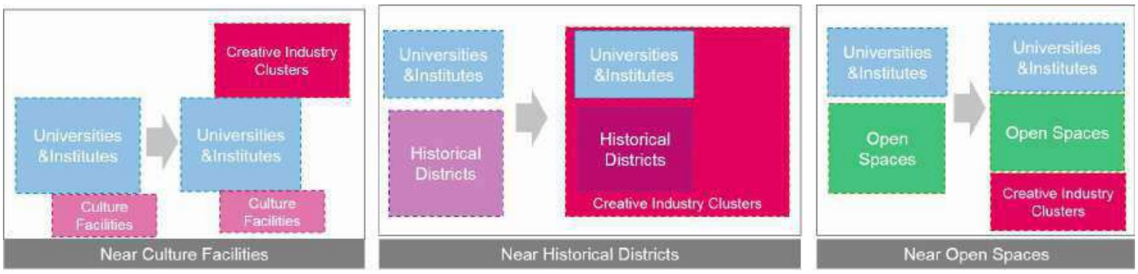

Figure8: Location Analysis of Creative Industry Clusters Surrounding Universities

Aiming at the problems of lacking research commercialization, innovation enterprises, job positions and venture capitals in the core area of Wuhan "Univercity", it has been proposed to layout the innovation spaces along with urban regeneration based on the key disciplines of universities and dominant industries of Wuhan. On one hand, nurseries for new born start-ups have been suggested to locate in old communities and factories neighboring universities. On the other hand, incubators for growing start-ups have been proposed to be located in areas with easy access of public transport. Also, accelerators for grown-up start-ups has been suggested to be locate in industrial parks with abundant land. Based on this, there will be a whole innovation chain from nursery, incubators and accelerators in accordance with the growth of start-ups from the north to the south and the east to the west(see Figure 9). Besides, seven creative industries districts and six innovation service centers has been proposed to be locate based on the social science and humanity disciplines and dominant industries.

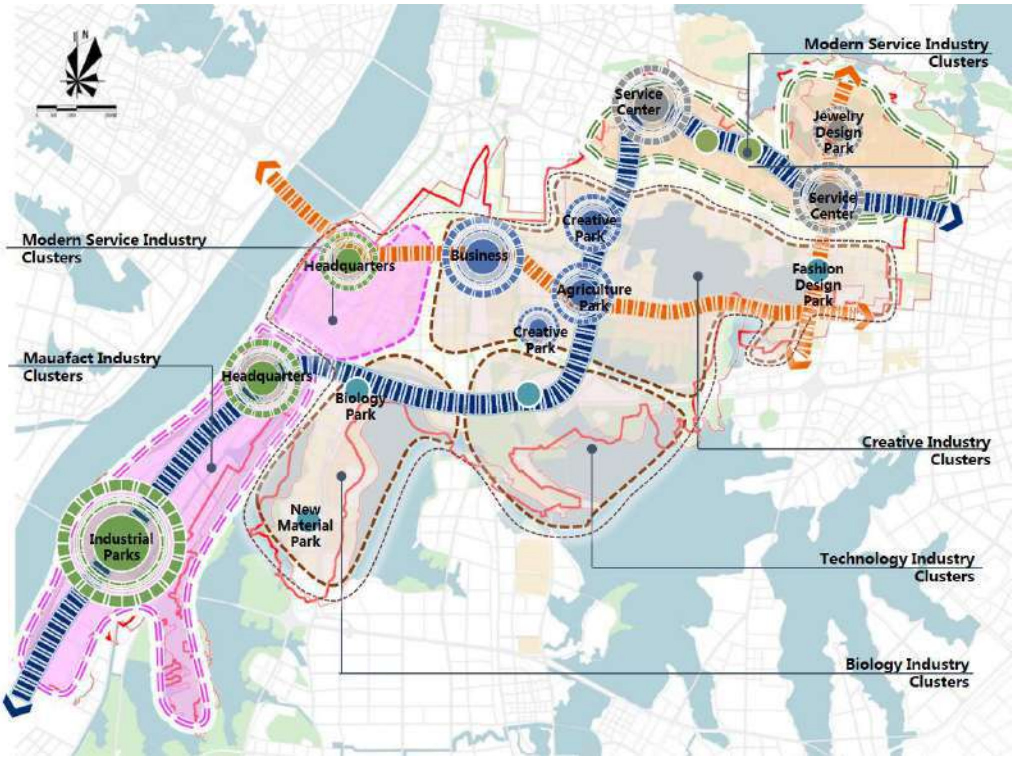

Figure9: Layout of the Industries in the Core Area of Wuhan "Univercity"

4.3 Connecting Universities with Cities to Share Service Facilities

Connecting universities with cities to promote the sharing of public facilities, open spaces, roads and municipal facilities will not only improve the quality of urban environments but also increase the city competitiveness of innovation and attraction for talents.

4.3.1 Providing the sharing spaces of public services

On one hand, activities centers, libraries and gyms in universities have been encouraged to be gradually open to the public with all kinds of culture activities organized in the weekends or holidays to improve the efficiency of campus facilities. Meanwhile, some of university facilities with large scale, high qualities and good accesses located in the areas with a shortage of public facilities would be suggested to be regulated as urban public facilities with incentive mechanisms of co-management between universities and governments. Taking the core area of Wuhan "Univercity" as an example, it has been proposed that the sharing percentage of service facilities in universities should reach the goal of at least 70% in 2020 and 100% in 2030. Once the facilities have been shared with the public, 60% of the residential areas will be covered with an improvement of service efficiency as large as 8 times(see Figure 10). Besides, three gyms of universities have been chosen to be reconstructed and invested by governments and regulated as the land use of urban sports facilities so as to improve the efficiency of lands.

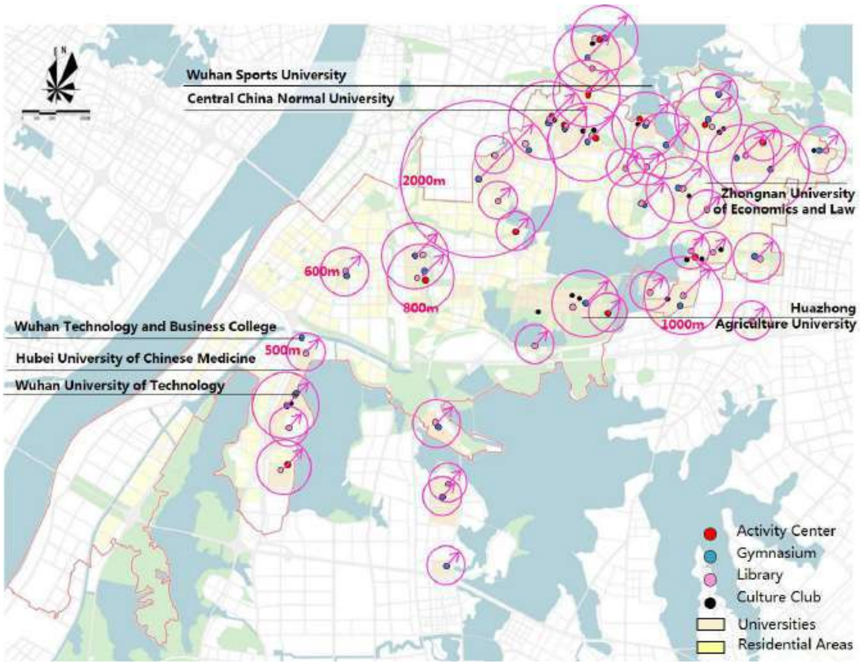

Figure10: Efficiency Analysis of the University Facilities in the Core Area of Wuhan "Univercity"

On the other hand, it has been proposed to focus on the features and provisions of service facilities according to the requirements of innovative talents. To meet the demands of college students, research service facilities which can provide functions including academic communications, talents apartments, retails, leisure, offices, exhibitions and sports have been proposed to be established in the built areas with low efficiency of land use surrounding universities. Not only the current public facilities have been proposed to be upgraded with corresponding incentive mechanism on land use and finance, but also high quality public facilities have been encouraged to supply with larger amounts(see Figure 11).

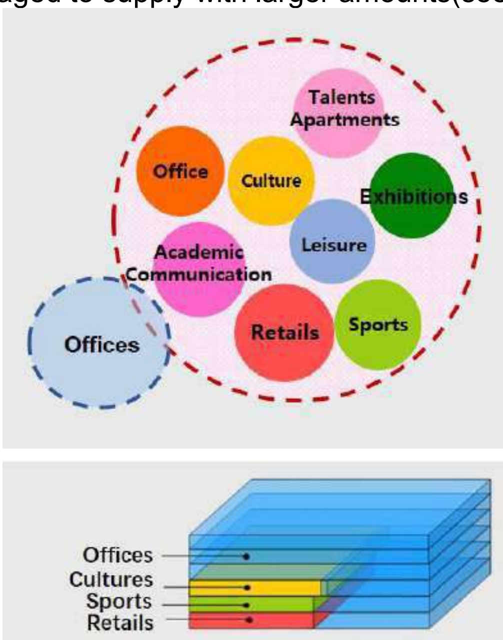

Figure11: Function Analysis of the Research Service Facilities in Universities

For the core area of Wuhan "Univercity" which can be divided into the upgraded district, the supplemented district and the new-built district according to the current public facilities, it has been proposed to build up six research service facilities including talent apartments and communication centers especially in the assembled areas of innovative talents, so as to solve problems of the failure to meet the demands of talents(see Figure 12). Especially for the urban regeneration aiming at building research service facilities, policies have been proposed to give a reward of 1.1 to1.3 times FAR. Meanwhile, building standards of schools and hospitals have also proposed to be improved so as to establish a high quality living circle of facilities within 15 minutes' walk distance.

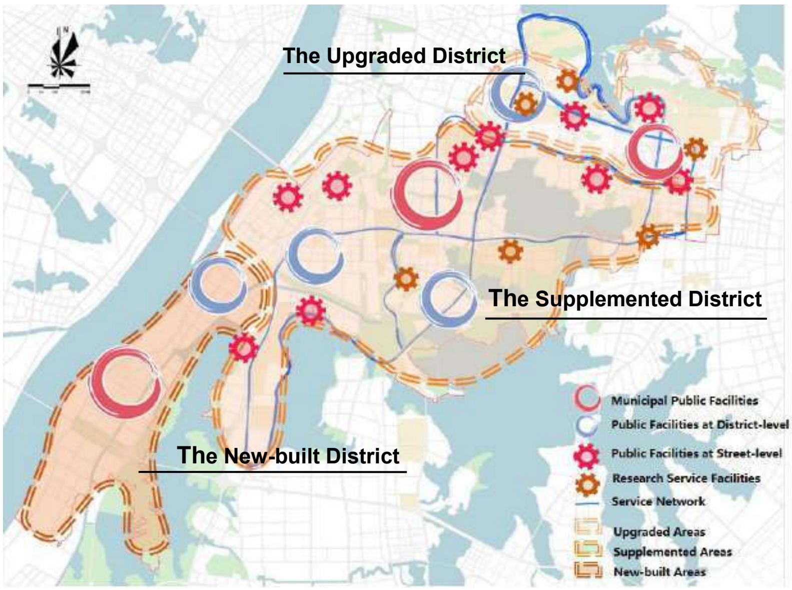

Figure12: Layout of the Public Facilities in the Core Area of Wuhan "Univercity"

4.3.2 Establishing a Green Network System of Transit

The historical spatial model of "Compound" has not only led to the isolation of network system but also urban diseases like failure of implementation. Therefore, campuses should be gradually opened without the influences on teaching and living activities in universities. Driveways should also be opened to the public with the slowing-down design so as to densify the networks and improve the efficiency (see Figure13). Besides, the system of public transport between universities including metros and buses has been proposed to be built to establish a special system of public transport door to door between universities (see Figure14).

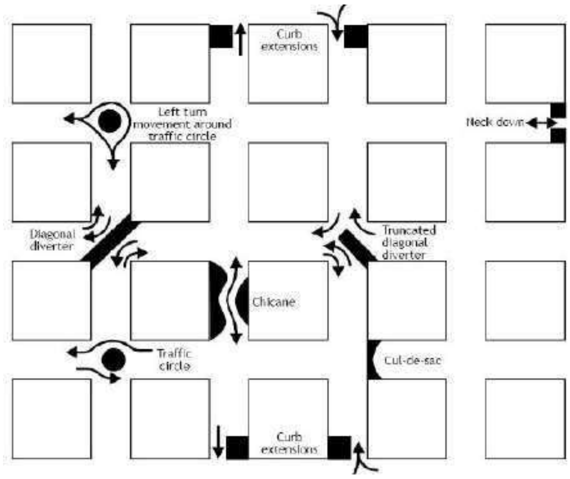

Figure13: Analysis of the Slowing-down Design

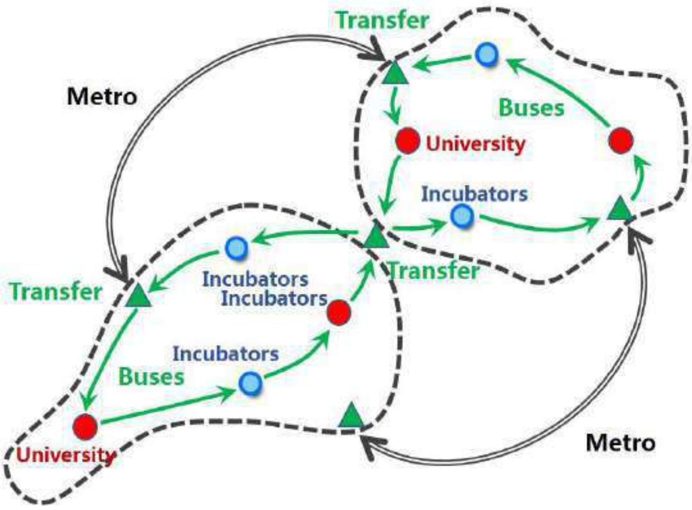

Figure14: Analysis of the public transport door to door between universities

Aiming at the problems including low densities of current networks, lack of minor roads and low efficiency of public transport, it has been proposed to add a new ring of metro surrounding the Wuhan "Univercity" and a special line of buses and water buses, so as to cover all the universities in the core area（see Figure 15）.

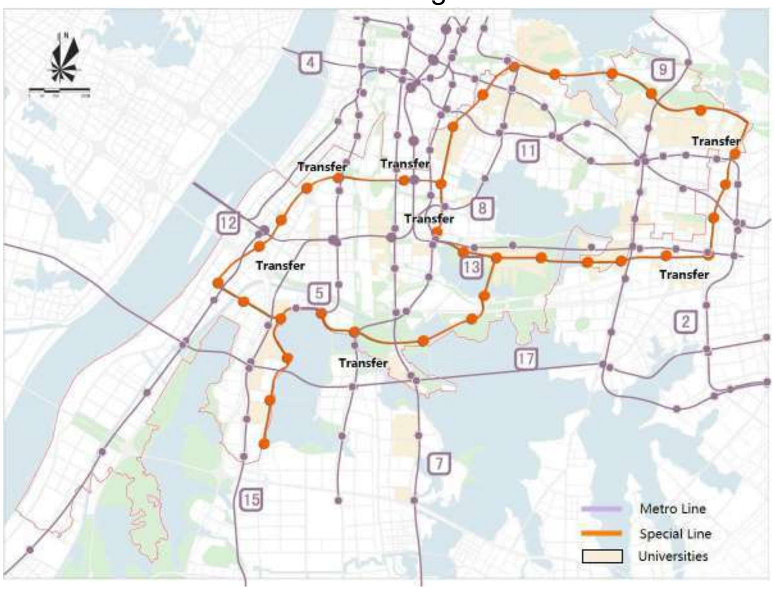

Figure15: Layout of the public transport in the Core Area of Wuhan "Univercity"

4.3.3 Establishing a Network of Open Spaces

Open spaces is not only the public domain for people to talk in informal ways but also the physical spaces to represent the image of the "univercity". On one hand, libraries, squares, green areas and sidewalks have been proposed to make full use of as the landscape node to present the natural and cultural image of universities. It has also been suggested that all kinds of college festivals should be planned and touring routes in campuses should be organized so as to promote the communications between universities and cities. On the other hand, pockets parks with scales ranging from 400 to 10000m^2 have also been proposed to be set around communities, universities, research facilities and other innovation spaces so as to provide spaces of informal communication for creative talents. Accordingly, green networks should be built surrounding mountains, lakes and universities so as to establish a system of landscape in and out of campuses and make the open spaces easy to access(see figure16).

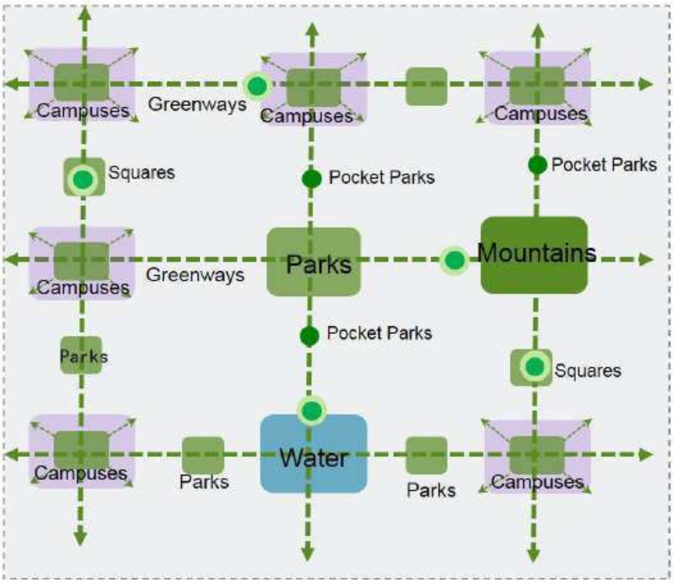

Figure16: Analysis of Open Spaces Network

To make full use of the nature landscape resources of the core area, it has been proposed to connect mountains with cities, link rivers with lakes and build water culture parks surrounding the six lakes, aiming at the problems of isolated landscape, insufficient green areas and obscure image identities(see Figure17). Surrounding universities, there will be loop of innovative culture and six identified areas with three featured touring routes as greenways along with mountains, lakes and universities, which will link the pocket gardens surrounding innovation spaces. Based on this, a network of ecology and culture to integrate cities, universities and nature landscapes will be built so as to rebuild the identities.

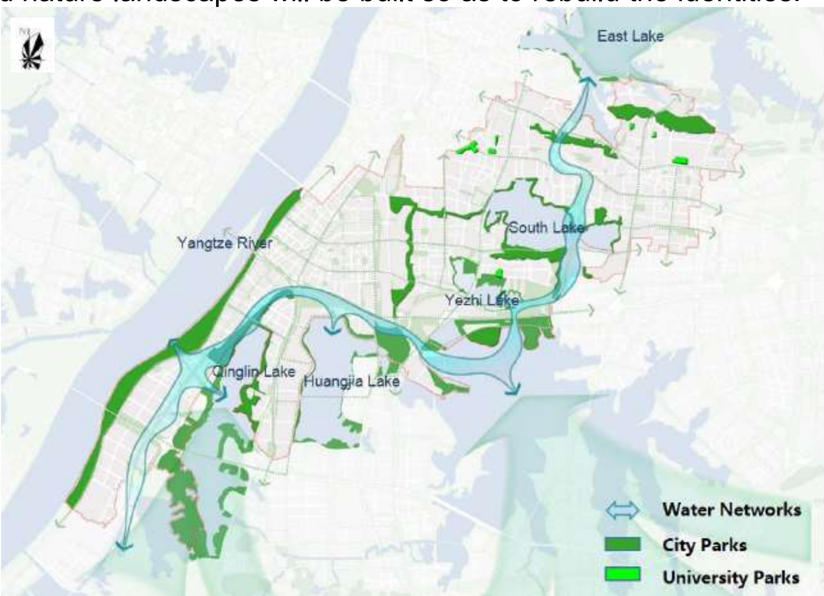

Figure17: Analysis of Open spaces in the Core Area of Wuhan “Univercity”

5. Conclusions

By comparing the historical experiences of universities reacting with cities home and abroad, this paper attempts to interpret the meaning of the “univercity” by both qualitative and quantitative methods, and discuss the spatial strategies by taking the core area of Wuhan “Univercity” as an example, so as to build theoretical and practical foundations for this topic.

One thing to be mentioned is that all the spatial elements of the "univercity" actually overlap each other, which may have been neglected in the discussion in order to analyze their spatial relations and layout requirements as well as define the spatial features. Therefore, it is suggested that a regulation system of indexes should be established especially for the "univercity". In this way, regulations for all the spatial elements of the "univercity" can be implemented in the statutory plans as well as master plans of universities so as to make guidance for environments building in and surrounding campuses. More importantly, the three aspects of the "univercity" do not only need physical spaces but also policies and systems. Therefore, more attention should be paid on the political innovation in the fields of land use, industries, talents, taxation, finance, research commercialization and intellectual property. It has been suggested to make further study on making land use policies and implementation measures as well as encouragement mechanism for sharing university facilities with the public. Influenced by the traditional ideologies, it is a long term process to make universities react with cities , but only the innovation of policy making would open the fences of ideologies.

Acknowledgements
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Endnotes

[1]There are 37 universities, 17 national labs and 594 thousand undergraduates which take up 46%, 59% and 50% of the municipality accordingly in the core area of Wuhan "Univercity" scaled at 134.66 km^2.

[2]See:http://www.most.gov.cn/mostinfo/xinxifenlei/fgzc/gfxwj/gfxwj2016/201612/t20161213_129574.htm;

[3]See: http://www.gov.cn/zwgk/2013-03/04/content_2344891.htm;

[4]See: http://www.gov.cn/zhengce/content/2016-08/08/content_5098072.htm ;

[5]According to Philip Nicholas Cooke, the first, second and third spatial elements of innovation cities are universities, incubators and service facilities.

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Analysis on the Working-Living-Entertaining Spatial Relations of New Towns based on Mobile Location Data: The Case of the National Independent Innovation Zone of East Lake in China

(How do New Towns Relate with the Main City in Working-Living-Entertaining Aspects)

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Synopsis
This paper offers some structural thoughts of people-centered planning models which are to optimize the space supply according to the current human activities. By using mobile location data, we do not only describe the current human activities and interpret the reasons underneath, but also analyze whether the current model of space use is sustainable and the future model of space supply is necessary to be changed.

1. Introduction

As the new-rising innovation districts all over the world shows, a remarkable shift is occurring that a great emphasis has been put on the integration of working, living and entertaining, which is reshaping the spatial geography of innovation. In China, there has been a mass birth of new towns aiming at developing innovation economies and evacuating over-crowded population from the main city. Due to their common development process, the industries of new towns are often more-developed than residential functions which are still highly dependent on the main city, let alone the leisure ones. In the early 21th Century, new towns have emerged in Wuhan following the *Wuhan Master Plan (2006-2020)* which has proposed the spatial structure composed of one main city, six new towns and multiple centers. At present, revision is being made to the original plan which is becoming due. It has been proposed in the *Wuhan Master Plan (2016-2035)* that three of the six new towns will be promoted as anti-magnetic forces more independent from the main city[2](see Figure 1). As one of the three towns, the National Independent Innovation Zone of East Lake(NIIZEL)which was established in 1988 has been undergoing the transformation from an industrial district to a self-contained new town specialized in innovation economies. Therefore, one of the key questions to be answered is whether the NIIZEL has got the foundations to be promoted as a more independent town, which sets the background for the research.

Figure 1: The Spatial Structure of Wuhan in the Wuhan Master Plan (2016-2035)

As a typical high technology new town, the NIIZEL has been planned to be composed of five functional clusters including the Western Research District, the Central Service District, the Eastern Technology District, the Northern Technology District and the Southern Technology District (see Figure 2). Except the Western Research District is a built-up area, the other four are all new areas in construction. Being in quite different phases of development, those five clusters have all been confronted with problems of lacking residential and leisure functions while the industrial function has been over-developed. Aiming at the goals of a self-contained new town, it is necessary to make reasonable guidance on the space supplies of the NIIZEL based on the current human activities, which location data can be used to describe. In the case of the NIIZEL, we collected location data from mobile devices to evaluate the current working, living and entertaining activities and identify their spatial relations between the new town and the main city, so as to propose suggestions to optimize planning in the perspectives of human behaviors. This paper offers some structural thoughts of people-centered planning models which are to optimize space supply according to the current human activities rather than populations we commonly rely on. By using mobile location data, we do not only describe the current human activities and interpret the reasons underneath, but also analyze whether the current model of space use is sustainable and the future model of space supply is necessary to be changed.

Figure 2: The Functional Clusters of the NIIZEL

2. Study and Methodology

2.1 Literature Review

Most of the previous research on the relations between new towns and the main city focused on the spatial analysis of working and living activities like comparing employment and residence densities by using economic and population census statistics (Niu, Ding and Song, 2017). Recently, there have been some research using cell phone data to record human activities and analyzing the relations of working and living by recognizing the employment-dense and residence-dense areas (Zhou, Liu and Zhu, 2018). These new emerging research has made up for the shortcomings of traditional data which often focus on the relations of spaces, and also established balance indexes such as the ratio of local employment to residence, etc[3](Zhen, Xu, Zhang and Yu, 2015). Generally, there have been certain foundations for the relations of working and living between new towns and the main city. However, there are actually three aspects of basic functions including not only working and living but also entertaining. The previous research has focused on the relations of working and living, but neglected the relations of working and entertaining, or living and entertaining, which would fail to provide sufficient evidences to evaluate the dependency of new towns.

2.2 Thoughts and Framework

Quite like cell phone data, location data from mobile devices are new emerging data which can not only record the activities of working, living and entertaining, but also can be obtained for a duration of time, so as can be used to analyze human behaviors. The relations of working, living and entertaining are influenced by the layout and transit of cities, which in reverse determines the spatial structure of cities (Zhen, Xu, Zhang and Yu, 2015). Therefore, it can play the roles of describing the current spatial structure and optimizing the future planning structure. Moving objects in cities especially like human and their behaviors are as important as still objects and if we do not know the flow, we can never define the evaluation standards of forms(Lynch,2001). Using location data from mobile devices by recording human behaviors, this paper attempts to follow the idea of people-centered planning which can be illustrated as that forms follow flows.

At first, location data from mobile devices can be used to describe current activities. Then the dense areas of working, living and entertaining activities were identified by analyzing the average densities, leading to a comparison about densities and area ranges between the new towns. After identifying the original and influential areas of the working, living and entertaining activities in the NIIZEL, we analyzed the relating directions, strengths and lengths among the original, influential and functional areas themselves. On the basis, an overall evaluation of the amounts, balance indexes and influencing ranges in different scales can be made on the relations of those three functions between the NIIZEL and other areas, which can be compared with the current and planned land use. In this way, problems can be discovered in the space supply, and evidences can be provided to optimize the current master plan scheme. By analyzing the differences between human activities and current spaces, whether the future model of space supply is sustainable can be determined, so as to provide suggestions to optimize the existing planning schemes, which can be considered as an upgradation for the traditional planning thoughts.

2.3 Data Processing

With the location data from mobile devices during five weekdays of 2017, this study has collected and cleaned almost 11 million samples from more than 2.5 million mobile devices in the municipality of Wuhan. In this way, the activity ranges of working, living and entertaining can be defined by setting the standards of occurrence frequencies. For instance, the locations with the occurrences of mobile devices staying in the radius of 1000 meters from 9 to 12 o'clock which reach above 60% can be included in the range of working activities. Likewise, the locations with the occurrences of mobile devices from 19 to 21 o'clock and from 22 to 24 o'clock can be included in the range of entertaining and living activities separately.

3. Research Contents

Based on the statistic of the current residents and employees in the NIIZEL, the activities of living, working and entertaining have been analyzed in the aspects of distributions, relations and comparison with current land use. Then an overall evaluation has been made from the aspects of amounts, balance indexes and influencing ranges, so as to provide suggestive guidance for the planning optimization.

3.1 Current Population

Till the end of 2016, the number of residents in the NIIZEL has reached almost 1.08 million, taking a percentage of 9.8% in the municipality. With the immigrant amounts and resident density ranking top, the NIIZEL has become the area with the rapidest growing population and the largest amount of young people in Wuhan. Besides, the NIIZEL with a number of employees reaching 0.55 million and taking a percentage of 13% in Wuhan, has the densest job positions in Wuhan. Although the NIIZEL has played a key role of the economic development in Wuhan, the current ratio of local employees to residents has only reached 0.63, which is below the acknowledged standard of 0.8(Cervero,1989&1991). With a quite unbalanced distribution, more than 80% of the populations of the NIIZEL have been centralized in the Western Research District (see Figure 3).

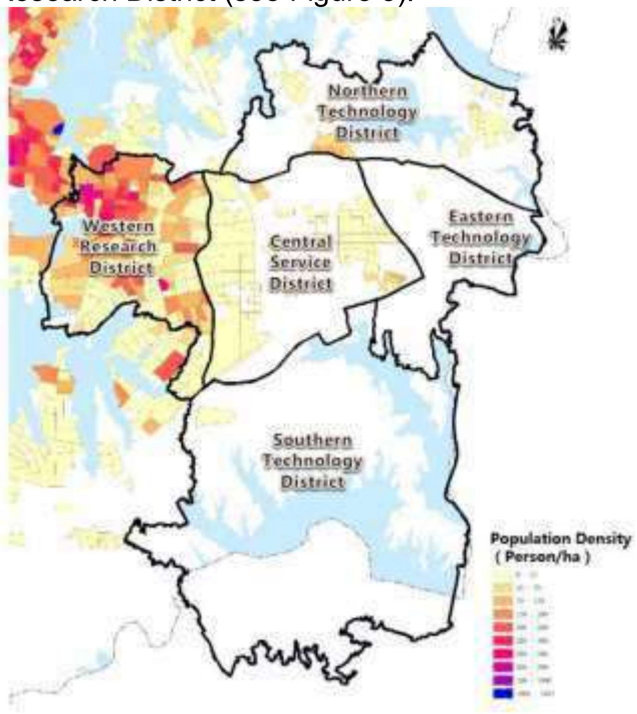

Figure 3: The Population Density Analysis of the NIIZEL

3.2 Activity Ranges

According to the location of mobile devices in the NIIZEL in the designated time, the average and maximal densities of living, working and entertaining activities can be demonstrated by grids of 100m*100m.Then the areas with higher densities in the level of significance by 5% can defined as working-dense areas, living-dense areas and entertaining-dense areas (see Table1 and Table 2). Based on this, the percentage of people coming to the NIIZEL from all the other places in the municipality engaging in all activities can also be defined. Once the percentage reaches above 50%, the places will be considered as the influencing areas of the NIIZEL.

Table 1: Analysis on all the activity-dense areas in the Municipality

Name	Working-dense Areas			Living-dense Areas			Entertaining-dense Areas		
	Percent	Average Density (person /k ㎡	Maximal Density (Person /k ㎡)	Percent	Average Density (person /k ㎡	Maximal Density (Person /k ㎡)	Percent	Average Density (person /k ㎡	Maximal Density (Person /k ㎡)
The NIIZEL	9.59%	153.4	8205.7	11.54%	207.4	11472.1	2.28%	32.2	1998.5
Airport Economic Zone	6.33%	102.9	7643.7	8.65%	137.4	7842.6	1.49%	26.3	2193.0
Economic Development Zone	3.91%	74.4	4068.6	6.12%	101.4	7145.9	0.78%	17.1	1041.5
Southern New Town	6.09%	102.9	6531.1	7.95%	147.6	9698.6	1.51%	23.6	1305.8
Eastern New Town	2.04%	46.1	3995.0	3.16%	57.3	5603.6	0.26%	9.8	941.2
Western New Town	6.35%	108.9	2080.2	9.84%	147.6	3055.8	0.87%	25.4	791.5
Main City	44.20%	683.4	12049.2	48.97%	907.5	14412.1	16.34%	143.5	3461.8

Table 2: Analysis on all the activity-dense areas in the NIIZEL

Name	Working-dense Areas			Living-dense Areas			Entertaining-dense Areas		
	Percent	Average Density (person /k ㎡	Maximal Density (Person /k ㎡)	Percent	Average Density (person /k ㎡	Maximal Density (Person /k ㎡)	Percent	Average Density (person /k ㎡	Maximal Density (Person /k ㎡)
Western Research District	88.14%	882.7	8205.7	84.63%	1102.9	10791.2	97%	169.25	3461.83
Central Service District	7.75%	73.0	3143.2	9.47%	83.4	6413.4	2%	15.26	857.24
Northern Technology District	2.18%	27.9	2585.5	2.95%	33.2	2455.5	——	5.12	478.81
Eastern Technology District	1.45%	19.0	1256.0	2.11%	24.6	1968.2	——	4.17	546.44
Southern Technology District	0.48%	4.5	2722.9	0.84%	6.2	5863.5	——	1.05	382.01
Main City	--	683.4	12049.2	48.97%	907.5	14412.1	——	143.5	3461.8

3.2.1 Working activities

According to the statistics of working-dense areas in the municipality, the scale of the NIIZEL ranks the second with the highest number of area percentage, average and maximal densities. Especially the maximal density of the NIIZEL has reached 1.5 times the one ranking second, which indicates its key role in industrial development (see Figure 4). For all the functional areas in the NIIZEL, the working-dense areas also demonstrates the over-centralized distribution with close to 90% of working activities gathering in the Western Research Area which has the average and maximal densities far above the others (see Figure 5). By comparing the working-dense areas with the maps of enterprises and the current land use, it is evident that there have been unofficial industrial spaces in residential lands with low cost of rents, which can offer finance, information and technology services for medium and small companies. Besides, the industrial lands have the largest area of working-dense areas but with the lowest maximal and average densities, which indicates the inefficiency of industrial land use. While the commercial lands have the highest maximal and average densities, the business lands have much lower densities close to the industrial lands due to the vacancy of current office buildings.

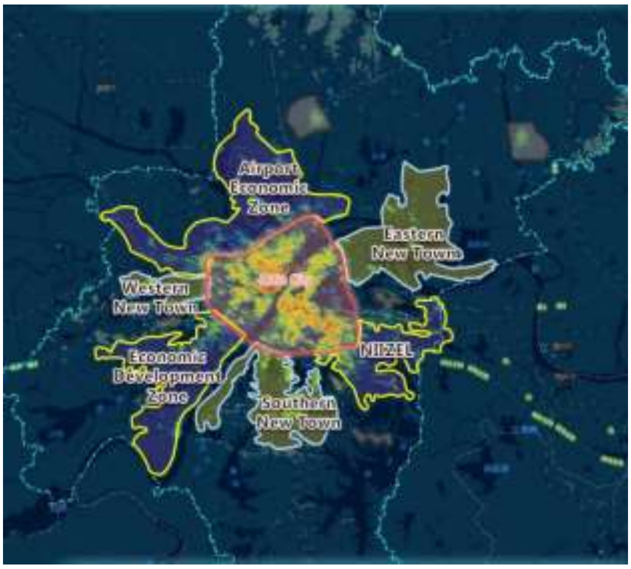

Figure 4: Analysis on the Working Activities in the Municipality

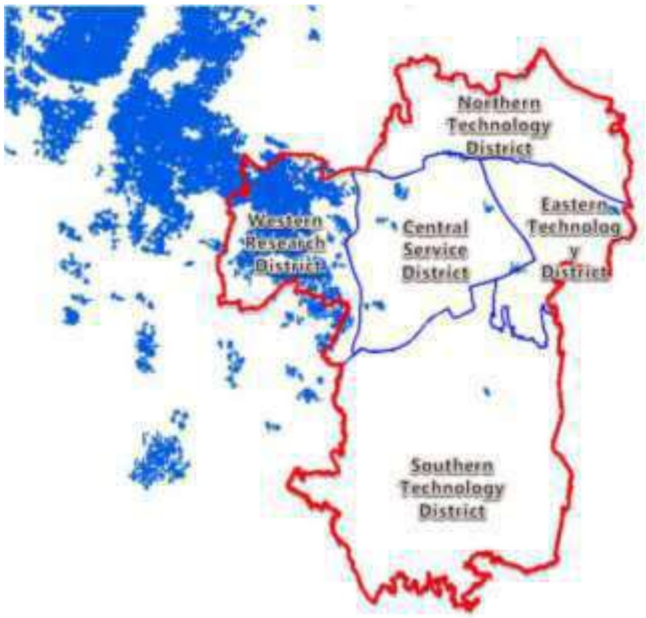

Figure 5: Analysis on the Working-dense Areas in the NIIZEL

It is evident that most of the people working in the NIIZEL come from the neighboring districts, which makes up a large portion with the percentage ranking the second in the municipality. By analyzing the influencing areas, it is estimated that almost 80% of the people working in the NIIZEL live in the circle at a radius of 15km and especially in the circle of 5-10km, which will take an hour to drive. Also there is also 10-20% of the people living almost 3 hours' drive from work, which indicates the strong force of long-distance employment of the NIIZEL. Except the Central Service District, all the other four districts have higher local residential ratios to employment than the average level of the municipality, which also indicates the lack of residential attraction for local employees in the Central Service District. The first choice where people working in the NIIZEL will live in is the Western Research District with its strong connection with the Central Service District. For the Western Research District itself, the ratio of local residence to employment is relatively higher than the other four districts, with a stronger connection outside of the NIIZEL than inside.

For the people working in the NIIZEL, the ratio of local leisure to employment is far behind to residence. Not only do people working in the NIIZEL tend to go entertaining in the neighboring districts and are also willing to drive relatively longer distance for leisure. All the five districts of the NIIZEL have lower ratios of local leisure to employment than the average level of the municipality, which indicates the lack of service functions. The first choice where people working in the NIIZEL will entertain themselves is also the Western Research District with a stronger connection outside of the NIIZEL than inside.

3.2.2 Living activities

Compared with the working activities, the current living activities of the NIIZEL have a larger scale and bigger spatial agglomeration. The scale of the current living-dense area ranks the second in the municipality with the percentage, average and maximal densities ranking the top among the new towns. Especially the maximal density of the NIIZEL is close to the main city and much higher than the other new towns (see Figure6). With a match to the distribution of local residents, the densities of current living activities of built-up areas and new areas are quite different. Especially the current living-dense activities of the Western Research District have larger scales than working-dense activities, with higher average densities than the main city. However, new areas like the Central Service District and the Eastern Technology district are lack of residents and thus have lower densities of living activities due to the implementation of residential lands (see Figure 7).

For the people living in the NIIZEL, the ratio of local employment is relatively higher, which indicates the residential function along with the strong force of employment. Due to the cost and distance, most of the people living outside of the NIIZEL will choose the neighboring districts. It is also estimated that almost 80% of the living activities stay in the circle at a radius of 15km and especially assemble in the circle at a radius of 5-10km.Compared with the working activities, the living-dense areas has been distributed more evenly with a weaker long-distance force than employment. Specifically, there is a higher ratio of local employment for the people living in the NIIZEL, which is higher than the average level of all the other new towns. The top choice that the people living in the NIIZEL will make to work in has proved to be the Central Service District, which indicates its strong force of employment. For the Western Research District, there is a smaller number of people living locally who choose to work outside of the district than people working locally who choose to live outside of the district, which indicates its strongest force for employment. Meanwhile, there is a larger ratio of local leisure to residence than to employment, which ranks top among all the new towns in the municipality. Especially, the Northern Technology District and the Central Service District are well-established with service facilities for residents. Most of the people living in the NIIZEL will choose to entertain in the Western Research District which proves to supply most of the leisure spaces.

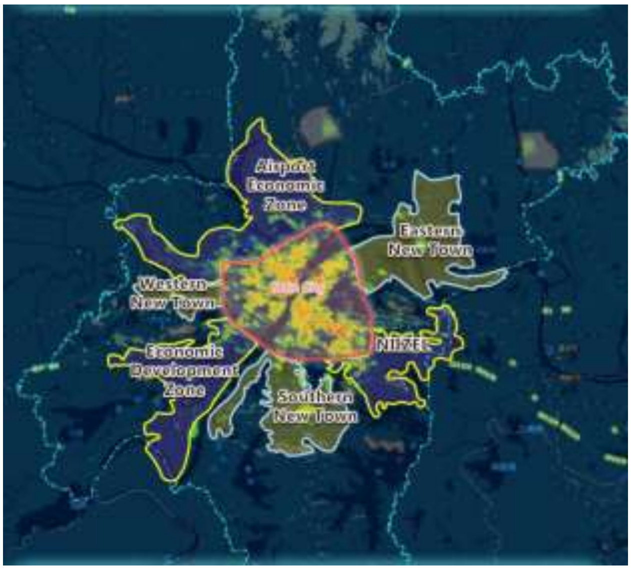

Figure 6: Analysis on the Living Activities in the Municipality

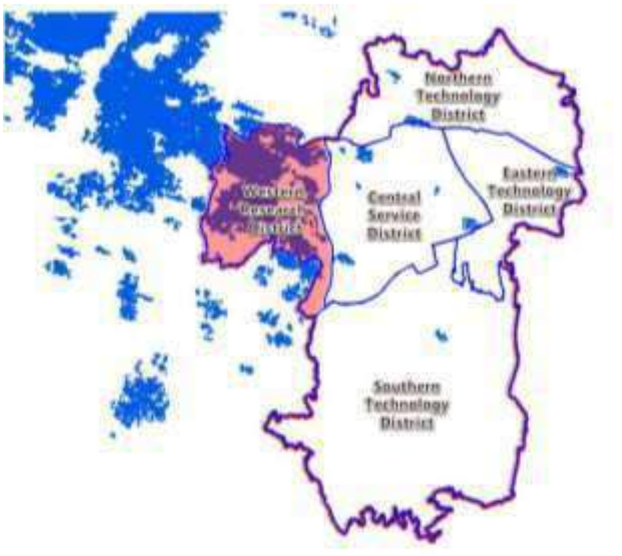

Figure 7: Analysis on the Living-dense Areas in the NIIZEL

3.2.3 Entertaining activities

Compared with working and living activities, the scale of current entertaining activities in the NIIZEL is obviously smaller, which indicates the lack of service functions. Although the percentage of entertaining-dense areas and their average densities rank the top among all the new towns, but are much lower than the main city (see Figure 8). Close to 97% of entertaining-dense areas are centralized in the Western Research District with the average and maximal densities high above the main city. By comparing the entertaining-dense areas with the spatial distribution of current retail facilities, it is evident that there have been a large number of entertaining activities in the non-commercial areas of the Western Research District, which can be considered as unofficial spaces of leisure. On the contrary, new areas like the Central Service District have lower densities of entertaining activities due to the failure of implementation of commercial lands (see Figure 9).

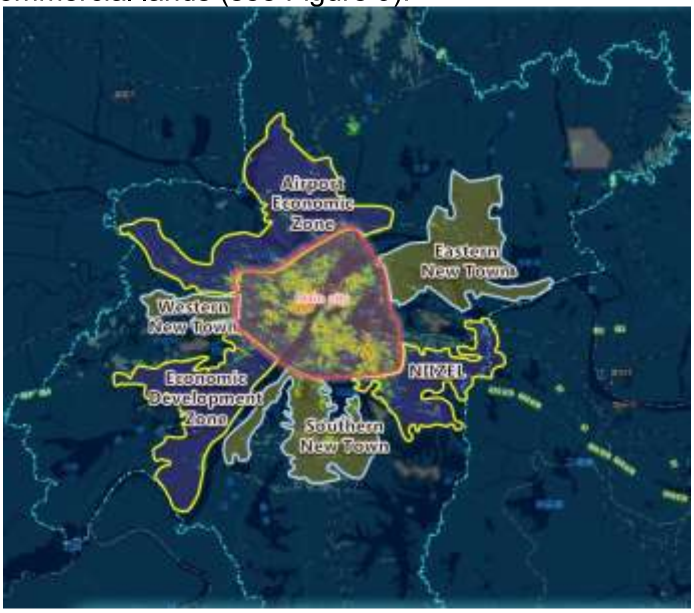

Figure 8: Analysis on the Entertaining Activities in the Municipality

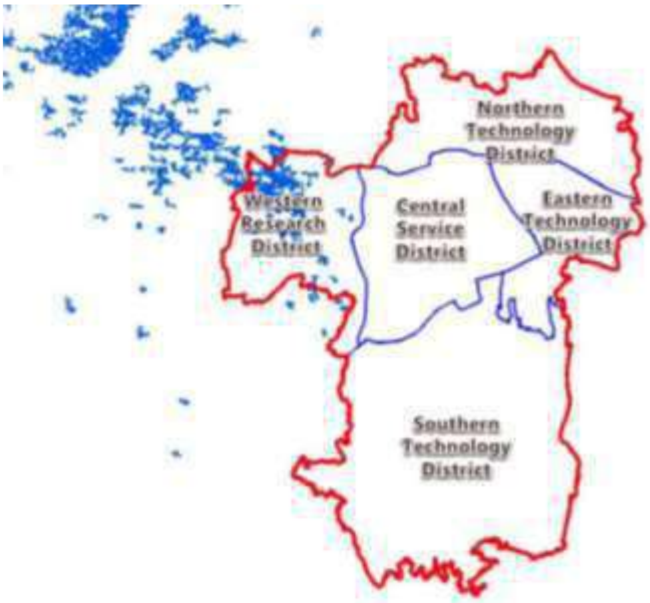

Figure 9: Analysis on the Entertaining-dense Areas in the NIIZEL

Quite unlike the ratio of local leisure to employment, the ratio of local employment to leisure ranks the bottom among the new towns, which indicates that the local service facilities of the

NIIZEL lack of influences. All the functional clusters have relatively low ratios of local employment to leisure, especially new areas like the Central Service District, the Eastern Technology District and the Northern Technology District. Most of the entertaining activities in the NIIZEL are undertaken by the people working in the Central Service District, which proves to be the most service-insufficient cluster. Although there has been a strong force of the service facilities in the Western Research District for the people working in the Central Service District, it still lacks of attraction for people working outside of the NIIZEL.

On the other hand, the ratio of local residence to leisure ranks ahead of most of the new towns, which indicates its stronger influences of service facilities for residents. Although there is an obvious difference in the efficiency of leisure functions for every cluster, the ratios of local residence to leisure for new areas are quite low. Planned as the central activity zone in the NIIZEL, the Central Service District fails to provide leisure functions for people living there who end up going to the other clusters. And the Western Research District proves to be the first choice where people living in the other four clusters who will go to entertain themselves, which indicates the district has equal influences of leisure between employment and residential functions. By analyzing the influencing areas of the leisure function of the NIIZEL, it is evident that more than 80% of the entertaining activities can attract people living and working in the circle at a radius of 15km. More specifically, they are centralized in the circle at a radius of 5km, which indicates that distance is a major factor for leisure function.

3.3 Overall Evaluations

From the scales of the municipality, functional clusters and plots of the NIIZEL, overall evaluations have been made in the aspects of amounts, influencing areas and balance indexes of the working, living and entertaining activities, so as to provide suggestions for the space supply of future activities.

3.3.1 Amounts

The amounts of working, living and entertaining activities can be used as indicators to evaluate the basic functions of employment, residence and leisure. For the NIIZEL, the amounts of working, living and entertaining activities all rank the second among all the new towns. On one hand, the amount ratio of working to living activities is close to 1, which is to some extent different from the amount ratio commuted by populations. On the other hand, the amount ratio of working to living and entertaining is fall behind other new towns, which indicates the lacking of leisure functions (see Figure 10). Specifically, there is quite a difference in the amounts of working, living and entertaining activities for every functional cluster. The entertaining activities of the Western Research District is relatively small to working and living, while the other four districts are all underdeveloped in all the activities (see Figure 11). By comparing the working, living and entertaining activities of every plots, evaluations can be made on the degrees of muti-functions. It is evident that the muti-functional plots have been centralized in the Western Research District while plots of the other four districts are mostly single-functioned. Considering the overall ratio of implementation to plan schemes has reached above 70% with the industrial functions overdeveloped than residential and leisure functions, it has been proposed to improve the degree of muti-functions for every plot unimplemented as plans so as to keep up the supplies of service facilities with rapid urbanization.

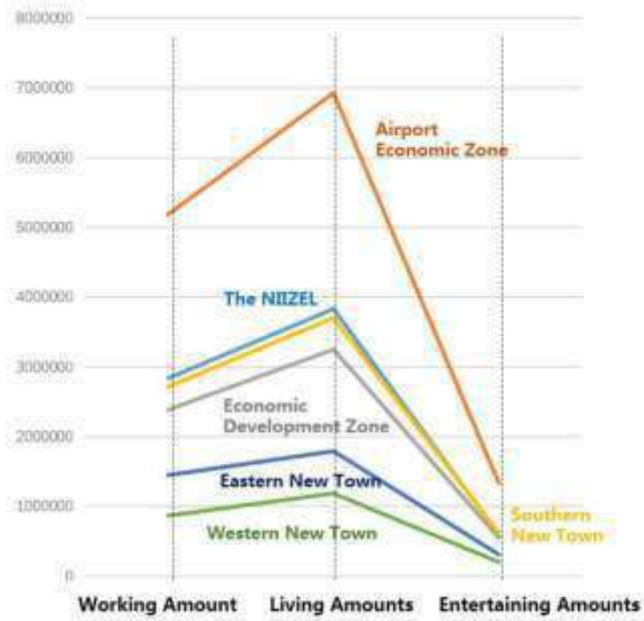

Figure 10: Analysis on the Activity Amounts in the Municipality

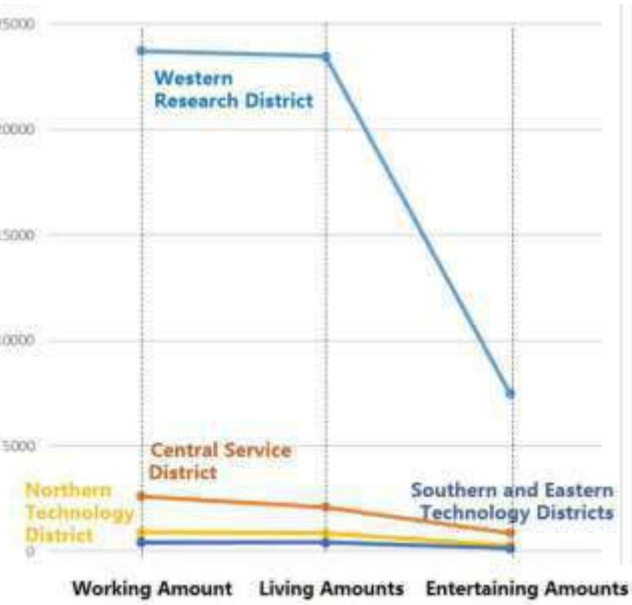

Figure 11: Analysis on the Activity Amounts in the NIIZEL

3.3.2 Influencing ranges

The influencing range can be an important indicator to evaluate the attraction and influence of some function. It is evident that the influencing ranges of the current working, living and entertaining activities are all to the south of the Yangtze River, with their amounts and ranges decreasing one by one. The working activities have the strongest pull for long-distance employment, while the living activities are more dispersed and the entertaining activities are more influenced by walk-able distances. With the implementation of the master plan, the center of the NIIZEL will move to the east. In that case, not only the influencing range of the working activities will enlarge further due to the long-distance attraction, but also the entertaining activities will probably expand the outer ring and shrink the inner ring, leading to more long-distance commutes (see Figure12). Considering the lack of regional transit for the NIIZEL at present, it is proposed that the transport planning need to be optimized at a larger scale.

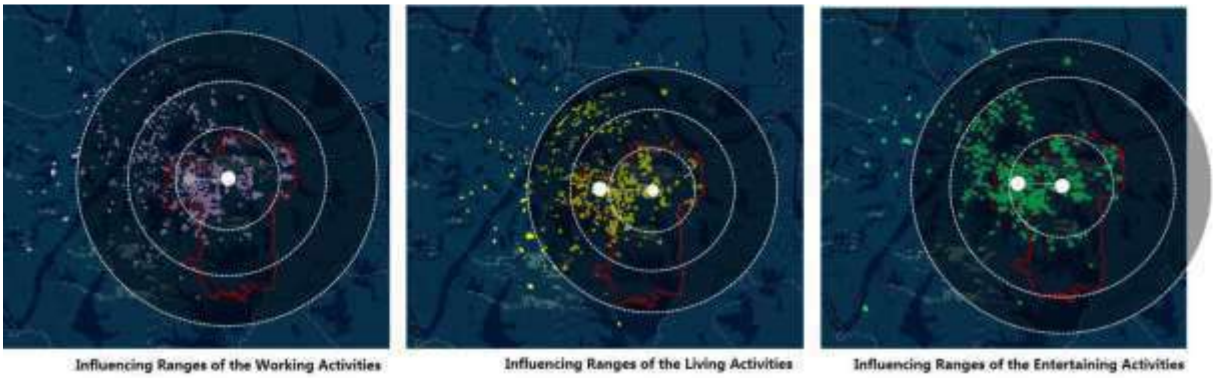

Figure 12: Analysis on the Influencing Ranges of Activities in the NIIZEL

3.3.3 Balance indexes

As an indicator to reflect the relations between the functions, balance index has been commuted as the ratio between every two of the three activities namely working, living and entertaining, which can be used to evaluate the development of new towns[4]. Except the ratios of local residence and leisure to employment are relatively low, all the balance indexes reached above the average levels of the new towns (see Figure13). Among these, the ratio of local employment to residence proves to be the highest, while the ratio of local leisure to employment is the lowest. Especially the Central Service District and the Northern Technology District which can offer large amounts of opportunities for employment though are underdeveloped with their residential and leisure functions (see Figure14). It is also evident that the Western Research District, as the connection node between the NIIZEL with other new towns, has confronted with a series of urban diseases due to its role as the only gateway. Considering the weak links between the NIIZEL with other areas and between the functional clusters, it is supposed that balances between working, living and entertaining should be kept at a smaller scale in every functional cluster or every plot. Following the standards of appropriate commuting distances between working and living as well as between living and entertaining[5], evaluations have been made for every plot of the NIIZEL from the aspects of local residence to employment, local leisure to residence and local leisure to employment (see Figure15). It is evident that the balance index of local residence to employment is relatively higher than the ratios of local leisure to residence and to employment.

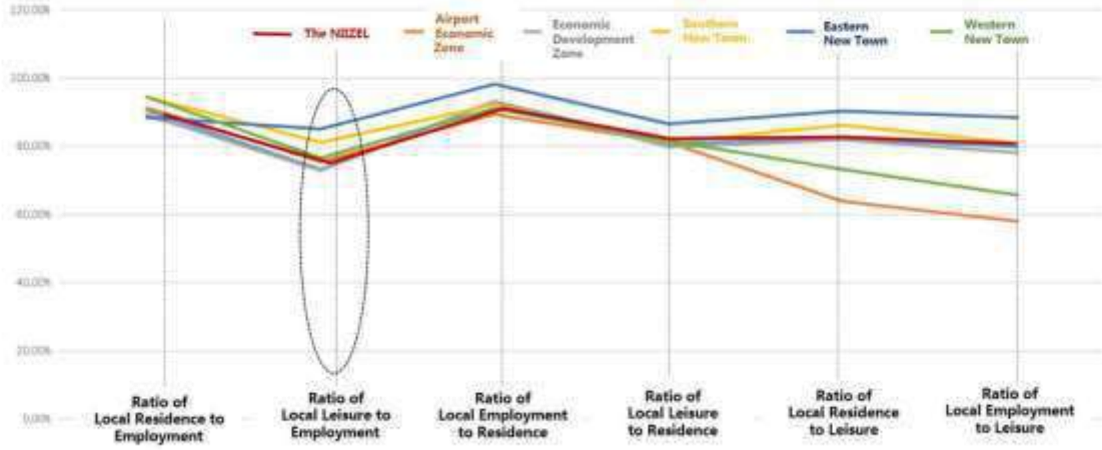

Figure 13: Analysis on the Balance Indexes of the New Towns

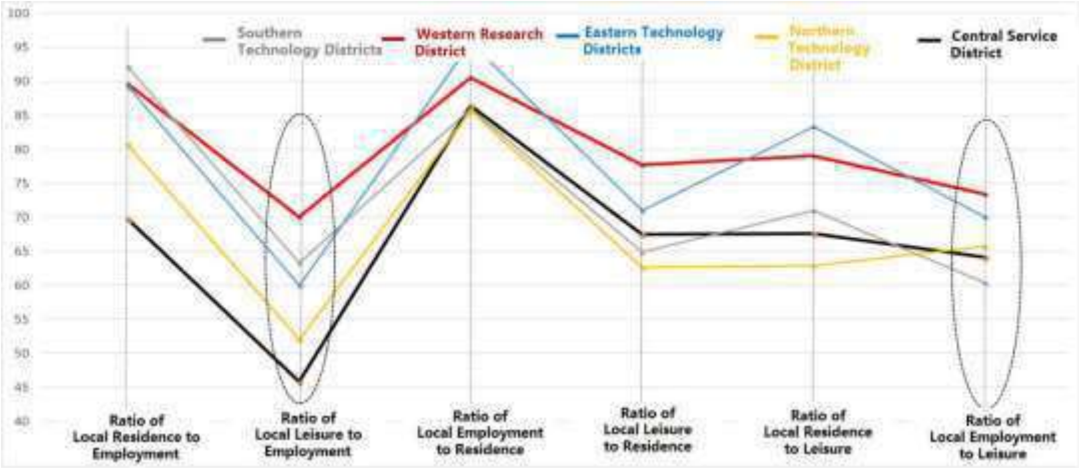

Figure 14: Analysis on the Balance Indexes of the Functional Clusters in the NIIZEL

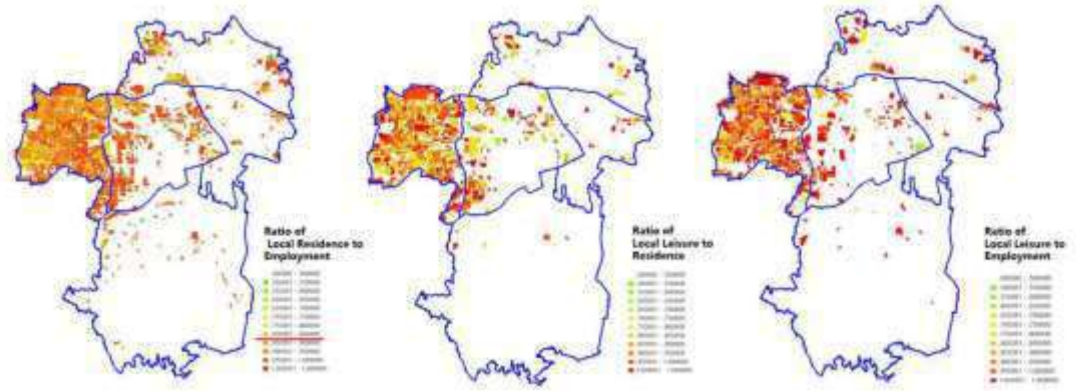

Figure 15: Analysis on the Balance Indexes of the Plots in the NIIZEL

4. Applications of the Results

By the evaluations of amounts, influencing ranges and balance indexes, it is evident that the NIIZEL has the foundations to be promoted as a more independent town. And strategies have been given at different scales to optimize planning as the applications of the results.

4.1 Strategies at the Scale of the Municipality

By analyzing the amounts of current working, living and entertaining activities, it is evident that the NIIZEL ranks far head of the other new towns and proves to be one of the major new towns in the whole municipality but with limited access. Thus the strategies at the scale of the municipality should focus on the regional functional balances to improve the access of the NIIZEL. It is proposed to improve the role of the NIIZEL further in the long-term plan and the NIIZEL should be integrated with its neighboring district considering their close connections. On one hand, the functional axes between the NIIZEL and other new towns as well as the main city should be re-stressed in the existing master plan of the municipality, so as to establish an innovation system centered at the NIIZEL. On the other hand, rapid transit including highways and metros between the NIIZEL and other new towns as well as the main city has also been suggested to make, so as to deal with the future change of the influencing ranges of human activities.

4.2 Strategies for Every Functional Cluster at the Scale of the NIIZEL

Considering the underdevelopment of functions in every cluster of the NIIZEL and the role of the Western Research District as the only gateway, it has been proposed that multiple connections should be set up between every functional cluster of the NIIZEL. Thus the strategies at the scale of every functional clusters in the NIIZEL are proposed to focus on the structural function balances by remaking connections. Based on the existing plans, suggestions have been made about adding two north-south axes on both sides of the original axis and stressing the connections between the clusters. Taking references from other innovation districts, it has been proposed that the functional clusters should be recategorized as knowledge innovation, technology innovation and service innovation models. Besides, all kinds of service centers should be added in every cluster so as to improve the rate of local leisure to employment and residence. According to the statistics of the implementation, the original spatial structure of facilities should also be optimized by upgrading the service facilities for living and adding more service facilities for working.

4.3 Strategies for every plot at the Scale of the NIIZEL

According to the evaluations at the scale of every plot in the NIIZEL, it has been proposed to stress the function balances at human scales by improving the degrees of muti-functions. Based on the current land use, missing functions have been proposed to add to the lands which haven't been implemented as plans and transits have been also suggested to rebuild for the plots with functional connections but lack of access. Then following the latest regulations on land use, optimizing work can be done by regulating the muti-functions of every plot in accordance with the regulatory plans. To fulfill the goals of function balances at human scales, the spatial modes of innovation cells have been proposed and further study will be made to give instructions on land use planning.

5. Conclusions

By using location data from mobile devices, this study attempts to analyze the spatial distributions and relations of the working, living and entertaining activities, so as to reflect the features of human behaviors. After comparing the human activities with the current and planned spaces, it proposes corresponding strategies at different scales so as to play the role of optimizing spatial supplies. As a supportive study for the Master Plan of Wuhan, some suggestions has been absorbed into the undergoing plan so as to give further instructions. Meanwhile, this study also gives a structural framework on the Wuhan Planning Lab[6], so as to play the role of evaluation, monitoring, warning and dynamic regulations. It is also necessary to mention that there is some shortcomings and problems with the data processing. On one hand, the data can only be used to recognize human activities by common senses due to the lack of behaviors information. On the other hand, the statistics can only be used to compared with and need to be expanded with a larger sample.

Acknowledgements

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Endnotes

[1]Han ZOU is the corresponding author, email zouhangogo@qq.com .

[2]It has been proposed that there will be six new towns in the spatial structure of *Wuhan Master Plan (2006-2020)*, including the NIIZEL, Airport Economic Zone, Economic Development Zone, Eastern New Town, Southern New Town and Western New Town. In the Wuhan Master Plan (2016-2035), the NIIZEL, Airport Economic Zone and Economic Development Zone has been promoted as anti-magnetic forces more independent from the main city.

[3]The balance indexes have been established such as the ratio of local employment to residence and the ratio of local residence to employment. The former indicates the ratio of residents who working in a certain range to the residents, while the latter means the ratio of employees who living in a certain range to the employees.

[4]Based on the concepts like the ratio of local employment to residence and the ratio of local residence to employment, this study proposed balance indexes like the ratio of local leisure to

employment, the ratio of local leisure to residence, the ratio of local residence to leisure and the ratio of local employment to leisure.

[5]It has been proposed in the *Research on the Distribution of Current Population and Balance of Local Employment to Residence in Wuhan* that the appropriate distance between working and living is 12km and the one between living and entertaining is 15minites' walk.

[6]Wuhan Planning Lab, funded by Wuhan Planning Bureau, is an intelligent decision-making platform by using big data to describe human activities, monitor city functions, simulate urban systems and predict future space supplies.

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Landscape as a service. The potentials of integrating different approaches

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Abstract

The social and environmental changes that characterize our time and the awareness that has increasingly emerged about their causes, have led to a deeper consideration of the importance of landscape, not just as perceptible expression of the nature but as a provider of services, well being and sense of identity for people. In this sense, the landscape has to be conceived and managed as a driver of regeneration for rural and peri-urban regions. However, the historically transdisciplinary concept of landscape is still the object of a number of different approaches that make its evaluation and management uncertain and varied. The European Landscape Convention (ELC, 2000) is a milestone in the evolution of the meaning of landscape and an attempt to define a European comprehensive vision of the matter. At the core of the ELC definition is the landscape as "interaction of natural and/or human factors", defining it as the junction between the natural-ecosystemic sphere and the anthropic-cultural one. The contribution reports the preliminary results of a doctoral research in progress, whose main objective is to define an innovative methodology for the integration of landscape management in planning policies and practices at regional and local levels, strengthening its strategic role as socio-cultural service and as conveyer of ecosystem services. To this aim, a bibliographic analysis of the concepts of "Cultural Landscape" and "Cultural Ecosystem Services" has been carried out in order to underline the intersections and the differences between them. This conceptual framework has built the basis for a comparative analysis of a range of methods and tools for the interpretation and assessment of landscape, deriving from different approaches and disciplines.
Starting from the results of this analysis, the paper investigates the potentialities of an integrated approach to landscape assessment and management, drawing up a methodology for the integrated evaluation of the landscape.

1. Introduction

The social and environmental changes that characterize our time and the awareness that has increasingly emerged about their causes, have led to a deeper consideration of the importance of landscape, not just as perceptible expression of the nature but as a provider of services, well being and sense of identity for people.
Therefore, the historically transdisciplinary concept of landscape (Palang et al. 2006) is still the object of a number of different approaches that make its evaluation and management uncertain and varied. This has led to the proliferation of many evaluation systems that have attempted to decipher the intrinsic complexity of the landscape according to different approaches and through different lenses. Nevertheless, in many European countries, and among these Italy, these evaluations have not found an effective response in planning and practices.
Moreover, the use of different approaches in a targeted manner and without any kind of integration has led to a functional division of the landscape in which some areas have become representative of the environmental component, others of cultural values and others devoted exclusively to production. The polarization of the characteristics of the different

portions of territory has determined a banalization of the interrelated values of the landscape and the impossibility to elaborate a comprehensive strategy for it.
At the end of the last century, an increased interest in landscape management emerged, which in Europe particularly focussed on its cultural values. The first call for a landscape convention was made at the conference “Landscapes in a New Europe: Unity in Diversity” in Blois, October 1992 (Antrop, 2013). Eight years after, the European Landscape Convention has been a decisive point in the affirmation of the complex and relational nature of the landscape, but no many tools and methods have yet emerged for its application, neither on a regulatory nor operational level.
According to the ELC, the landscape should be assess on the basis of what is perceived by the populations, thus the inclusion of people at each stage of the assessment process is crucial. In the practices, more frequently the citizens are called to participate to the process only at the later stage, when the major decisions concerning the transformation have been made and the space of manoeuvre is reduced.
As Turri (2006) argues, despite the theoretical innovations in landscape studies, these have difficulties to be transferred into actions, both at the level of policies and projects, leaving the inhabitants and users frequently outside the management system. This has led in many contexts in different periods, to what has been called the *landscape crisis*. This term is used to denote the malaise and inquietude people feel because they cannot cope with the increasingly rapid changes of “their” landscape (Antrop 2005).
For these reasons, the contribution argues that there is a need for a novel trans-disciplinary operational framework to integrate the culture-oriented and the ecological approaches at the different stages of landscape evaluation and planning.
To do so the research has investigated in parallel the most advanced approaches and tools. More specifically, on one side have been studied the interrelations and divergences of the conceptual categories of Cultural Landscape and Ecosystem Services, intended as the leading edges of the ongoing process of integration. On the other side a critical analysis of a number of methods currently used for landscape evaluation has been carried out. As a results, a set of operational tools for a more comprehensive assessment of the landscape values have been drawn up. Lastly, a reflection on their applicability in the Italian context, and more specifically in the Emilian Romagna planning framework, has been developed.

2. Different approaches to landscape assessment and management

The constitutive elusiveness of the concept of landscape is reflected also in its semantic openness. The English terms “landscape”, with its related system of interpretations and translations, comprises a multiplicity of meanings that makes its significance ambiguous and intrinsically interpretable, both in the common and in the scientific language. As Antrop highlights the early stage of landscape research focused on the investigation of the exact meaning of the word (Olwig 1996; Claval 2004; Antrop 2005). Due to the impossibility to affirm a unique and exhaustive meaning, a number of adjectives have been progressively added (e.g. cultural, natural, urban, etc.) (Antrop, 2013). By affirming the multiple phenomenology of the landscape and the relation between its comprehension and the subjectivity of the observer/user, this process produced as shortcoming the complexification of the use of the term, leaving unexplained the relation among the general concept of “landscape” and its “sub-categories” (e.g. Cultural landscape, natural landscape, urban landscape, etc.).
However, it is noticed that this vagueness have created space for different disciplinary inputs that have been a stimulus for debates, attracting a wide range of interest (Conrad et al., 2011). At the end of the twentieth century different approaches in landscape research could be identified: landscape ecologist, historical geographer, humanistic and cultural geographer, landscape architects (Antrop, 2013). In parallel, moving the focus from the disciplines to the key lines of division, a number of conflictive relations could be identified: aesthetic versus ecological; preservationist versus functional and productive; special area versus whole

landscape; rural versus urban; qualitative versus quantitative; and expert versus participatory interpretations (Kidd, 2013).
Among these, the major conflict in landscape studies seems to be between the humanities and the natural sciences, which have subdivided over the time the field of landscape studies into two directions (Palang, Fry, 2003). David Cosgrove call these two discourses *ecological and semiotic.* The focus of the first, on the one side, is on the natural processes (geomorphological, climatic, biological, vegetational, etc.), their interrelations and the relations among these and human activities (Cosgrove, 2003). All these processes are studied as factors that, moulding differently portions of the territory, produce different *landscapes*. On the other side, the *semiotic* discourse focuses more on the cultural meanings, human representations and symbols that a specific area or context embodies and how these shape the natural environment. As Cosgrove affirms, while the ecological approach is often charged of an insistent pessimism (considering human activities mostly detrimental for the natural landscape), the semiotic discourse has more generally a politically progressive stance, considering it as a result of social and political dynamics (Cosgrove, 2003).
Since the beginning of the 20th century, these two spheres have produced in parallel a set of definitions, assessment methods and regulations, whose diverse results are still clearly visible in the regulative framework of many European Countries. As Tress argues, although landscape as a concept already implies interdisciplinarity, its study rarely achieves levels of theoretical integration (Tress et al. 2003).
In the last thirty years, a process has been undertaken from both sides directed to combine these two approaches, considering the landscape as a hybrid system (Hein et al. 2006, Bastian et al., 2014).
As a result, a series of *hybrid concepts* have been put forth: among them, the categories of "Cultural Landscape" introduced by the World Heritage Convention in 1992, and the "Ecosystem Services" defined by the Millennium Ecosystem Assessment in 2005, seem the ones that express better the capacities of landscape to play a strategic role in regional development.

2.1 Cultural Landscapes

The German geographer Friedrich Ratzel in the 1890s for the first time defined the term ''cultural landscape'' as ''landscape modified by human activity'' (Jones, 2003). Since then, the concept has acquired a central role in human geography and in the related disciplines.
The Cultural Landscapes, as internationally recognized categories, were introduced in the International Convention for the Protection of the World's Cultural and Natural Heritage (often referred to as the World Heritage Convention) by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) in 1992.
The Convention describes the Cultural Landscapes as "the combined works of nature and of man." [1] This definition contains many of the principles that characterise the innovative approach of the category and which have been progressively in-depth deciphered through subsequent studies and publications.
The innovations led by the Convention can be summarized in three main aspects.
Firstly, the definition given by UNESCO extends the field of heritage, by attributing the Outstanding Universal Value to the relational and associative dynamics (combined works) rather than to physical objects or circumscribed areas detached from their context.
Secondly, it brings the work of man and the one of nature to the same level, affirming that no cultural landscape can be conceived without the interrelated action of the two components (natural and anthropic), and that it is the result of a process of mediation, adaptation and mutual transformation of the two.
Lastly, the use of the term "works" presupposes a process in progress, an evolutionary system that protects and regenerates its value through its transformation over time.
The Convention then defines three categories of Cultural Landscapes:

- Clearly defined landscapes designed and intentionally created by man.
- Organically evolved landscapes in two categories:

(i) A relict or fossil landscape in which an evolutionary process has come to an end but where its distinguishing features are still visible.
(ii) Continuing landscape which retains an active social role in contemporary society associated with a traditional way of life and in which the evolutionary process is still in progress and where it exhibits significant material evidence of its evolution over time.

- Associative cultural landscapes: the inclusion of such landscapes is justifiable by virtue of the powerful religious, artistic or cultural associations of the natural element rather than the material cultural evidence.

This category, especially if related to other declarations and documents issued by UNESCO, marks an evolution of the approach to heritage and the cultural approach to the landscape. In particular, it affirms that the variously defined social body, is a builder, interpreter and custodian of heritage and landscape and that a new approach is need to include into the living dimension of the communities.
The last one is particularly interesting because it strives for the inclusion of heritage and landscape in a project *for the future*.

2.2 Ecosystem Services, Cultural Ecosystem Services and Landscape Services

The ecosystem services framework has been developed in response to the substantially exploitation, degradation, and destroy of ecosystems and natural resources occurred in the last century as consequence of the global increase of economic and societal prosperity (MEA, 2005). At the core of the Ecosystem Services framework there is the awareness that environment provides food, raw material, energy, and other natural resources, but also non-material services such as symbolic and aesthetic values (MEA, 2005).
The concept of ecosystem services can be defined as an interdisciplinary concept, not for its origin, but for its aim to reveal the relation between natural ecosystems and the living community, evaluating the benefits that it can produces. Thanks to the the concept of ‘‘service’’, it converts ecological components and processes into recognizable terms in the social system (Daily, 1997).
The Ecosystem Services have been subdivided in four categories, according to their “functions”: supporting services, provisioning services, regulating services, cultural services. The latter results particularly interesting as *hybrid concept*, connecting the ecosystem with the cultural values, knowledge and experiences that the *users* can benefit.
The Cultural Ecosystem Services (CES) are commonly defined as the ‘nonmaterial benefits that people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experience, including, e.g., knowledge systems, social relations, and aesthetic values’ (MA, 2005). In other words, they are ecosystems’ contribution to the nonmaterial benefits (e.g., experiences, capabilities) that people derive from human‐ecological relations (Chan et al. 2012). As Fish argues, the Cultural Ecosystem Services are to be understood not as part of subject-object ontology - as a priori products of nature that people utilize for a particular benefit to well-being - but rather as relational processes and entities that people actively create and express through interactions with ecosystems. Thus, the philosophy behind the framework is relational (Fish et al. 2016).
From this overview emerges that Cultural Ecosystem Services represent a relevant category to investigate and assess the multiple values of landscape. Nevertheless, expanding the analysis to all the range of Ecosystem Services, it becomes clear that the landscape dimension is present also in other categories of ES. While the landscape is intrinsically integrated in CES for their focus on the *experience*, in providing, regulating and supporting services the landscape emerges when they have a spatial connotation.

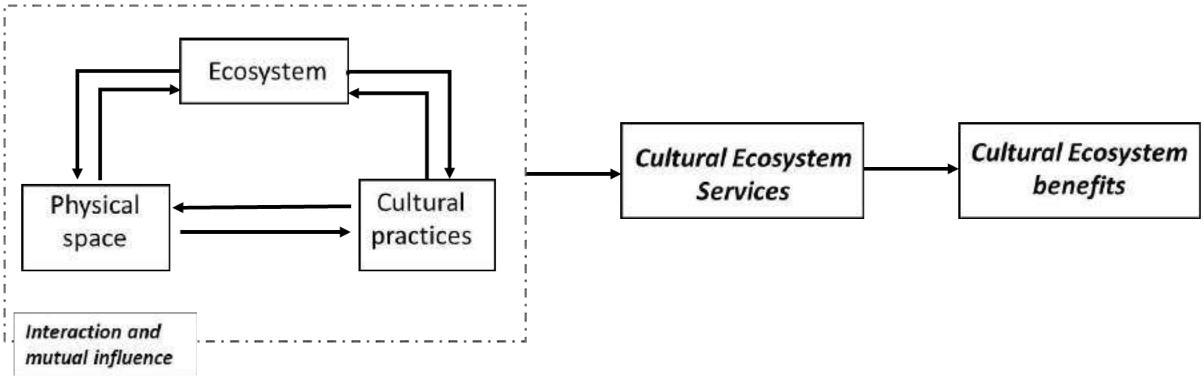

Figure 1: Conceptual framework of the Cultural Ecosystem Services

This reflection has led to delineate a particular transversal sub-category, the Landscape Services, which has acquired relevance in the last ten years (e.g. Burkhardt et al. 2009; Termorshuizen and Opdam 2009; Willemen et al. 2012; Wu 2013; Bastian et al. 2014). These have been defined as the contributions of landscapes and landscape elements to human well-being (Bastian et al. 2014).

According to the literature abovementioned, the Landscape Services, as compared with the general definition of ES, are characterized by a more site-specific and contextual perspective, a stronger focus on human action, a more operational and participative approach. As O'Neill argues, the term *landscape* reveals the importance of the spatial structures and their relation within a specific context (horizontal – on the surface), whereas the word *ecosystem* emphasizes the relationship (vertical – in depth) between ecosystem components (O'Neill 2001). Lastly the term *service* brings out the functional utility of them for the human beings and introduces in the concept the temporal dimension (process relationship).

The category of Landscape Ecosystem Service is not to be considered as an alternative to other ES, but rather a transversal sub-category where are included all the ES having the characteristics outlined (spatial dimension and context specificity, focus on human action, potential to be managed with a strategic and progressive approach).

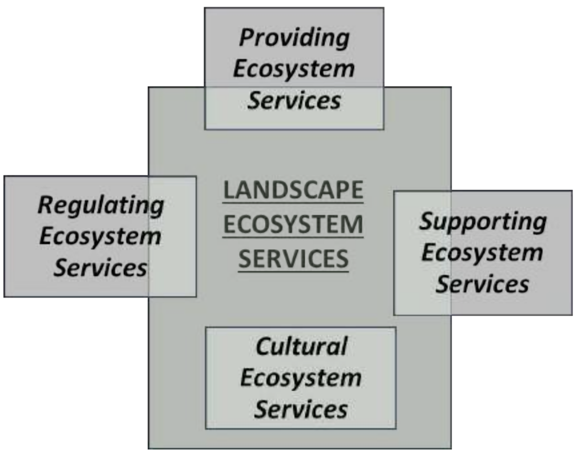

Figure 2: Relation among the Landscape Ecosystem Services and the Ecosystem Services defined by the MA (2005).

In this way the Landscape Ecosystem Services could contribute to shift the approach of ecosystem and landscape management from the pessimistic and conservative perspective (Cosgrove 2003) to a progressive and future-oriented one.

2.3 Heritage or service: a comparative analysis of different approaches

To build a structured comparison of the concepts introduced in the previous paragraphs, they have been analysed in relation to six themes: the areas of application, the types of elements prevailing in the assessment, the types of assets, the temporal dimension, the assessment methods, and the prevailing approach in terms of governance and process management. In relation to these, a reflection on the main advantages and shortcomings of each concept has been developed in order to outline a potential direction for a novel transdisciplinar perspective.

Considering the areas of application, the category of Cultural Landscape, having been introduced by UNESCO, has always appeared apt to be used for areas with exceptional characters, or even reducing the field, with those having Outstanding Universal Value. Nevertheless, in terms of approach, it is possible to apply the concept to non-exceptional landscapes, although the great emphasis given to the material traces of the past makes difficult its application to the "everyday landscapes". Both CES and Landscape Ecosystem Services can be applied to the whole territory. However, as already expressed, the Landscape Ecosystem Services tend to have a better defined spatial dimension and are therefore more suitable for context analysis.

For what concerns the prevailing elements in the evaluation, differences can be detected, depending on the relation between *man* and *nature* that underpins each category. Here the terms *nature* is wide and includes also the ecosystems and the relation among them (following the "dwelling theory" of Ingold, 2000).

The figure 3 briefly shows for each concept if it has relate to a specific landscape context, the relation between nature and man, and the type of assets on which the assessment focuses primarily. It is interesting to note the particular human-nature relation in the framework of LES; as Limburg argues, the landscape services are services usable by man resulting from its interaction with the landscape (Limburg, 2002), emphasizing the interaction between a physical system and the variety of use and non-use values recognized by man. So the landscape services exist only because there is a community using them and giving value to the landscape, in an essentially anthropocentric perspective (de Groot 2010).

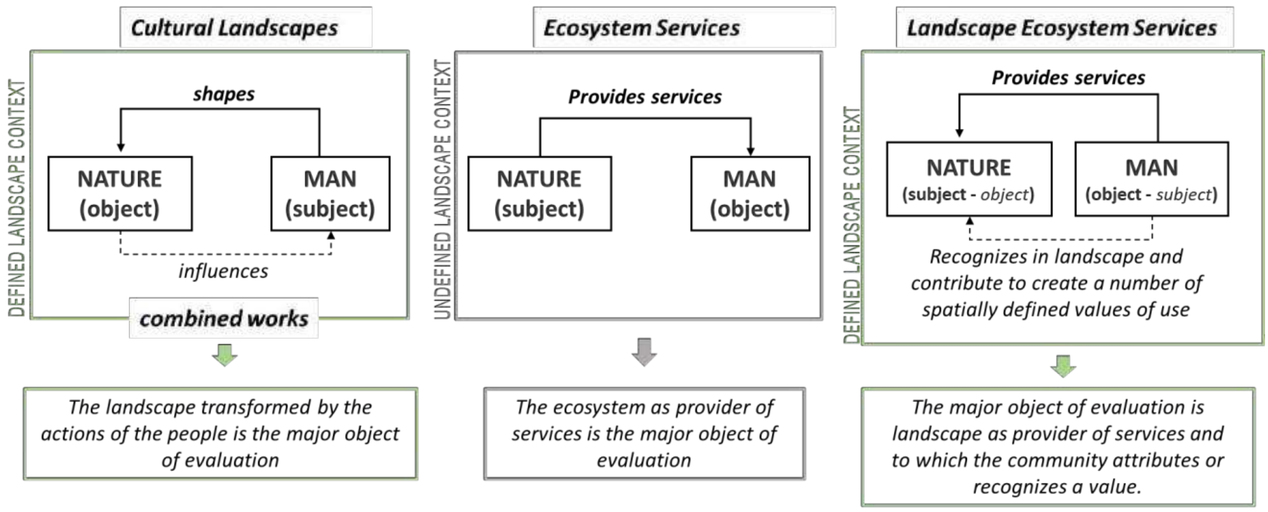

Figure 3: Nature-man relation and major object of evaluation in Cultural Landscape, Ecosystem Services and Landscape Ecosystem Services approaches.

Referring to the temporal dimension, the CL approach, deriving from the long-lasting conservation tradition, focuses on the time-depth detectable experiencing the landscape. The services approach is based on the capacity to respond to current needs and therefore it is intrinsically contemporary. This difference is crucial and determines the use of different evaluation methods. The Cultural Landscape approach privileges the classical methods of the historical geography (e.g. archives research, archaeological research, land use maps and aerial photograph analysis, inventories of historic features, etc.). Differently, in the assessment of cultural ecosystem services, qualitative research (mainly referring to the socio-economics tradition) plays a stronger role.
The temporal dimension analysed and the methods used are in strict relation to the governance models put into place. Due to the conservative approach that implicitly underpins the Cultural Landscape approach (at least in the practices), the evaluation and the actions are mostly defined according to top-down models. Nevertheless is worth noting the emerging of phenomena of bottom-up promotion of cultural landscapes, when it is understood by the people as a way to achieve an economic sustainable development.[2]

	Cultural landscapes	***Cultural ecosystem services***	***Landscape ecosystem service***
Definition	The combined works of nature and of man	The ecosystems contribution to the nonmaterial benefits that people derive from human‐ecological relations.	The contributions of landscapes and landscape elements to human well-being.
Areas of application	Landscapes with distinctive characters	All the territory	All the territory
Elements prevailing in the evaluation	Anthropic elements	Natural / environmental elements	Balance among Natural / environmental elements and anthropic-cultural features.
Temporal dimension	Time evolution (time-depth)	Present situation	Present situation
Types of assets	Mainly tangible heritage	Mainly intangible heritage	Intangible heritage
Evaluation methods	Mainly qualitative (experts opinion)	Quantitative and qualitative (mainly based on questionnaires)	Qualitative and quantitative (depending on the type of ES)
Governance approach	Mostly top-down	Top-down and bottom-up	Top-down and bottom-up

From this analysis, emerge the different shortcomings of the investigated approaches: for what concerns the Cultural Landscape approach the main limitations derive from its difficulty to be applicate to all the territory and a conservatory vision that persists although several publications by UNESCO have underlined the permanently evolving nature of landscapes (e.g. Mitchell N. 2009). In the same way, several shortcomings of the current Ecosystem Services approach have been widely detected: among them the more critical is the inherently exploitative human–nature relationship and the risk of a commodification of the environment. In addition, from an operational perspective, the Cultural Ecosystem Services have a mediated relation to the territory and therefore they seem not able to evaluate the value or the state of a landscape. Landscape Ecosystem Services have the greater potential to innovate the landscape management and planning; nevertheless, at this stage it results still a weak concept (built by the combination of two already hybrid concepts) that has not reach a comprehensive and shared definition.
Lastly, the three approaches, even when have been transferred into operative tools[3], they have been rarely incorporated into planning policies and instruments, so that it is evident a gap between the theoretical framework and the planning practices.

3. The potential of integrating approaches and methods

The limitations and shortcomings identified in the previous paragraphs bring out the potential of incorporating the concept of Ecosystem Services and the more traditional culture-centric

methods of landscape assessment. As de Groot argues, this integration could "enhance landscape performance and make planning become sensitive to the non-linear relations between landscape change and its performance" (de Groot et al. 2010). Moreover the need to understand from one side the characteristic of the landscape at the very local level and from the other side the perceptions of the population makes evident the convenience to embrace a trans-disciplinary approach. The ecosystem services, being very concretely experienced by people, could play a role in building a collective view on the future of a landscape and be a motive for collective actions (Bastian et al. 2014).
To do so a methodology for an integrated landscape assessment has been drawn up. This has been elaborated starting from the conceptual framework described above and based on the results of previous experiences[4], pursuing the criteria of feasibility and effectiveness. With the objective to achieve a strong integration of the methodology into a specific planning, it is being currently implemented in a case study in the Emilia Romagna Region, in Italy. Although this adaptation to a specific context could reduce the replicability of the methods, it greatly increases the possibility of its effective use.
The landscape assessment methodology here proposed aims at integrating landscape planning within the two main levels of governance: the regional level, which identifies the characters of the landscape and defines the general strategies, and the local level that should incorporate in them the specific needs of the related area. Through the trans-disciplinary integration of Landscape Ecosystem Services in planning, the local dimension can acquire greater importance as the one primarily responsible for land management and capable of gather the aspirations and the will of the people.
The methodology consists of two phases, a quantitative analysis through indicators and a consultative-participatory one. This subdivision follows Tudor's assertion that the landscape analysis shall distinguish the characteristics (assessment) from its value (evaluation) (Tudor 2014). The first step aims at identifying the characters of landscape, while the second endeavours to quantify the values deriving from the functions that the landscape performs in relation to the users' needs and aspirations. The indicators used on the first phase have been defined on the basis of the literature (e.g. OECD 2001, Limburg 2002, Feld 2007, Fisher 2009, Nogué 2009, Cassatella and Peano 2011, Cassatella and Seardo 2015, Albert 2016) and validated by a pool of international and local experts. This indicators cover nine specific areas, five referring to the intrinsic characters of the landscape (geographical setting, natural and environmental resources, historical and cultural features, perceptive and aesthetic characters functions and territorial structures) and four to the Landscape Ecosystem Services it provides (cultural, providing, regulating and supporting).
Already in this first phase the methodology envisages a multi-level and trans-disciplinary exchange. In relation to the specific context of the Emilia Romagna Region, it has been verified that most of the data required can be collected and processed at regional level; for few of them field surveys or local consultations could be foreseen. The aim of this phase is to determine the characteristics of the landscape, in an easily representative way and by means of comparable data on a large scale. On the basis of these values, the Regional Authority will be able to determine landscape attributes in relation to which specific regeneration, valorisation and conservation strategies could be defined.
The second phase of participation envisages a first consultative moment in which citizens are called to validate the results emerged from the indicators assessment by proceeding to refine the input data regarding specific issues. Then, a second phase of participation opens for the definition of actions to preserve and enhance the ecosystem services of the specific landscape.

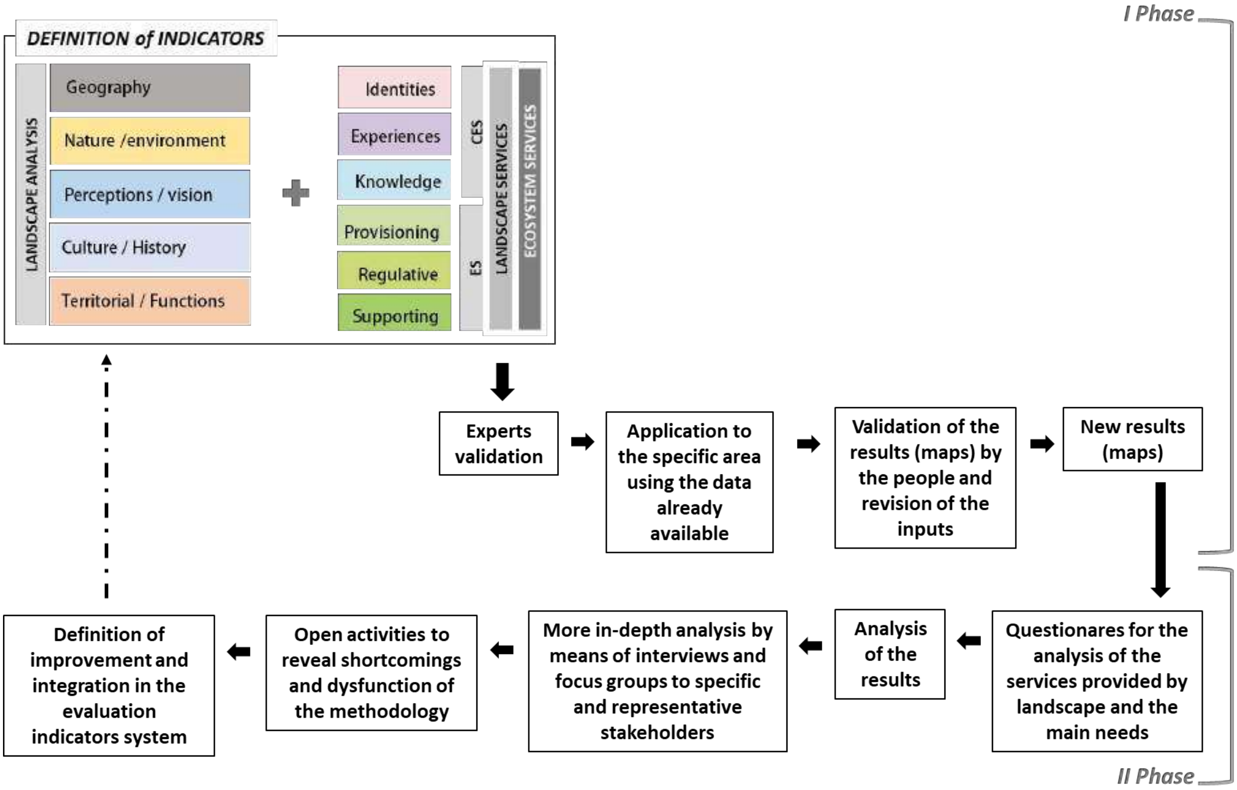

Figure 6: The methodology

This methodology, based on different conceptual frameworks and through the use of very diverse methods has the objective to give to landscape planning a more operational and effective stance. In this direction, in particular:

- It provides a set of quantifiable and comparable data as a base for the definition of grounded strategies;
- The integration of *long-term* conservative approaches and the *ready-to-use* services approaches relates the action of the present-time with the dimension of the *History* and the *future*;
- It comprises data referring to different approaches putting in evidence the interrelation among them;
- It works in parallel at different governance level, transferring to the policies the *multiscale charachter* of landscape and ecosystems;
- The assessment is not meant to define sectors, or landscape units, but variable geometries, enhancing the heterogeneity of landscapes rather than their repetitive patterns;
- The participation of the people in the assessment phase will ensure the inclusion of their perceptions, needs and aspirations and will contribute to refine and adjust the results of the assessment through indicators.

The overall goal of the outlined process is to enhance the role of landscape as provider of services and human values, as sensible representation of the interrelation between the man and the ecosystem, as driver of sustainable regional regeneration.

4. Conclusions

Landscape can play a fundamental role as a driver of sustainable development, not only for rural areas with particular aesthetic, environmental or cultural values, but also for those transformed or *everyday landscapes* that often lack of services, recognition and identity

values. However, despite the interdisciplinary origin of the concept, for a long time the landscape has been sheathed in disciplinary subdivisions, preventing an overall vision and leading to a sectorialization that often finds little evidence in reality.
The integration on the one hand of broader and more progressive approaches to heritage (such as those of Cultural Landscapes) and, on the other hand, of the Ecosystem Services approach can redefine a conceptual framework in which are explicitly manifested the mutual benefits that man and the environment can derive from the correct management of the landscape.
The evaluation methodology proposed and briefly outlined here represents an attempt to combine an objective, replicable and comparable analysis with a participatory approach. This aims to avoid subjective analysis and top-down approaches, which can lead to stereotypizations and banalization of landscapes.
In this sense, the promotion of the landscape as a service seems to be full of potential for different reasons. Firstly, the landscape is brought back from the aural, aesthetic and cultural dimension to the present and the everyday. Secondly, the concept of service allows to express its potential in improving the quality of live, in terms e.g. of needs satisfaction, risks prevention and pollution mitigation, social and economic development.
However, some critical issues should be noted, such as the difficulty in translating these values into policies and projects, which often clash with structural barriers such as the fragmentation of private property, the absence of adequate business and governance tools, the lack of effectiveness of public action. Furthermore, the economic-based evaluation approach of the Ecosystem Services raises the risk of a commodification of the landscape and the radicalization of the tourism exploitation processes already under way in many areas. Finally, the non-implementation of participatory actions or their reduction to consensus building tools can lead to the dissolution of the added value of the services approach, regressing the landscape to a marginal or frozen space in the planning framework. On the contrary, fostering the idea of the landscape as a service for the community, in its broader meaning, can mobilize the participation of citizens, even the activism. This offers the possibility of promoting more inclusive policies, empowering the stakeholders and increasing the collective awareness of the role of human - environment interactions in determining our common destiny, reinforcing a sense of personal responsibility also in terms of sustainability and resilience.

[1] WHC, Revision of the Operational Guidelines for the Implementation of the World Heritage Convention: Report of the Expert Group on Cultural Landscapes (La Petite Pierre, France, 24–26 October 1992)

[2] An interesting case is the candidature as UNESCO Cultural Landscape of the Priorat in Cataluña, Spain. For more information, see: http://prioritat.org/ (visited 13/07/2018)

[3] For example the Common International Classification of Ecosystem Services (CICES). https://cices.eu/ (visited 13/07/2018)

[4] In particular have been analzed the experiences developped in Piemonte Region, in Italy (Cassatella and Peano 2011), in Cataluña (Nogué 2009) and in Switzerland (Kienast 2015).

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Development of Land-Use Suitability Assessment Criteria for South Africa

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1. Background to the Project

Land as a resource is limited in nature and its use is not only determined by the user but also by the capability of that land to sustain productive activities. Land capability in turn is governed by the different land attributes such as the type of soil, underlying geology, topography and hydrology. These attributes define the extent to which land can be put to competing purposes in order to optimize its return. Currently a criteria or a scientific basis for the selection of the most appropriate and sustainable use of land for a particular area does not exist in South Africa. For example, agriculture, commercial development, creation of conservation areas and urban development are crucial for the growth of South Africa's economy, but when confronted with competing potential uses, it is currently not clear how the choices are to be made in an objective, transparent and consistent manner. It is evident that currently, certain land activities are practiced on unsuitable lands and this problem is likely to persist in future if not addressed. Little has been done to model and project land performance for various competing uses going into the future.

It is against this backdrop that the Department of Rural Development and Land Reform (DRDLR) commissioned a project to develop Land Use Suitability Assessment Criteria (LUSAC) for South Africa. LUSAC is an important tool in bringing to effect the provisions of the recently enacted Spatial Planning and Land Use Management Act (SPLUMA, 2013). SPLUMA seeks to promote consistency and uniformity in procedures and decision-making processes related to spatial planning and land use management. Among the key changes brought by SPLUMA is the confirmation of municipalities as authorities of first instance in matters of land development and land use management. The broad principle is that the vast majority of land use and spatial planning decisions are to be taken at municipal level. Section 20 of SPLUMA requires a municipality to prepare a Spatial Development Framework (SDF) one of whose functions is to guide development and the identification of land that is suitable for various types of developments.

In order to achieve the above, it is necessary that land suitability assessments are carried out on land before any developments are implemented. The tool would also assist municipalities in preparing land use schemes and SDFs as they would have the knowledge of what is more suitable and viable before undertaking the process. The content of Municipal SDF is comprehensively described in Part E Section 21 of SPLUMA. Elements of the SDF require that assessment practices towards future land use demarcation or identification be introduced. The requirements that are relevant to Land Use Assessment criteria and that must be in the SDF include:

- A written and spatial representation of a five-year spatial development plan for the spatial form of the municipality.

- A longer term spatial development vision statement for the municipal area which indicates a desired spatial growth and development pattern for the next 10 to 20 years.
- Estimates of the demand for housing units across different socioeconomic categories and the planned location and density of future housing developments.
- Identify, quantify and provide location requirements of engineering infrastructure and services provision for existing and future development needs for the next five years.
- Identification and designation of areas where a national or provincial inclusionary housing policy may be applicable.
- A strategic assessment of the environmental pressures and opportunities within the municipal area, including the spatial location of environmental sensitivities, high potential agricultural land and coastal access strips, where applicable, and
- Determination of the purpose, desired impact and structure of the land use management scheme to apply in that municipal area.

Equipping municipalities with the tools necessary to undertake these assessments would go a long way in supporting efficiency and effectiveness of the preparation and implementation of land use schemes and SDFs. When applied, the criteria would help rank various potential land uses where the land is capable of being used for multiple purposes. Embedded within the criteria will be clear procedures and processes to be followed to enable the generation of optimal land-use models or a mix of land-uses that yield the *"highest" overall cumulative suitability*.

It is however appropriate to mention here that regardless of the quality and performance of the proposed tool, the final decisions on how land uses are allocated will be based on consultations, and the integrity of the decisions by those vested with the responsibility of making such decisions. This implies that issues of governance, efficient and sustainable use, are among other key underpins of Land Use Suitability Assessment Criteria (LUSAC).

2. The Concept of a Land Use Suitability Assessment

Broadly defined, land-use suitability analysis aims at identifying the most appropriate spatial pattern for future land-uses according to specific requirements, preferences, or predictors of some activities. It relates to land performance when used for a specified purpose, based on an evaluation of the land form, soils type, vegetation, geology, topography and other features in order to resolve competing potential uses within a framework of the applicable proposed developments

Every portion of the Earth's landscape is characterized by a different set of features that render it more suitable for certain uses than others. Land Use Suitability Criteria consist of three main elements:

- ***The Land*** – ground or soil of a specified situation, nature, or quality
- ***Suitability*** – adapted to a use or purpose, and
- ***Analysis*** – the process of separating of the whole into its component parts, and therefore allowing structured decision making.

Based on the above 3 components, land suitability analysis is the separation of the nature or quality of land into its component parts based on the land's ability to serve a particular use or purpose. ***"High land suitability"*** means the land has relatively high numbers of the component parts in favour of its use for a particular purpose, while ***"low***

land suitability" means the land has relatively low numbers of the component parts it needs to serve a particular use or purpose.

Land suitability assessment has two sides to it. It involves classification of characteristics according to their suitability for a particular activity, that is to say, identification of which land use is to apply in some given circumstances. The second element of the analysis defines where the best site to apply a particular type of land use is located given a set of potential alternative sites. The explicit site search analysis determines not only the site's suitability but also its spatial characteristics such as its shape, contiguity, and/or compactness by aggregating the basic units of observations according to some criteria.

The value of land quality is the function of the assessment and grouping of land types into orders and classes in the framework of their suitability – generally categorized as suitable (S) and not suitable (N). These suitability classes can then be further sub-divided, as required. In practice, three classes (S1, S2 and S3) are often used to distinguish land that is ***highly suitable, moderately suitable and marginally suitable*** for a particular use. Two classes of 'not suitable' can usefully distinguish land that is unsuitable for a particular use at present but which might be useable in future (N1), from land that offers no prospect of being so used (N2).

The procedure for optimizing land use allocation will depend on whether the land uses are compatible or conflicting. When the land uses are compatible, technically there is no pressure to allocate land for alternative uses, hence the allocation is based on a descending measure of overall or cumulative suitability for the compatible land uses. However, the optimal land use allocation procedure is a bit more complicated when the objectives are conflicting. In this case, allocations are exclusionary, that is land units can only be allocated to one use only. Mendoza (1997) advised a prioritized allocation to solve this problem that is the land uses are compared in terms of priority. Allocation is done to the land use rated as the highest priority. Then allocation of remaining land units is done for the lower priority land uses.

Land Use Suitability Assessment can be a powerful tool in support of Land Use Planning. It involves all kinds of urban and rural land use such as agriculture, forestry, wildlife conservation, tourism, transportation, water resources and industries among others. It is an important part of forward planning as it provides a predictive framework on the suitability of the land for different demands and the consequences of such demand on the environment. Land suitability inventory provides feasibility information to developers and investors on the possible location of various investments and the limitations therein.

3. Multi-Criteria Decision Analysis as an Underpinning Principle

In our daily lives, we usually use multiple-criteria analysis to implicitly make regular decisions such as what to buy, where to live and what to eat. We are often comfortable with the consequences of such decisions even when they are made based on our mental frame or intuition.

On the other hand, when stakes and the costs of consequences are high, it is important to properly structure the problem into various options and explicitly use a multiple criteria analysis to determine the attendant trade-offs between the choices. In making the decision of whether to build a nuclear power plant or not, and where to build it, there are not only very complex issues involving multiple criteria analysis, but also multiple parties who are deeply affected from the consequences. Structuring complex problems well, and considering multiple criteria explicitly, may lead to more informed and better decisions.

Land use suitability assessment is inherently a multi-criteria issue, that is to say, it is a decision making problem process that involves consideration of a variety of factors to identify the use that leads to the best possible range of outcome for society. The principal problem of land suitability analysis is to measure both the individual and cumulative effects of the different factors on land.

Multi-Criteria Decision Analysis, or MCDA, is a valuable tool that we can apply to many complex decisions. It is most applicable to solving problems that are characterized as a choice among alternatives. It has all the characteristics of a useful decision support tool. It helps in focusing on what is important, is logical and consistent, and is easy to use. At its core, MCDA is useful for:

- Dividing the decision into smaller, more understandable parts
- Analysing each part, and
- Integrating the parts to produce a meaningful solution.

3.1 GIS and Multi-Decision Analysis Criteria

Use of GIS is the centrepiece of the recommended methodological approach. The strength of a GIS environment is that it allows for the development of integrated GIS-based multi-criteria approaches and model(s) which combine the spatial capabilities of GIS with multi-criteria analytical capabilities. Fundamentally, integrated GIS-based multi-criteria approaches to site (land-use) suitability take into consideration the different factors (i.e. both the socio-economic and biophysical land parameters) affecting suitability of the site/land, as well as specific land uses. The factors include (but are not limited to) natural system constraints, compatibility with existing land-uses and development patterns, existing land-use policies, and the availability of community facilities. The map analysis techniques in GIS-based site (land) suitability assessments include (but are not limited to):

- Retrieval and reclassification
- Measuring distance and connectivity
- Characterizing and summarizing neighbourhoods, and
- Overlay (combination of various datasets) techniques.

Within a GIS environment, an MCDA framework is developed for both *site (land-use) suitability analysis* and *land allocation*. Although, one is distinct from the other, the former serves as a basis for the later. The MCDA framework captures the multi-criteria nature of land-suitability assessment/evaluation/analysis, and simultaneously allocates land by maximizing overall suitability of a land area.

GIS is an enabler of site (land-use) suitability analysis as well as the intricately linked land-use allocation. This, it does, by integrating the various elements needed for this entire assessment process (refer to Figure 1). GIS creates a convenient and powerful platform which integrates cross-sectional datasets (i.e. vector and/or raster) and Multi-Criteria Evaluation (MCE) and allocation methods (approaches and indices) all within a MCDM framework. Having linked all these facets, GIS goes on to enable spatial analysis, through both quantitative and qualitative techniques (e.g. reclassification, measuring distance and connectivity, buffering, overlay, etc.). The outcomes of this integrated GIS-based process include: decision making tools/products such as land-use models/scenarios, and optimal land-use mixes (which optimize cumulative suitability).

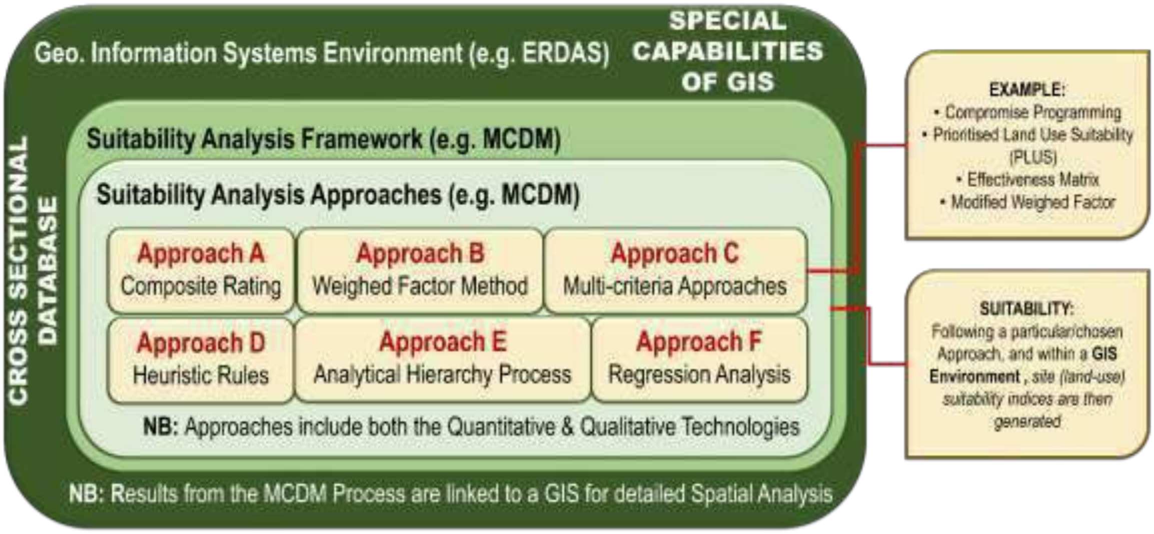


Figure 1: Land Suitability Analysis, MCDM and GIS interface

It should be noted that GIS has been used extensively to develop decision-making tools (particularly maps) to enable the evaluation of site suitability and the assignment of various measures or attributes of suitability to specific sites or geographic areas. Presented in the following sections are a select few exemplar cases from South Africa and elsewhere (international), respectively.

4. The Proposed Tool: A Two-Pronged Sustainability Approach

The proposed and use suitability model consists of two major sub-models. The first is a ***Developability index*** and the second a ***Desirability index*** (refer to Figure 2 below).

Figure 2: The two components of the criteria

4.1 The Developability Index

Developability includes criteria which are in most cases non-negotiable (e.g. very steep slopes). The Developability criteria are mostly natural and policy constraints which makes development impossible or very costly. A non-negotiable criteria item may cause certain areas to be "no-go" areas for development and are removed very early in the process.

4.2 The Desirability Index

Desirability criteria are mostly qualitative in nature. In most cases all the areas are developable, but the degree of desirability differs (e.g. it is more desirable in terms of travel cost to live close to employment centres than far from them). Most desirability criteria are negotiable and different values (weights) can be given to each. A low value (weight) given to an area does not mean it is a "no-go" area.

4.3 The Main Information Pillars of the Model

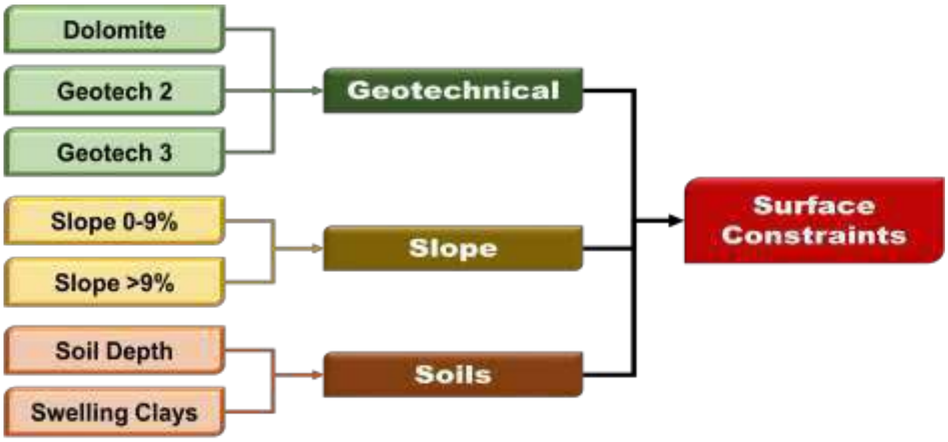
The second level of the proposed land suitability tool is based on major information pillars. The developability and desirability sub-models get informed by various relevant information topics. The following paragraphs describe each of these topics.

4.3.1 Developability

Figure 3: Sub-components of developability index

4.3.1.1 Surface Constraints

Surface constraints includes slope, geo-technical conditions and soils (refer to Figure 4 below) that are in some cases regarded as no-go areas and in other cases may be very costly to develop on.



- ***Geotechnical constrains*** includes no-go areas such as dolomite as well as other geological conditions that either is unsafe or costly to develop
- ***Slope*** has a cost impact on development and un-developability at steeper slopes
- ***Soil*** has a cost impact on development and may also impact on development timeframes

4.3.2 Desirability

As noted previously, desirability criteria are mostly qualitative in nature. They involve value judgments of what is desirable or ideal and even when an area scores low on desirability for a certain development, it does not totally disqualify it. The desirability index consists of the following 4 sub-models as shown in Figure 3 below:

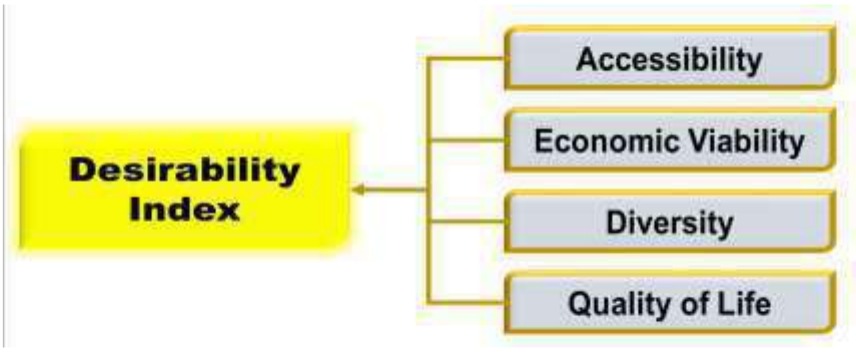


Figure 3: Sub-models of the Desirability Index

4.3.2.1 Economic Viability

Figure 4 below shows that economic viability is underpinned by the assumption that areas with demonstrated economic potential provide greater livelihood and income protection because of a greater diversity of income sources.

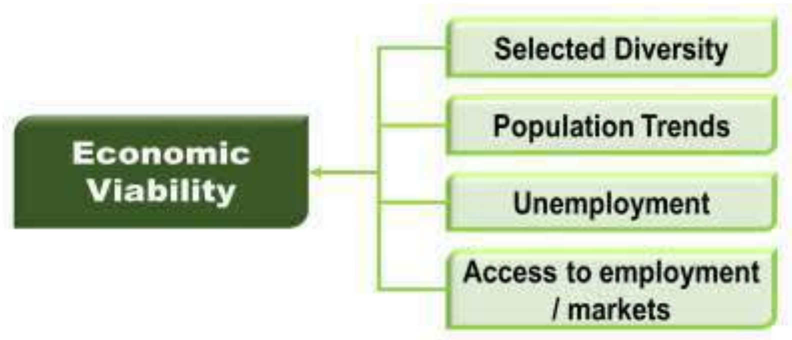


Figure 4: Economic viability considerations

- ***Sectoral diversity*** is a characteristic of a healthy economy. Single sector economies should be highlighted before large scale community developments are planned.
- ***Population trends*** refer to areas of growth and decline.
- ***High unemployment clusters*** should be avoided. More inclusive development without large scale "poverty traps" is preferred, and
- ***Access to employment/markets*** secures greater diversity of income sources and will always be preferable for development.Accessibility.

4.4 The Full Model at a Glance

While the foregoing sections have unpacked in relatively more detail the various criteria relating to the Land Suitability Multi-Criteria Model, Figure 5 below provides an overview of the model as a whole.

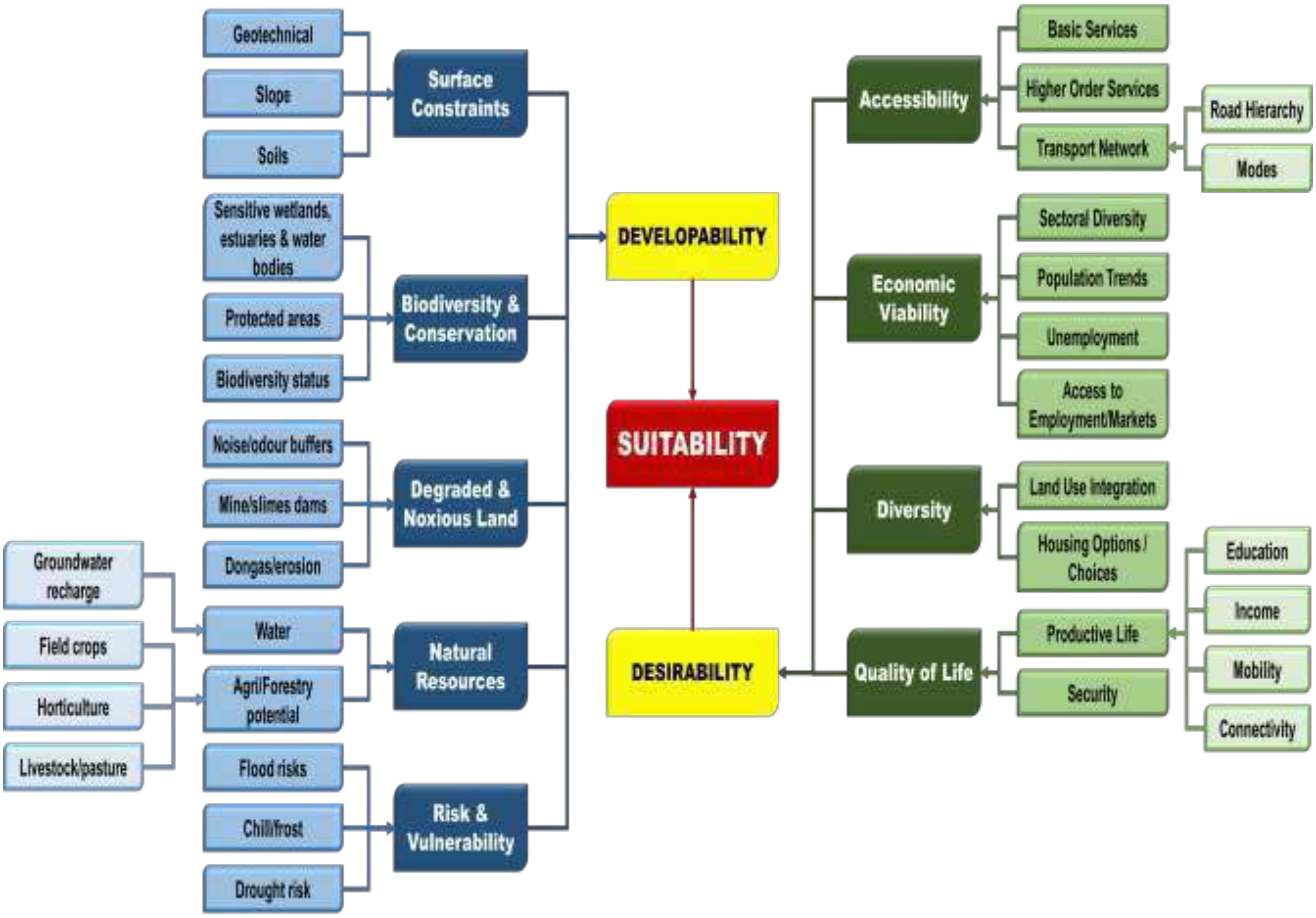


Figure 5: Integrated LUSAC Model

4.5 Interpreting the Results of the Model

As explained in the beginning of the document, the multi-criteria decision-making process is carried out on the basis of creating indices, with the final suitability result expressed as an index. The index can be from 1 to 10 or from 1 to 100. This normally depends on the amount of detail required to make a final decision. The following example is based on suitability assessment for densification in Gauteng. The index is from 1 to 10 with a score of 1 the lowest and a score of 10 the highest level of suitability.

Figure 6 below is a Gauteng example depicting a densification assessment.

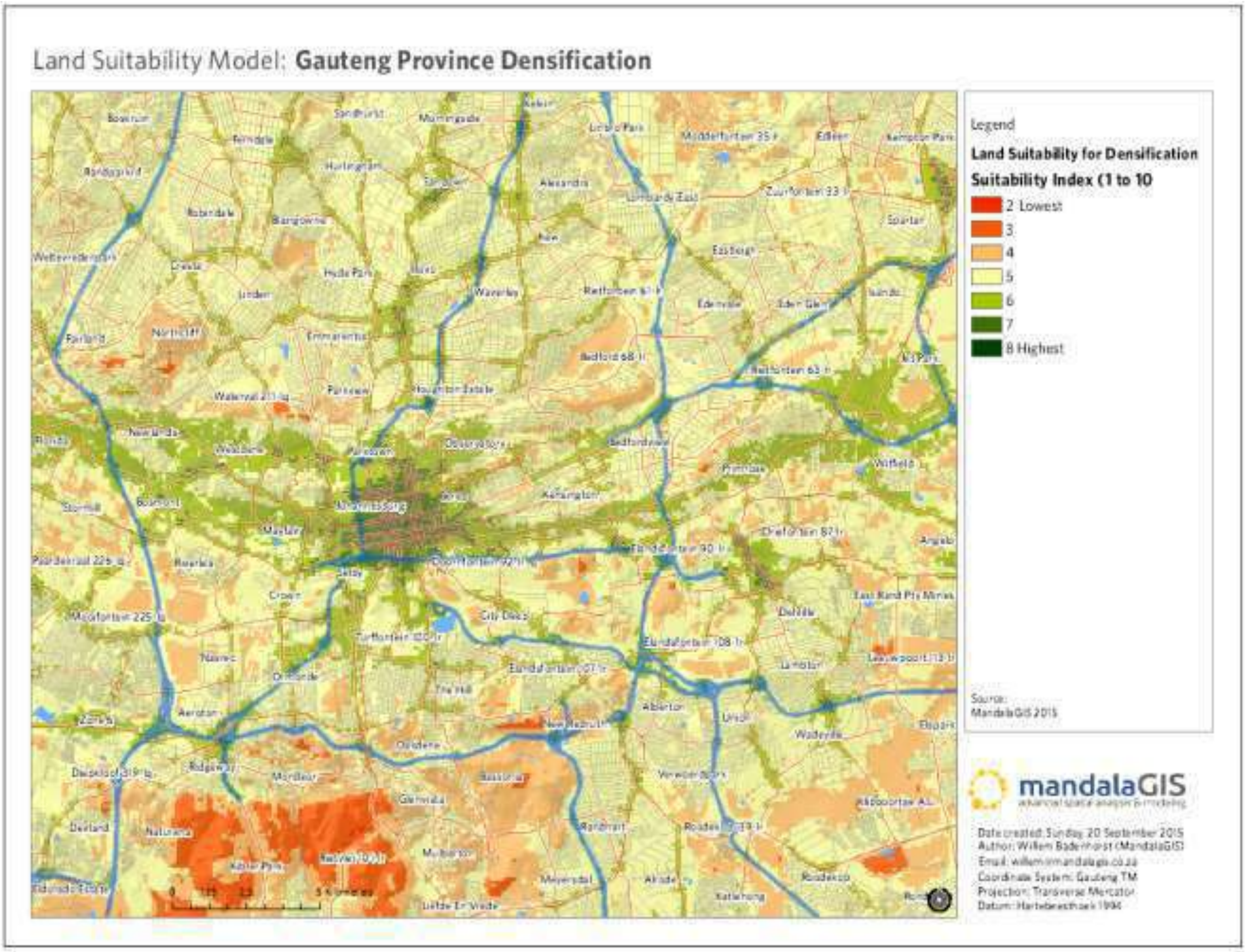


Figure 6: Example of Densification Assessment in Gauteng

Figure 7 below represents a typical result for a proposed development study area.

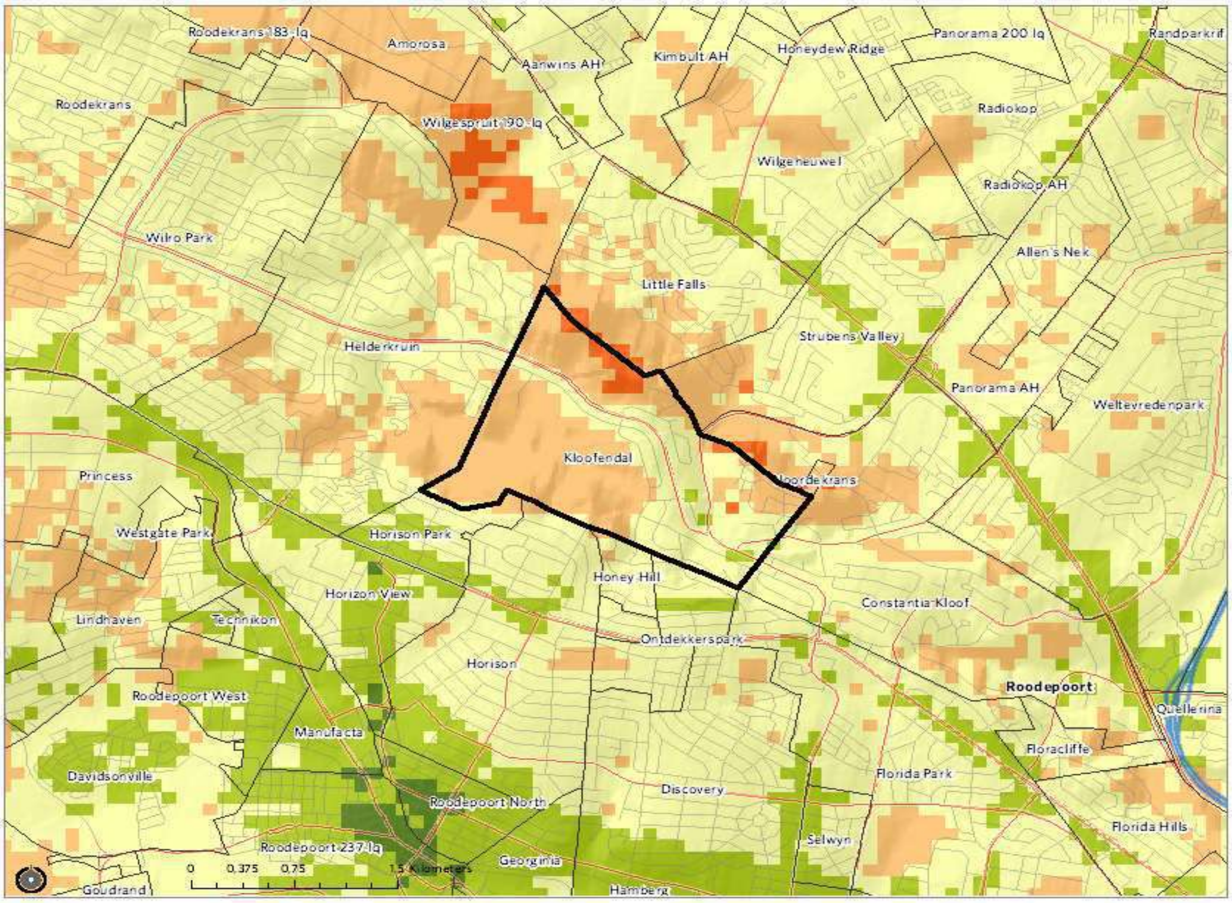
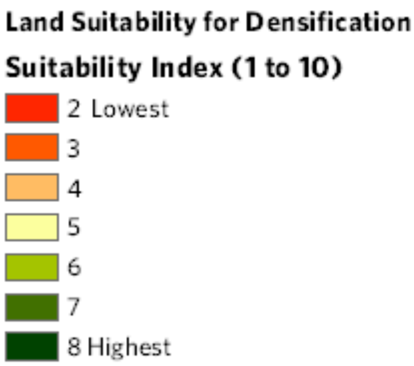


Figure 7: Typical assessment of proposed development



In the above example, the interpretation of the suitability result is that the study area, or proposed development, does not comply with the desired conditions for densification. The reason can then be found in one of the input criteria layers (e.g. a lack of public transport infrastructure).

4.6 Contextualising the Results

It is always be important to remember that the result of the suitability model is only a guideline and should be interpreted with the local context in consideration. A suitability model for use across the whole of South Africa, will not be able to take in consideration all the local nuances and characteristics that differ from place to place. However, the suitability model should very clearly indicate any unsuitable areas that fall in the non-negotiable class (e.g. protected nature areas).

4.7 Software and Skills Challenges

The nature of multi-criteria decision modelling requires two very important sets of conditions. The first is availability and cost of appropriate GIS software packages, and the second, is the appropriate GIS skills and knowledge to interpret the input information.

5. Way Forward and Conclusions

The proposals presented are tailor-made for a simply constructed tool that is easy to use bearing in mind that the capacity for collection and analysis of complex data sets is a bottleneck for most municipalities in South Africa. It has been noted that LUSAC relies on multi-criteria decision modelling which requires two very important sets of conditions. The first is availability and cost of appropriate GIS software packages, and the second, is the appropriate GIS skills and knowledge to interpret the input and output information.

The issue of availability of appropriate GIS skills and knowledge across the country has been highlighted. Multi-criteria analysis as the basis for LUSAC relies on a very rich data environment. Although this is very advantageous, it also requires that the users of the tool should have a very good knowledge of the input information and how to interpret it. Local municipalities with lower skills level may have difficulty in interpreting the input information as well as the output results. This may imply that the “depth” levels of the models may need to be varied to suit the knowledge and capability levels of the users in different organizations.

To address the question of capacity, two scenarios of application have been provided. Municipalities or other entities with high levels of GIS skills may be able to use the full model with all its multiple layers. In the case of lesser knowledge and skills levels, the depth of the model may be offered on a lesser scale with some of the sub-models being pre-processed by sectoral experts. In this case, the organization will only use the First Level of the model to contextualize and make decisions.

References:

1. MENDOZA, G.A. (1997) ***A GIS-based Multi-criteria Approach to Land Use Suitability Assessment and Allocation,*** Proceedings of the 7th Symposium on Systems Analysis in Forest Resources, Traverse City, Michigan, USA, 28-31 May 1997.
2. Associating a combination of factors and their various impacts with respect to potential land-uses [Mendoza, 1997].
3. The actual process of designing an optimal mix of land-uses based on their estimated suitability and perceived management objective [Mendoza, 1997].

Values for Planning.

Olga MAXIMOVA, University of Rome – La Sapienza, Italy, Russia

The paper presents the results of the PhD research of author supported by the Erasmus Mundus Action 2 Programme of the European Union. The PhD research is dedicated to: “The Landscape: comparison between Italy and Russia. The general values for legislative and planning instrumentation”.

1. Introduction.

Values for planning. Values for future. Values for life. Which values have to be the basic for legislative and planning instrumentation? The paper demonstrates the differences of understanding the landscape related to social, linguistic, economic, environmental aspects and its interrelationship depending on the territory. The concept of landscape will be explored from the conceptual and cultural point of view, in the different traditions and in the European Landscape Convention (Florence, 2000), also in case of Russia. The aim is to identify the analogical-related concepts and their importance, for the possible integration of the European Landscape Convention (ELC). The research investigates the theme of the landscape planning after European Landscape Convention, in particularly to the Italian experience, is concerned with the integration of the European Landscape Convention into the Italian legal system and with development of the regional planning system, focusing on its organizational, operational structure, its legislative content, disciplinary and management innovations, the mechanisms and procedures for the elaboration of the general planning instruments (landscape plan) in order to identify criteria, principles and tools to produce the basic model, which can be applicable in different countries, for example, in Russia.

The research investigates the theme of landscaping planning in Italy to answer the main question of the thesis: can be and if how can the ELC's addresses be applied to the Russian case through experience of Italian landscape planning.

2. The Concept ‘Landscape’ Does Exist?

The language is a reflection of our life and culture, shows the importance of the local environment and everything around us. The concept of perception includes the different ways of human perception: visual, sensory, through taste, hearing, smell, touch, temperature, humidity, etc. That is obviously depends on surrounding conditions and characteristic of the environment and of the landscape and of the way of individual and collective perception. Key elements of this influence the cultural policy and development of the territories.

Former Steering Committee for Cultural Heritage and Landscape (CDPATEP) of the European Council has elaborated the document “Landscape policies – synthesis document”[1] based on the information of the landscape policies provided by the Member States of the European Council. The document is based on the information of the previous documents, those that were elaborated from 2002 to 2009: T-FLOR 2 (2002) 11, T-FLOR (2007) Rev[2], CEP-CDPATED (2009) 3 Bil[3] and T-FLOR 3 (2003) 11 rev[4]. Each representative of the Council of Europe member states (those who provided the information) answered the questions related to the landscape and its management in the report "Presentation of the status of landscape policies in the Member States of the Council of Europe", including the relevant legislative system, planning structure and special policies related to the State. Among the questions related to the addresses of the Convention there are the questions of section 5 "General mesures" as: 5.1. How is the term "landscape" defined in your language? 5.2. Is there a legal definition of the term "landscape"?

The question reflects the permanent and indissoluble link between environment, language and culture. About twenty representatives answered the question. This presents the complex and mixed picture of official diversity. From the comparison we can identify 2 types of answers: the first type is based on definitions and native (autochthonous) words, while the second on definitions and words of foreign origin, borrowed those that represent scientific or legislative significance. If instead analyzing these definitions on the basis of linguistic groups, the roots of similar words are found in each group, but at the same time the meaning is not always very much the same.

In the Russian language the term 'landscape' (rus. "ландшафт") derived from German 'landschaft', is not the autochthonous word. There is also the etymological concept of the 'space' in a different way, that is 'prostranstvo' (rus. «пространство»). In the Italian language 'paesaggio' ('landscape') has the colors of the different senses and feelings, as well as the 'taste' ('paesano'). It is the concept with many layers, like Mediterranean climate with ability to cover everything with its humidity. All the two concepts 'prostranstvo' and 'landscape' include the ability of moving, around, between and within. The concept 'prostranstvo' does not directly correspond to 'space', because the concept of 'space' is relative to the concept closed, whereas the concept of 'prostranstvo' is more related to the concept open.

This shows the difficulty of identifying what the 'landscape' is in general, and, in particular, the difficulty of finding direct analogies in different languages and cultures. Therefore, it is evident the difficulty in applying the international documents in the field of the 'landscape' in a homogeneous way. It is necessary for each country to create its language for 'landscape' with specific local tools.

3. Importance of 'Landscape' for Contemporary Life.

The Convention is a result of international collaboration in the framework of the Council of Europe's cooperation. The purpose of this cooperation is the realization of the closest union among its members to safeguard and promote the ideals and principles that are their common heritage, and which is pursued through agreements in the socio-economic field. Where the landscape is represented as 'a resource favorable to economic activity'[5]. So, the Convention presents itself as an economic instrument. It is the important moment that at the international level means 'an area, as perceived by people'[6] has been defined as an economic resource in general. It opens many possibilities for development and collaboration but also creates many risks.

"Aware that the landscape contributes to the formation of local cultures and that it is a basic component of the European natural and cultural heritage, contributing to human well-being and consolidation of the European identity"[5], it addresses such global processes as the problem of the sustainability of local culture and identity in a global society.

Chain:

cultural and natural heritage - landscape - identity - population,

creates a link / connection across the landscape between the European cultural and natural heritage and the local population, thus protecting the 'identity' of the local population.

The document proposes the following questions:

- What are the criteria to define various desires of the people, "the public's wish to enjoy high quality landscapes and to play an active part in the development of landscapes"[5]?

- How the opportunity 'to play an active part' can be on a more intense and professional level?

The European Landscape Convention, on the one hand opens the perspectives, but on the other hand entails risks, raising the following questions of interpretation and possibility of realization at the time of total globalization, economic instability and its practicability, as well as the possibility of being applied in different climatic, cultural, economic and other areas. And, as a result, highlights the questions about the risks and their consequences, emphasizes possible advantages and benefits for a single country or for a participant of the Convention.

4. Goals for Landscape Management.

How the integration of the European Landscape Convention is carried out, for example, in a single state of Italy, which goals have to be achieved for the landscape management? "Landscape management" means action, from a perspective of sustainable development, to ensure the regular upkeep of a landscape, to guide and harmonize changes which are brought about by social, economic and environmental processes[6]". The Italian legislative system, as a Parties to the Convention State, implements its principles by development of its own mechanisms of integration of the Convention into the legal framework, into the system of the management of the territory, in the system of territorial and landscape planning.

DECRETO LEGISLATIVO 22 gennaio 2004, n. 42 - Codice dei beni culturali e del paesaggio (the Code) is a main instrument for carrying out the governance of cultural heritage on the Italian territory. By this Code have been introduces basic concepts for landscape management (main): landscape, cultural heritage, landscape values, cultural values, protection, enhancement. The question is how to perceive the landscape, is essential for the definition of the landscape in the Convention, because it determines that the landscape is perceived by populations. So, it introduces the way how the landscape should be perceived, contemplated and interpreted, that is, the human scale, because it is perceived by man, in this way introduces the problem in the interpretation of the basic concepts.

The goals of the Code can be structured in three groups: introducing the basic concepts for the governance of cultural heritage, cataloging and recognizing national cultural heritage, establishing regulations for use and responsible bodies. That all sets represent the general measures for the governance of cultural heritage, where the main concept is the enhancement of national culture through the protection and enhancement of the cultural heritage of the Nation (Art. 1, c. 2). It can be defined that the enhancement is the new integrated concept to safeguard and protection the territory, to use the land, to develop the territory, to build a new landscape and a new city, that Italy follows to be applied with the Code. The protection and enhancement all together form the principles to activate concepts of the Code in legal framework and planning for the management of the Italian territory.

The definition of the term 'landscape' and its derivatives should still pass the review period in its development if we take into consideration the development of our life, including changes in economic activities, ecological and social situation in the evolutionary process, because the landscape is a dynamic matter.

The Code has introduced a new type of plan on the whole (apart from the regions that have autonomy in this matter) the Italian territory with the main objective that the territory should be adequately known, safeguarded, planned and managed, taking into consideration the different values expressed by the different contexts that it constitutes[7], that can be interpreted that the Italian territory with different values expressed by the different contexts that constitute it, all together represent the landscape of the Nation, with its diversity and complexity.

The Code and the Plan are the main tools of a multilevel governance to realize the landscape policy on the Italian territory. Where the development of culture, the memory of the national community and the territory have been put at the center for 'landscape quality objective' (ELC).

5. Landscape Transformation in Russia.

Russian Federation has not signed the European Landscape Convention and, consequently, does not implement it. But it is completely involved in global processes. It has its own urban planning system, the system of ecological and environmental legislation. The term 'landscape' is not defined in the legal documents, but presents as a natural landscape, or as a cultural landscape, or as a place of interest, or as a natural complex and so on. The framework of laws relating to spatial planning, cultural heritage and ecological legislation presents a complex system of concepts for the protection of the environment, cultural heritage, nature and resources, and has its structure and contents connected to each other.

Is completely involved in global processes, with the same general global problematic statement: fragmentation of landscape, chaotic development, weak programmatic aspect, disappearance of small town and villages, but intensive development of the large cities.

In 2012 in Moscow, there was an important event - *The international Urban competition for the elaboration of the draft concept of the Moscow city agglomeration development*. It was made a significant impact for the future development during the next 6 years: Moscow needs the rethinking the river complex system, the nature and park complex system, the transport system. As the next action there was held *The competition for the concept of the urban development of the territories adjacent to the Moskva-river (2014),* and others competitions. So, the Moskva-river was considered as a unique landscape unit or area. There were defined 5 goals[8] to be achieved in the competition elaborations:
- reorganization of the embankments of the priority of formation of public spaces;
- ensuring permeability and improving links between adjacent areas and river;
- improving the quality and comfort of the urban environment, improving the appearance of the territories in order to improve the overall image of the city and making it more attractive for residents and tourists;
- improving the environment through the rehabilitation of the river and its valley complex;
- improvement of investment prospects for the relevant areas through the enhancement of market value of existing and planned real estate assets.

We can structure those goals into six aspects: public space aspect, requalification aspect, interconnection aspect, ecological aspect, attractiveness aspect for people, and attractiveness for economic aspect. If we make the comparison with the Italian concept of enhancement, which includes such functions: to promote the development of culture, requalify buildings and areas, public use of the landscape, creation the new landscape values; we can define that the goals of the Competition are partly equivalent of the Italian concept of ‘enhancement’, and don’t correspond to the function ‘to promote the development of culture’.

6. Importance of Landscape for Planning in Russia.

During the research there were elaborated the questionnaire on the theme of landscape for the interview of the Russian specialists in the field of landscape planning, urban planning and architecture. The goal of the interview is to analyze how the specialists of the field take into consideration the theme of landscape planning in the Russian Federation. Next will be shown some answers for the one question for the interview:

How important is the 'landscape' for living and everyday life for the contemporary person?

Answer of O.E. DRUZHININA, Architect, associate professor in the Moscow University of Architecture; leading specialist in the Laboratory of Urban Studies of the University of Architecture in Moscow; main research interests - urban and regional planning:

“The landscape for the man - it is at the same time, and a place of life (environment), and the source of life (resources). The landscape contributes to the formation of an individual’s perception of the world around him: of the characteristics of the relief / terrain (mountain / valley), nature (aqua / forest / steppe, etc.), of the forms and activities of human action, of the types and forms of human settlement, of the man-made objects (buildings / structures), of history and culture. In the interaction between man and landscape it develops an active human relationship (responsible) or passive (consumer) to the world”.

Answer of A.V. KHOROSHEV, PhD Geographical Sciences; Member of the International Association for Landscape Ecology (IALE), Member of the Russian Geographic Society, Associate Professor, Lomonosov Moscow State University, Faculty of Geography, Department of Physical Geography and Landscape:

“From the point of view of visual sensations - an exceptionally high value. From the point of view of the understanding of natural processes (movement of matter in a wide sense) - often ignoring of landscaping principles in decisions during the planning”.

Answer of F.S. KUDRYAVTSEV, Architect, General Director of Architectural bureau ArchNOVA LLC, Head of the Laboratory of Urban Studies, Moscow University of Architecture:

“It is important, but there are changes, but to judge by how deep and inclusive they are serves the research. It seems to me, that in our culture, the landscape has always been important, words like expanse, vastness / «раздолье, ширь» have not yet disappeared, if they are still in the language is, then they are also is in our culture. The landscape itself is changing, for various reasons, become less permeable, attitude to the landscape also is changing. Both in natural or uncontrolled manner, but the landscape begins to change much more. The landscape is important, but this is the subject of specific research. Now, a person can create a world completely without landscape, but before he could not”.

Answer of A.A. SKOKAN, PhD, President, Founding Partner, Chief Architect in the Architectural Bureau Ostozhenka (www.ostarch.ru), Corresponding Member of the Russian Academy of Architecture and Construction Science (RAASN, www.raasn.ru):

"The 'landschaft' («ландшафт») is that outside of the city, the countryside (though of course there is the urban landscape, 'paysage') – 'out of town', 'kraiobraze'. And this countryside - is what is essential for the people of the city, what them lacks in their urban existence. This rural landscape should be harmonious and should remember the eternal values of nature – spaciousness, beyond the horizons, open sky (if it is not the forest) – everything that can be contemplated to recover from the hustle and bustle of the city. In other words, from the landscape for us serves its contrast with the city, it is a kind of emotional contraposition with the city".

Answer of A.A. TISHKOV, PhD in Geographical sciences, Deputy Director of the Institute of Geography of the Russian Academy of Sciences (www.igras.ru), Professor, Honored Worker of the Russian Federation for Nature Conservation (2003), Honored Worker of Science (2009):

"In fact, natural or man-made landscape - the basis for the strategy of the life. A person may (1) adapt to the landscape, (2) transform it in the right direction for himself, (3) live, without changing either himself or landscape, while remaining part of it. To save landscapes, landscape diversity - one of the major global problems of humanity. In this – all the diversity, which provides life itself – geological, biological, humanitarian, environmental management systems, languages, countries, people, habits, mentalities and more".

7. Conclusion.

The results of the study can be used as a basis for the preparation of methodological / conceptual guidelines, duly declined to the Russian case, aimed at studying, planning and designing documents and documents at federal level; the guidelines will be aimed at the conservation, conservation and management of landscaping assets and can provide methodological and scientific support for the drafting of some urban planning instruments of the Russian Federation.

Endnotes

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Urban Rehabilitation

Realities and paradoxes in Bairro Alto and Bica, Lisbon

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Synopsis

The paper discusses the current urban reality in Bairro Alto and Bica and under the scope of the next Urban Rehabilitation Plan, as a contribution to the Urban Planning Department of Lisbon. Critical aspects, in the research section, are to be presented.

1. An urban idea rooted in the Renaissance

Despite the unfortunate story involving the acquisition of the land, as a result of the persecution of Jews since the 16th century, Bairro Alto would be designed following a renaissance idea of a new modern and aristocratic neighbourhood.

Bairro Alto is organised, from a boundary defined by the *Moinhos de Vento [Windmill] Road* to the north and the east, along with the Wall of King Fernando, and which today consists of differently named streets: Escola Politécnica [Polytechnic School], D. Pedro V [King Peter the 5th], with extension to Misericórdia [Mercy] and Alecrim [Rosemary] Streets towards the Tagus.

Formosa [Beautiful] Street, marks the western end, known today as O Século (a former newspaper), and by Horta Navia Road, to the south, today called Calçada do Combro and Calhariz (is a local typology in which a road broadens and gain the scale of informal open space). In national urban typology a *Calçada* is the main access road, usually stepped and paved in stone. Bela Vista, as it is known since the 16th century, gave way to *Congro* or the Combro [possible translation is debris or quarry-like].

This road used to be the primary link between the inner wall city (considering the various walls throughout time and own western doors) and Madragoa, the suburb to the west and fisher harbour in Santos.

In its inner area, an orthogonal fabric of streets was laid, with slight adjustments to topography and previous existences. In the centre, a wider street runs entirely from one end to the other: Rosa [Rose] Street.

Adjacent to the western door of the Wall – Santa Catarina Door -, the fabric was to be marked by the width and pavement of its streets where 'even carriages could circulate' (as it became usual to say about Bairro Alto), as opposed to medieval streets, where buildings used to advance onto the narrow passages and even onto other buildings. One palace or other significant building should have occupied each block.

Ideas to urbanise the area between Bairro Alto, the Tagus River and Madragoa were also considered and materialised in due time.

Such a process was seeded by a European idea of an "up-to-date city" in a small but ingenious country, that had already launched the first mundialisation, trough the worldwide

Discoveries. That is, a new residential up-town (*Bairro Alto* means a neighbourhood in a top of a hill) completely different from traditional, busy, probably not very clean, downtown centre (which is what *Baixa* – low/down – means)

However, with the earthquake of 1597, the Hill of Santa Catarina collapses giving place to two different hills and originating severe topographic changes. Harsh cracks of great irregularity, like the one of the Belver Peak between the hilltop of Chagas and the hilltop of Sta Catarina. Hence, severely constraining the 16th-century urban fabric of Bica, Boa Vista and Well of the Negros (an outer Wall pit where, supposedly, African slaves were buried). The urban plan for this area is usually credited to architect Teodósio de Frias. (Calado, Matias Ferreira, p 28-29)

For this reason, Santa Catarina area seems to have kept, for a longer time, its rural character, with Santa Catarina Church as the most critical landmark (lost to a fire, later reconstructed in a slightly different place).

Iconography (usually tiles [azulejos] panels depicting the city from the Tagus, as a scenery) often portrait this area as a significant gap with a church on the top and of distorted proportions, due to its importance at the time. Bairro Alto disappears behind it. The Windmills at the top were also essential landmarks (and economic activity) in the landscape. Hence, the northern boundary's name and recurrent representation in different iconography (Windmills Road).

2. Modern perspectives of the City, in Bairro Alto: from the Enlightenment to the mid-20th century

After the 1755 earthquake that destroyed practically the entire city of Lisbon, Bairro Alto established new relations with the rest of the city as it has been mostly spared to the impact of the event. The reasons lay in its geographical location, the excellent construction of the neighbourhoods' buildings as they were exceptional (Convents, e.g.) and justly, the low rate of built occupation at that moment.

This new relation of the neighbourhood to the city redefined its limits and its internal cohesion. The roads that limited it became more exceptional regarding the architectural trends, working as a kind of border between Bairro Alto and the city.

From then on, Bairro Alto becomes separated from Chagas area. Chagas was the lower area which had been destroyed by the fires and tsunami as a consequence of the earthquake. This part of the city would later be significantly transformed - in quality and social profile – translating a later face of the architecture of Pombal.

As a result of the new plan to rebuild Baixa and further Pombal's interventions, a new set of urban typologies were introduced. The classical square made its first appearance in the city of Lisbon, especially in Baixa Pombalina, the newly designed downtown. There, *Terreiro do Paço* (open area paved by dirt in front of the Royal Palace) would give place to a ravishing Square of Commerce (following a new political age) open to the Tagus.

At Bairro Alto, the connection between O Século Street (or Formosa) and the interior of the neighbourhood resulted in some urban transformations, seeking to a better connexion within the context of the city.

It is a street of exceptional erudition, designed as a scenery to beautify the Marquis of Pombal Palace, absorbing the height difference and hiding a sophisticated aqueduct, between this street and the upper side, at the near level of *Convento dos Inglesinhos*, in the centre of the neighbourhood [Little Englishmen Convent], an exquisite Mannerist set of buildings from the 16th-17th centuries. Unfortunately, in the absence of a better fate, it became a private condominium, by the end of the 20th century.

Thus, some streets were rebuilt, causing the 14th and 15th-century lands to be reconfigured to different plot division, usually narrower to the streets and more extended in depth. The general urban layout was preserved, in any case. Pombal's buildings were later built along the eastern boundary, facing the old Wall, and especially towards the south, in Chagas, an upper-class neighbourhood.

Therefore, by the 18th century, and as usual in most designed/planned urban fabrics, Bairro Alto was shaping and adjusting to new challenges.

It still is.

Architectural typologies and the design of façades from the 18th and 19th centuries may now seem as very similar to 16 th and 17th centuries. However, five-story buildings were only introduced in Bairro Alto with the Marquis of Pombal Plan for the devastated city, after the 1755 earthquake, tsunami, and fire. Until then, buildings in Bairro Alto usually had two to three floors, even the most sumptuous.

Nonetheless, till the 19th century, this area remained somewhat rural, with less population density, and possibly occupied by much smaller buildings and farms. Large religious estates like the Jesus Convent or Cardais Convent, in the vicinity, were walled and these days' preserve of open space within a very dense urban fabric, with which they became intertwined.

In the 19th century, once again Portugal underwent hard times: Napoleon and the French occupation brought Lisbon down to a very different condition, and the Court moved to Brazil.

A civil war related to the succession of the new King of Portugal, state bankruptcy, deprived and derelict urban areas, an utterly delayed industrialisation, marked a challenging period.

Bairro Alto witnessed a socioeconomic change, with the settlement of leading newspapers in old abandoned palaces, generating a new artistic scene that expanded a bit throughout the neighbourhood. A certain bohemian and artistic flair brought the artists, but also prostitution, petty crime, and gambling.

A deprived small aristocracy rented their crumbling buildings to smaller newspapers, bars, and industrial workers for accommodation. Later, and already under the aegis of Fontes Pereira de Mello, a growing bourgeoisie would find new places to live, towards the north of Lisbon in Avenidas Novas [New Avenues], or Boulevards, designed by Ressano Garcia, following to an extent Haussmann Parisian model.

In addition to this expansion of Lisbon towards the north, Ressano Garcia dedicates his time to the management of the existent city as well. Hence, promoting infrastructure upgrade, mainly at the level of basic sanitation and the realignment of facades and pavements. Documents in municipal archives, interalia, show that it also happened in Bairro Alto and other older areas of Lisbon.

With the end of the monarchy (1908), the rise and fall of a very troubled 1st Republic with participation in WWI with significant casualties (1910-1925), a dictatorial regime would start settling from 1926 onwards, bringing profound restraints in architectural and urban design.

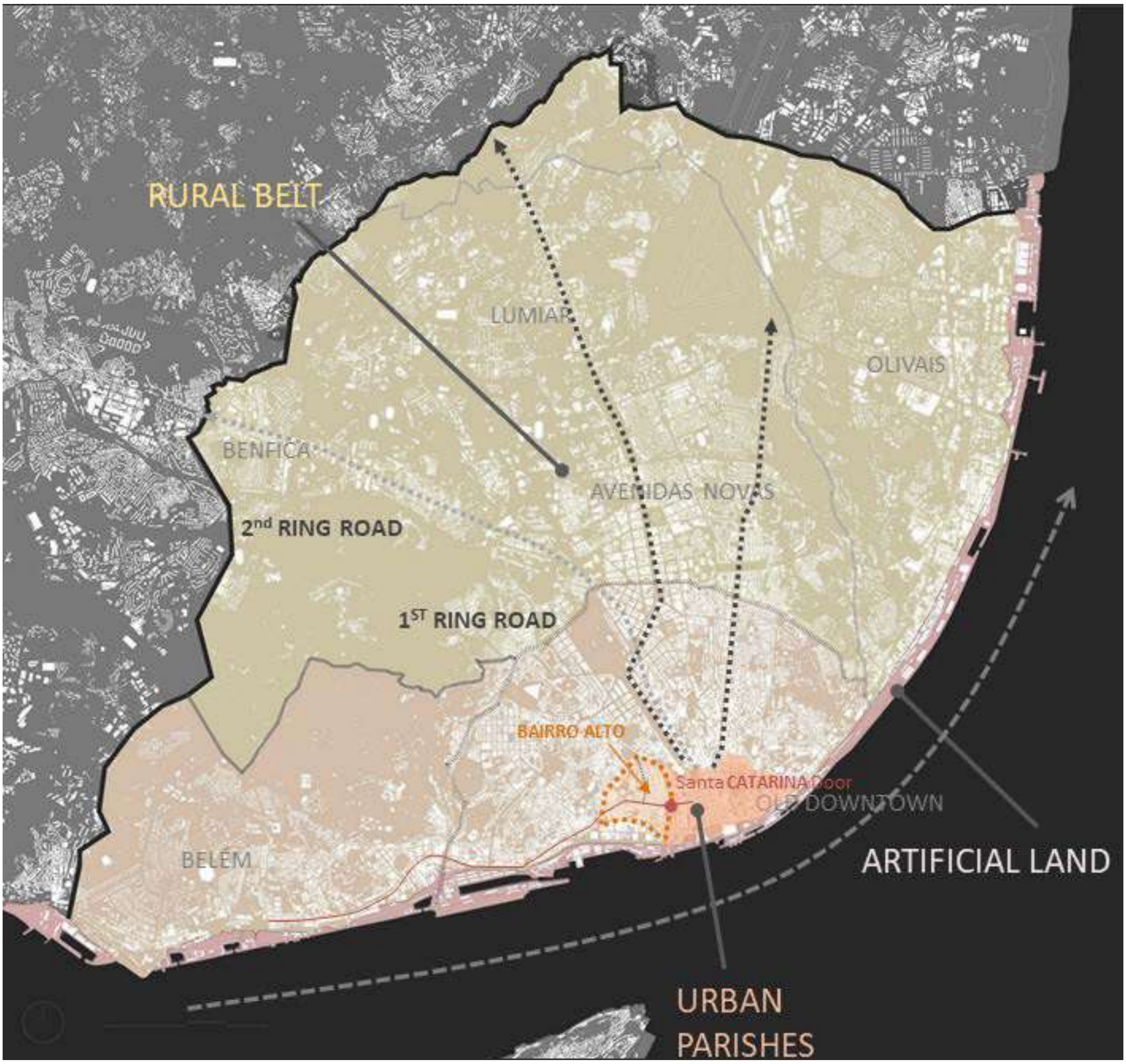
In 1951-52 a Partial Urbanization [Development] Plan was settled to remodel Bairro Alto. A survey was carried out by Sequeira Matos, a renowned connoisseur of the City of Lisbon, who included then a report.

However, Cristino da Silva, Chief Architect of the Plan, concluded that Bairro Alto did not have the necessary sanitary conditions to house the dense population and that was a severe obstacle to the future development of the capital's communications network, given the almost labyrinthine layout of its narrow streets.

Although Sequeira Matos concluded his report by referring to the care that should be taken in the intervention, the measures presented by Cristino da Silva would have definitively eradicated the Bairro Alto, had this Partial Urbanization Plan been implemented!

However, in areas now seen as heritage, similar plans were partially implemented, such as in Alfama, and even before, half of the Mouraria was demolished (in the Valley between Satana Hill and the Castle Hill). In either case, cloaked political motivations against the Regime opponents were well-known. They would endure until 1974, with the Revolution, ending in 1976 with the first free elections and a new democratic regime.

> *One of Bairro Alto's most exceptional qualities results from a complex overlapping of architectural interventions that run for four centuries without establishing ruptures or disarticulating the unity of the first urban structure*. (Carita, 1990, p 57).



Bairro Alto in the context of Lisbon. Source: Morgado, S., 2015, adjusted to this article by herself.

3. Urban Rehabilitation in Lisbon since the end of the 20th Century

By the end of the 20th century, and already since the 40s, Bairro Alto welcomed a new sort of population. Fado houses, bars and discos, restaurants, fashion designers and antique shops put Bairro Alto on the route to a particular intellectual nightlife. (Carita 1990, p 44) While the ground floors received newcomers, the upper floors started losing residents, as the quality of the built environment decayed, and the resident population began to age.

However, this transformation in the neighbourhood's profile would be followed by the exponential increase of tertiary activities and replacing the vacant housing.

Small offices and shops moved into this very central place, following the urban and metropolitan development and the dawn of an economy based on knowledge.

Commuters by day and night activities soon started conflicting with an increasing loss of the heterogeneous local population, with their own identity and social dynamics. Such a trend would increase to the present day with new challenges put by, amongst other situations, austerity and a growing touristic pressure.

The first Urban Rehabilitation Plan in Lisbon was to the historic district of Alfama, in 1986, with the primary objective of promoting the recovery and adaptation of old buildings to current requirements of comfort without harming architecture. In the urban realm, the aim was to provide local shopping, healthcare and education facilities without tampering with the traditional urban environment. The Plan aimed at creating habitable conditions and favouring the permanence of local populations (Gaspar et al., 2006, pp. 397-400).

In the same year, the new Urban Rehabilitation Plan to the historical district of Mouraria and Castelo looked for measures to stop the process of physical and social degradation in the set of parishes of the area. Taking into account the traditional characteristics of Mouraria, it was sought to preserve the identity and memories of the community, primarily by fado singing and taverns and the entire ambience that is its main feature (Gaspar et al., 2006, pp. 397-400).

In 1990, the Municipality launched the Bairro Alto and Bica Rehabilitation Plan. As in previous neighbourhoods, Bairro Alto and Bica is an area where the built environment reached a rather high level of deterioration, while the inhabitants show severe underprivileged social and economic conditions. The primary goals of the Plan would focus on rehabilitating the built environment and improving the living conditions of housing, while maintaining the resident population levels, attracting and fixing younger groups, possibly younger families (Gaspar et al., 2006, pp. 397-400). To that end, several buildings were purchased, in different locations in Lisbon, including Bairro Alto, requalified and put to market, under specific conditions by EPUL (Lisbon Urban Public Enterprise)

4. Urban Rehabilitation as an urban management concept

At the international level, the safeguarding and rehabilitation of historic centres were actively promoted by the 1964 Charter of Venice, which extended the notion of heritage to settlements, sites, and landscapes, hitherto conferred only on monuments.

Additionally, the conservation of a monument implied the preservation of a framework on its scale (art.6, Charter of Venice, 1964). The Charter of Venice and other documents and relevant authors, such as Choay, were sought of to fight practices that had been installed by all Europe, coming from the concepts of heritage developed in the 19th century and early 20th century. In 1910, Portugal would frame the first attempt to preserve unique buildings classified as monuments. However, the journey towards these days' idea of heritage - from tangible to intangible – was still a long one to do.

The principles of the Charter of Venice would later be supplemented, in 1976, with the Nairobi Declaration, on the Safeguarding of Historic Assemblies and their Role in Contemporary Life.

The Charter for the Conservation of Historic Towns and Urban Areas - The Washington Charter (1987, ICOMOS) also reinforced the ideals advocated in previous Charters. Thus, this Charter defines a set of principles and objectives, as well as methods and instruments of action, seen as appropriate to safeguarding the quality of historic cities, ensuring the report to historical towns and centres or districts threatened with deprivation or disruption, (point 1, The Washington Charter, 1987).

Following the newest survey on Popular Architecture, Portugal entails the international recommendations. So, from the 80's onwards, a cycle of safeguarding and rehabilitating the historical centres of cities and towns began, promoting the conservation and restoration of buildings and urban structures with heritage value.

Maintaining the resident population in these places, through the restoration of monuments, the improvement of the living conditions, and the qualification of the public space, was pivotal. Promoting the economic and cultural dynamism of the place was also an essential trait to the process. (Gaspar et al., 2006, p 384).

Thus, the late 20th century would become one of the most passionate periods in architecture and urbanism, in Portugal.

5. Through the lens of democracy

Urban improvement in Lisbon has its origins in the urban struggles of the post-25th of April when inhabitants of disadvantaged neighbourhoods organised to fight for better housing and living conditions. However, it was not until the 1980s that the local technical offices began to appear in the historic districts.

Locating the offices in their area of intervention has changed the relationship between the population and the local administration.

The population had direct access to the support services; the technicians directly involved with the problems of the neighbourhoods allowing participative and personalised management. Since it was not yet possible to carry out the initial plans, the work was developed based on the existing legislation and the provisional norms of the Municipal Master Plan. The areas to be rehabilitated were declared critical sites for urban regeneration and reconversion by the Government, under the proposal of the municipality.

In 1988 a local office was created to coordinate the works of Bairro Alto. Urban rehabilitation was considered a fundamental strategy in the recovery of the city.

Lisbon adopted strategic planning in the 1990s, as well as active urban management. It included a hierarchy of instruments ranging, top down, from the Lisbon Metropolitan Area, *i.e.* regional strategic level to the municipal levels of planning.

Lisbon Master Plan has finally ratified in 1994, tailed by different Development and Detail plans, that only later could be implemented. This shift gave rise to new legislation, mandatorily abided by all municipalities in the country, under the requirements of the structural funds provided by the EU (then EEC).

The approach aimed at maintaining existing structures, through the functionalisation and revitalisation, captivating private investment and appealing to the participation of the resident populations.

Urban planning in Lisbon focused on fundamental aspects such as the re-dimensioning, reorganisation and revaluation of the city centre. Such goals implied a number of actions including (1) recovery and rejuvenation of the population; (2) structuring of the tertiary-directional arc; (3) connecting the city to the river; (4) development and integration of the eastern zone with Expo'98; (5) creation of a system of transport interfaces; (6) build and consolidate the green structure; and finally, (7) the reinforcement and rehabilitation of the central historic areas. Bairro Alto was integrated, with its Development Plan. In short, this was the main layout of the 1st Generation Master Plan for the City in 1994.

6. The scope of the empirical survey

Slowly, but steadily, Bairro Alto - as seen - evolved into a place of taverns, gambling, and prostitution and that is how the 19th century will find it. This trend will last till the 1950's when it starts becoming attractive to artists, dropouts, alternative people in general who benefit from a new direction connected to current fashion joints, antique shops but most of all, revamped taverns, new trendy restaurants, and bars. More recently, hostels, typically "new" old shops and high-class franchising, side by side with entirely refurbished buildings pop out daily.

However, to duly intervene in such an intricate urban, functional, social fabrics, empiric recollection was done, which allowed improving methodological approaches. Throughout the last two years, a team at the Lisbon School of Architecture, University of Lisbon, in its research group Murbs (CIAUD), has been carrying out a broad set of tasks which are to form part of the next Urban Rehabilitation Detail Plan of Bairro Alto and Bica (PPRUBAB),

The officially published Guidelines for the Plan (*Termos de Referência*) frame the study, which consists of a rigorous survey on land use, conservation, and heritage by design, photography and GIS of Bairro Alto and Bica. It will develop under the umbrella of the National Law for Urban Rehabilitation.

The team resorted to information gathered by building and street (with the assistance of drone, laser distance measurers, and a full photography portfolio) and available in GIS thematic cartography (land use, number of floors, construction type, maintenance status, and so forth). Heritage, land use, public space, and conservation state were mapped.

A designed code was applied, street by street. Quantities and qualities are under trial.

In this case, the study is applied to the Area of Intervention of the Urban Rehabilitation Detail Plan of Bairro Alto and Bica (PPRUBAB) and balances, in scientific terms, the work currently carried out by the team in collaboration with the Municipality of Lisbon's Planning Department (CML) for the Urban Rehabilitation Plan.

At the research level, the project aims to study and develop urban intervention strategies and practices in areas to be valued and preserved regarding urban and architectural heritage, lifelong ageing inhabitants and short-term younger residents, under heavy touristic pressure.

Public space, temporary and permanent forms of housing, socio-economic trends induced by a rising touristic curiosity, such as harsh gentrification, management and redesign of minimal-size public space under shortage of parking and car space in an old and delicate fabric, are critical factors to consider.

It gained additional interest, as a Masters' group of students dedicated their Urban design and planning studios (2 semesters), not only to interact with the Planning Department Team but also contributing to the start of the tasks (some of them would later join the team at Murbs) and developing solutions for the area.

While the team is not in the liberty of disclosing privileged information, the paper aimed to explore interrelated contents, drawn by research on current dynamics in the urban realm.

The team expects that this and further work will allow for responsible development of urban design strategies, grounded in heritage, environmental and social dimensions.

7. Debates

Despite the efforts of the technical teams in the elaboration of safeguard plans, there are still problems to overcome, to achieve the expected purposes, about the rehabilitation of these historic neighbourhoods.

The exponential access to culture and social matureness allowed the increase in the demand for cultural and leisure activities, which translate into tourist development as well. Urban rehabilitation and cultural heritage are promoters of wealth (Barata, 2005, p 260 - 269). As such, safeguarding and recovering heritage are no longer a burden but, conversely, a strategic investment. Integrated into a policy framework for tourism development and increasing competitiveness, however.

In the rehabilitation of historic centres, there is still some lack of criteria for the selection of the architectural elements to be preserved, together with measures for the repair of buildings. Very often, options lead to controversial building requalification practices.

The Declaration of Nara, which sets out guiding principles for assessing the authenticity of heritage, reflects the values of the 1964 Venice Charter, stressing the importance of cultural diversity as irreplaceable in the context of humanity (paragraph 5, Declaration of Nara 1994). However, the evaluation and conservation of cultural heritage depend on the ability to understand the intrinsic value to it and the credible degree of the information on the characteristics of the specific object considered as heritage (points 9, 10 and 12, Declaration of Nara, 1994).

One of the aspects of urban rehabilitation in the historic neighbourhoods is, significantly, the qualification of the public space. In short, the strategy adopted should be integrated, and transversal to all sectors - from architecture and public space to accessibility, environment, and heritage. Under the scope of the new generation of Municipal Plans, the Municipal Master Plan of Lisbon ratified in 2012, with several amendments adopted. One may infer, that new perspective promoted rekindling in development and detail plans, especially in those that remained inconclusive for so many years.

The city of Lisbon, under a prolonged demographic loss, joined new processes of urban rehabilitation in the oldest and traditional districts of the city. Later, an increasing urban pressure resurfaces as unexpected forms of gentrification. Nowadays, shortage of affordable housing in the centre and a growing interest in short time residence, mainly associated with a tourist interest of very significant dimensions, are raising the toll to the ones who wish to remain where they were born.

These phenomena, which are beneficial in economic and cultural terms, even to fund urban rehabilitation, have been challenging (or should we say tantalising?) the municipal executive, lashing citizens' movements and, political – either for or against -, to introduce useful tools, especially in the areas of greatest heritage interest, to prevent crude evictions of previous inhabitants.

In this sense, one may say that old problems rise as new. Given fresh perspectives on the urban dimension, new technologies for its management and the necessary valorisation of the public space and the built heritage, they re-emerge as urgent in daily media. With renewed instruments and through different lenses, three Plans would step forward. The first to be implemented, with success and awarded quality, was the Urban Rehabilitation of Mouraria, followed by a Plan to Madragoa. Bairro Alto and Bica, for which this team was called to collaborate in, will be the third. These are prime planning and design examples – that will be intensely scrutinised -, in top sites of Lisbon.

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Research on the scopes of eco-tourism development of areas along transregional mega linear projects of China ——a practice study of Yin Jiang Ji Huai Project

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ABSTRACT:

Due to the historical legacy and continuous promotion of the construction of mega infrastructure in
China, China has more and more trans-regional mega linear projects, such as the BeijingHangzhou Grand Canal, the South to North Water Diversion Project, the tourism road along the Yellow river, etc.

As these projects generally have a huge impact on the surrounding ecological environment, meanwhile multi eco-tourism resources are also enriched in the surrounding areas, how to develop eco-tourism which is based on ecological protection is one of the key concern for the decision makers of these projects.

In this context, planning or studies of ecological protection and eco-tourism development of areas along this kind of projects have emerged in recent years. One of the core tasks of these planning or studies is to research and define the controlling, radiation, and linkage scopes of eco-tourism development of the areas along the projects, for providing significant reference to the planning, construction, ecological restoration, tourism development and management of them.

However, this is where the difficulty lies: these projects involve a lot of administrative areas, and the topography, ecological environment, tourism resources and management bodies along them are extremely complex.

This paper attempts to explore an operational method and route for delimitating the scopes of the eco-tourism development of the areas along the trans-regional mega linear projects.

First of all, this paper will research three other relevant planning or studies——the study of national heritage and ecological corridor of Beijing-Hangzhou Grand Canal; the planning of eco-tourism belt along the middle route of South to North Water Diversion Project, the top-level design of the" tourism road along the Yellow river" Project——for studying and summarizing their methods, routes, and theories of delimitating the scopes of eco-tourism development.

Secondly, discussing the common route of delimitating the scopes: determining the priority of influencing factors——determining the scope levels ——determining the planning and control content within each level . Based on the route, we try to construct the theoretical model—— "multidimension flexible scopes". The model includes flexibility of special levels, flexibility of management, flexibility of planning control, etc.

Finally, focusing on the practice case ——the Yin Jiang Ji Huai project (project of diversion water from Yangtze River to Huai River), to explore the application of the theory in practice. The project is China's major water conservancy project after the Three Gorges Project and the South to North Water Diversion Project, which is also the most comprehensive strategic water resource allocation project in China. The project is more than 580 kilometers long, connecting the Yangtze river and the Huai river, and passes through two provinces with 46 counties and districts.

Developing a Conceptual Framework for Planning of Location- Allocation of Schools in Indian Cities

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Abstract

The government of India claims to have provided a school at a distance of 1km for every household in the country. Nevertheless, the majority of the parents do not prefer to send their children to the neighboring school. It is estimated that an additional 200,000 schools will be required in the near future. Hence comes the role of the city planners to control the siting of the heavy surge of the upcoming schools. An in-depth analysis of the current trends of school siting is done. To come up with an efficient approach for siting schools, theories about school effectiveness is studied. This study infers that the neighborhood concept of school is very effective from the locational point of view for an overall development of a child. However, it has its own limitations which makes it difficult to be applied, especially in the countries like India. The study concludes with an approach for the planning of school siting which respects the idea of neighborhood schools.

Keywords- school siting, neighborhood schools, school effectiveness

1. Introduction

Construction of a school requires a huge investment of capital, time, and resources and they are permanent structures having both transient effects on mode choice of children traveling to school as well as perpetual effects on the spatial development of the community (McDonald 2010). Location of schools is important from the perspective of school effectiveness, in terms of academic success and physical health and wellbeing (Angus 1993). A good location can promote community participation in the education of children (Sanders 2001), increase the rate of walkability and control the mode of transportation (McDonald 2008a). If sited in a neighborhood, it can provide space for several community facilities like library, sports ground, and amphitheater which otherwise is difficult to provide in the urban space crunch. It can restrict inequality of social infrastructure (Pal 2010) and most importantly, provide educational facilities according to the spatial characteristics of the region and help in reduction of social disparities (Hallak 1977). However, due to the growing education programs and owing to the need of future expansion and economics of scale, schools require having huge acreage of land which is not possible to acquire in the core urban areas. Therefore, schools tend to shift at the outskirts of the cities, where land is available in profusion and at lower price, a process termed as school sprawl. Nevertheless, this trend is perceived to have a lot of repercussions and the contemporary educationists and planners are making their effort to bring back the principles of neighborhood schools.

The main question addressed in this paper is that are the policy interventions imposed by the Indian government efficient enough for an equitable provision of schools. The discussion starts with the evolution of contemporary school system and how it led to the formation of the school siting guidelines. It then delves into how the concept of neighborhood schools came up along with its advantages and disadvantages. Next, it analyses the current trend of school siting and its repercussions that have come up. The importance of neighborhood schools, from location point of view is established. This is followed by identification of the gap in the policy intervention which does not allow the implementation of the neighborhood schools in Indian Cities.

2. Education: An evolutionary perspective

A profound discussion about the location of schools requires a little apprehension of the evolution of the contemporary school system in order to understand its importance and recognize its flaws. Initially, till the 1700s' the education was very informal in nature, significant only for the elite class(Murphy 1998) and the impartation was the responsibility of the religious institutions rivaling for their students (Bryk et al. 1993). The industrial revolution in the 1800s' brought an upsurge in the economic condition of the people. Therefore, the custom of child labor started breaking off and childhood began to be fathomed as a phase of learning (Gray 2008). The idea of universal education was highly appreciated and the advanced nations enacted laws of compulsory education. A revolutionary system of education was evolved in Prussia which was able to impart mass education, highly inspired by the industrial revolution of that age (Gray 2008; Khan & Noer. 2012). In 1837, Horace Mann, the head of Board of Education of Massachusetts, adopted the same model in the American states in order to produce an egalitarian state. By 1870, this became the most generic model of the education system, throughout the word and by the end of the 1800s', the system was highly formalized by setting a standard time period and curriculum (Khan & Noer. 2012).

3. The Idea of Neighborhood Schools

By the end of 19th century, schools had become important social infrastructures. Also, the industrializing cities had new characteristics that needed new planning principles. Clarence Arthur Perry, came up with a solution with a new planning model having neighborhoods as self-contained and functional planning units, in his paper in the 1929 Regional Plan of New York and Its Environs. One of the core principles of his neighborhood unit was a school-centric design where a school was the focal point of a neighborhood, situated at a walkable distance from all the residences (Perry 1998; Lawhon 2009). This was the first mention of the location of schools in the planning principles. It was universally appreciated and is adopted till present for its successful idea of making schools accessible.

3.1. Advantages of neighborhood schools

Several nations today follow the system of school districts, where every school has a defined attendance zone from which students are entitled to get enrolled. Students from other school zones are not eligible for admission to the school or they are deprived of some facilities. The biggest advantage of a neighborhood school is its practicality in terms of distance, time and other logistics (Beaumont 2000; Beaumont 2003; Allen 1977). Proximity gives parents opportunity to participate in their children's education, by interacting with schools and other parents (Beaumont 2003; Beaumont 2000; Net Industries 2017). Community feeling, which is important for an adolescent's growth is fostered in a neighborhood school since they are able to develop better bonding, belonging to the same location (Allen 1977; Sinha et al. 2005). Research has also shown that a group of adolescents tend to have better academic performance if they attend the same school (Sinha et al. 2005). Schools earlier used to be built as important landmarks to inspire civic pride and sense of community in the children. Neighborhood schools also avert dependence on vehicular transportation which is proved to be one of the reasons for children delinquencies (Beaumont 2000; Net Industries 2017).

3.2. Criticisms of neighborhood schools

Apparently, the system of neighborhood schools has its own limitations, which have been identified by the researchers very well. The first limitation is that there is lack of diversity which restricts children's personality development and tends to propagate social disparity (Sinha et al. 2005). Some argue that it is an outdated concept and it does not let the schools match with the current benchmarks (Beaumont 2003). The small size of the neighborhood schools is also criticized for the poor economics of scale and for not being able to provide enough space for extracurricular activities (Beaumont 2000). It lacks sustainability due to the incessant chance in the school going population of an area (McDonald 2007) and it may not always be possible to meet the threshold population of a school in every neighborhood, and thus, this school system may only be suitable for moderate to high-density neighborhoods (McDonald 2008a). It is also accused of promoting social segregation in the society on the grounds of race and other social classifications (Allen 1977; McDonald 2008a). In response, the United States government had started a bussing system to transport children from one neighborhood to schools in other neighborhoods with different socio-economic characteristics.

However, it was very interesting to note that when these authors had highlighted the drawbacks of the neighborhood schools, at the same time they had given suggestions and some counter-arguments against the criticized points as well, again making us realize the significance of the neighborhood schools. To counter the lack of diversity in the neighborhood schools, Sinha (2005) suggested allocating children from nearby neighborhoods with different socio-economic characteristics in a particular school and schools to encourage pupils in versatile areas. In order to prevent social disparity, there can be fixed lower and the upper bounds to the number of students from the same neighborhood who can take admission in any school. One of the most prominent criticism is about the restrained size of the school which does not let it meet the standards set by the authority. But the renovations of historic schools in Spokane, Washington; San Antonio, Texas; and Boise, Idaho, challenge the notion (Beaumont 2003). Moreover, large school buildings are not desired from design aspect and many educators suggest that smaller scale enables more personalized attention and provides a safer and more secure environment for the students. Research has also shown that though large schools at sprawl areas provide better sports facilities, the increased distance make children dependent on motorized transport which increases the percentage of overweight children (Beaumont 2000; Beaumont 2003). Also, according to Beaumont (2000), appropriate size and community centeredness are the two most important elements of a good school. Neighborhood schools are also condemned for aggravating racial segregation, so much so that the federal court of the United States had taken initiatives like the bussing program for its alleviation. Nevertheless, the initiative itself became one of the most controversial decisions for up surging transportation costs and abolishing the system which was believed to be the finest way of educating children (Net Industries 2017). Parents were concerned about the loss of the sanctified feeling of schools, loss of community feeling which would impede social bonding and the majority of the parent's valued neighborhood schools for practical reasons like cost, comfort, and logistics (Allen 1977). Furthermore, the allegation of impracticality in terms of meeting the threshold population of schools was resolved by MCDonald (2008) by suggesting that though, it is not possible to ideally follow the concept, including children's distance from school as a planning criteria is an effective way to change community design and encourage walking and in low-density areas and planners can optimize school development placement so that maximum number of children live within a walkable distance from their school (McDonald 2008a).

One important revelation from this review is that school choice does not seem to have an easy solution. However, it has its own benefits and the arguments in favor of it make impossible to ignore it. Thus, it becomes an important factor to consider while planning for school location and allocation.

4. Current Trend of School Siting

There are several studies which throw light on the current trend of school siting (Ewing & Greene 2003; Gurwitt 2004). The expansion of education program with every generation, demands for increase in the minimum size standards for school sites, resulting today, in such huge size requirement that is impossible to find in an urban area and thus, schools are forced to locate themselves at the outskirts of the city, away from the high demand region, a trend which is commonly known as school sprawl (McDonald 2007; Langdon 2000). Other reasons for large school campuses are scope for future expansion, space for recreational and sports activities, accommodation of huge admission demand and to harness the economics of scale.

4.1. Reasons behind this trend

Due to this growing concern, planners and social scientists have been trying to find out the reasons behind these trends. Some identified reasons are (a) school choice (Warrington 2005; Grize et al. 2010a), (b) schools shifting to outskirts due to policies like minimum acreage requirement for a school campus (McDonald 2007), (c) lack of consideration of school and residential location at the time of planning new communities or school attendance zoning (Timperio et al. 2006) and (d) trends like closing the current neighborhood schools and opening new bigger schools at the urban periphery for economic efficiency (Mitra & Buliung 2012).

4.2. Repercussions of Current Trend of School Siting

The current trend of school siting, which is increasing the distance of schools from residences is however not generally appreciated (McDonald 2010; McDonald 2007). Countries like Canada (Frenette 2006; Mitra & Buliung 2012), Australia (Timperio et al. 2006), Belgium (Van Dyck et al. 2010), Switzerland (Grize et al. 2010b), U.S. (McDonald 2008a; McDonald 2007), and states of U. S. like Oregon (Schlossberg et al. 2006) and Texas (Lee et al. 2013) have already recognized it as an issue and have started talking about its consequences, finding out the reasons and suggesting practical solutions.

4.2.1. Decline in Trend of Active School Transportation

Active school transportation is the use of active means, such as walking, bicycling and other non-motorized mode of transportation to and from school. They are assumed to be an active source of physical activity in children.

One of the biggest concerns about increasing distance of schools from home is the constant decline in the rate of active school transportation in children around the globe. This impacts children by filching away one of their favorable time of physical activity (Schlossberg et al. 2006; McDonald 2007; Mitra 2013; Black et al. 2001), the consequence of which has been observed as the increasing number of children becoming obese (McDonald 2007; Evenson et al. 2003; Black et al. 2001). It builds a car-dependent lifestyle at the very childhood (Black et al. 2001), which is a critical age for developing healthy habits to continue them lifelong (Schlossberg et al. 2006). It also hurdles children from developing a sense of independence (Banerjee & Lynch 1997). On the other hand, students walking to schools develop a traditional identity of the school in the community, which sadly has ended(Schlossberg et al. 2006). One serious accusation is also about increasing the traffic congestion during the commence and dismissal hours (Schlossberg et al. 2006) and affecting the local environment by adding to the air pollution (Black et al. 2001).The following table shows the declining rate of active school transportation that the researchers in different countries have found out:

Table 1: Declining rate of active school transportation

Country	Statistics	Source
United States	In 1969, 42% American students walked or biked to school whereas, in 2001, it was less than 15%	McDonald 2007; McDonald 2008b
Switzerland	In 1994, rate of active school transportation was 78.4% whereas, in 2000, it was 71.4%	Grize et al. 2010
Australia	In 1971, rate of active school transportation was 44% whereas, in 2012, it was only 22%	Ploeg et al. 2008
Canada	In 1986, rate of active school transportation was 53% whereas, in 2006, it was 42.5%	(Buliung et al. 2009)

United Kingdom	In 1975, rate of active school transportation was 71% whereas, in 1994, it was 662.3%	(Black et al. 2001)
China	In 1997, rate of active school transportation was 96.4% whereas, in 2006, it was 85.9%	(Cui et al. 2011)

4.2.2. Loss of Valuable Time of Children

A generous amount of investment in terms of time, money, psychological and emotional capital is required to grow up a child (Haveman & Wolfe 1995). The way children spend time effect their social and cognitive development (Hofferth & Sandberg 2001). A quality time filled with various social experiences bestow different skills and knowledge to the children. But unfortunately, children lose a lot of valuable time in their ambitious school activities(Goldscheider & Waite 1991), especially in traveling from home to school (André-Bechely 2007) which they can use for other productive activities important for their overall development. This also leads to improper sleep timings of children leading to behavioral problems (Wolfson & Carskadon 1998).The average time spent by children in different activities in different countries is illustrated in the table below:

Table 2: Time spent by children in different activities

Country	Time in School	Time in Sports	Source
United States	2.7 hour per day	48 min per day	(Larson & Verma 1999)
Italy	4.8 hour per day	8 min per day	(Larson & Verma 1999)
Korea	5.6 hour per day	7 min per day	(Larson & Verma 1999)
Japan	8.6 hour per day	1.08 hours per day	(Fuligni & Stevenson 1995)
China	7.3 hour per day	-	(Fuligni & Stevenson 1995)
Taiwan	7 hour per day	3.4 hours in sports	(Fuligni & Stevenson 1995)
Germany	-	52 min per day	(Larson & Verma 1999)
India	4.6 hour per day	4 min	(Larson & Verma 1999)

4.2.3. Community Participation in Schools

School effectiveness is a field of research which quests for analyzing the practices followed in schools and correlating them with student's achievements in academics and social life. Models like overlapping sphere theory(Epstein 1995) are developed to structure the school program highlighting all the interactions required by the children for overall development. This theory states that when school, family, and community work in partnerships, a caring community is formed around the children and helps them gain more developmental benefits. Epstein gave six types of involvement tips of family, school, and community(Epstein 2009).

5. Review of Educational Policies in Different Countries

A brief review of educational policies of different countries was done to check how important the location of schools is regarded at policy level around the globe.

Few people know that apart from Nokia phones, Finland is also known for its outstanding performance in PISA and World Economic Forum. They believe in small but sufficient time to be spent in education and have empowered every child to study in the nearest mainstream school. For this, they follow a decentralized education system in which the municipalities are authorized to take decisions under the supervision of the National Board of Education (Hautamäki et al. 2008; Seppánen 2003; Antikainen & Luukkainen 2008). The United Kingdom promotes sustainable travel and transport and has also recognized walking and cycling to school as effective ways to increase physical activity in children (Department for Education UK 2014). Singapore's Ministry of Education has mandated all primary schools to give priority to applicants who reside within one kilometer of school (Liand & Warrier 2015). South Korea has gone through numerous educational reforms focusing on consumer needs, diversity and school choice, which is realized to be a major concern by the service providers (Seth 2002; Kim 2004). Japan has established walking to school practice since 1953. The Board of Education in each municipality determines the method of commuting by considering geography, climate, and transport situation. This has helped them reduce childhood obesity rates by providing sufficient physical activity (Mori et al. 2012). China implemented its first compulsory education law in 1986 when it ensured the children to get their education in their neighborhood by directing the local governments to setup elementary and secondary schools. The Chinese education system provides free education and advocates school districts by exempting examinations to attend a neighboring school. In 2010, the National Long-Term Plan for Education Reform and Development has mandated the local government to regulate the school distribution to make it convenient for the students to attend neighboring schools (Zhao 2014). The transportation department in Queensland, Australia lays stress on increasing awareness about healthy living and promotes physical activities through walking and cycling to school (Department of Transport and Main Roads State of Queensland 2016). The United States has started to encourage more neighbor centric schools that are closer to students, teachers, and staff. They recommend the use of existing infrastructure for conserving energy and resources and also direct the schools to offer other facilities in the after school hours that can be used by the nearby residents (Ewing & Greene 2003). Chicago follows a multidisciplinary approach to understand the neighborhood schools and their potential impact (Sinha et al. 2005). Schools in Oregon are community focal points that are easily and safely accessible (Ewing & Greene 2003). The walkable communities in Manitoba have schools as their neighborhood landmark which strengthens their social network by providing an interactive space for people of all age. There is a collaborative consultation for site identification of schools which ruminates projected dwellings for new developments, expected timeline for development and the anticipated increase in school-age children (Province of Manitoba 2016).

6. Need of a Robust School Siting Guideline in India

According to census 2011 of India, 28.5% of the Indian population, which accounts for around 373 million, belongs to the age group of 0-15 years, which is the largest school-going population in the world. This has created a huge demand-supply gap requiring an additional 200,000 schools in the country (India Brand Equity Foundation 2017). At the same time, there is an upsurge in demand for education from the consumer side as well. The literacy rate in India has increased from 64.83% in 2001 to 74.04% in 2011. The enrolment ratio in schools has risen by 12.53% from 7th AISES in 2002 to 8th AISES in 2009. The per capita public expenditure on education has increased from Rs. 888 in 2004-05 to Rs. 2985 in 2011-12. (India Brand Equity Foundation 2017; Ghosh 2014).

These statistics show that in near future, the nation, especially the urban areas are going to see a stream of new schools coming up. The current scenario shows that out of the total number of schools in India, 78% of the schools are owned by the government and the rest by the private sector. But still, the percentage of enrolment in the private schools is 35% which is much higher in proportion (Ghosh 2014). Having realized the impending encroachment of private sector in the supply of schools (Pal 2010), it is very imperative to have robust planning guidelines for their siting to avoid an unsystematic emergence of schools which may further lead to a chaotic and inefficient space for society.

6.1. Neighborhood Schools in India

India has incorporated the concept of neighborhood schools in its planning through the enactment of the RTE Act, 2010 which enables every child to attain free and compulsory education up to the elementary stage in a neighborhood school (Ministry of Human Resource Development Government of India 2010). The government of India claims that 99% of the population lives within 1 km from a primary school (Ministry of Human Resource Development Government of India 2012). But the question is how many parents are sending their kids to their nearest school?

According to Larson and Verma, in their research done in 1999, children in India spend only 4 minutes per day in sports and almost 33% of their waking time is spent in school, not counting the breaks and traveling time (Larson & Verma 1999). The figures showing road accidents of school children in India add to the concern.

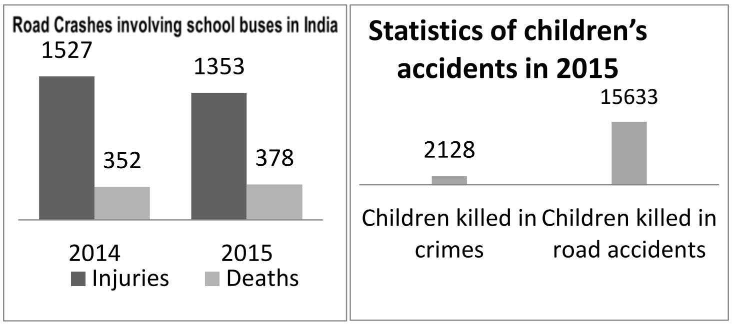

Figure 1: Figure 1: Road accidents of school children in India

Source- (National Crime Records Bureau 2015)

Finding Solution

There is a lot of emphasis in the literature on proximity and accessibility to schools. But it is not enough to provide a school in every neighborhood and provide universal accessibility. For in the countries like India where there is no concept of school districts and the practice of school choice prevails, parents often send their children to far off school even when there are schools in their proximity in search of better options in their view. Similarly, in the countries with school districts where the school is allotted on the basis of addresses of the children, often parents have to compromise a good residential location. Therefore, it is mandatory to understand the factors of every aspect, from personal and cultural to political that influence the school choice decision of parents in order to have an implementable policy.

A good location should allow the school to have the qualities identified by the educationists of a good school. The planners should understand their roles as facilitators and the level of their responsibilities. This requires an understanding of various kinds of needs of the society and the source of their information and bridging the gap in the literature.

6.2. A Good School

A study of different theories in school effectiveness and proficient school practices can show us some aspects which should be expected out of a school. First of all the achievements of a school should not be measured just in terms of mere academic excellence (Elias 1989) but in terms of the magnitude of its students' comprehensive development comprising of personality, social and affective persona and ability to face challenges of life (Sammons & Bakkum 2011). One important responsibility of schools is to distribute cultural capital (Apple & King 1977), which can be achieved by the correlation of family, school, and community in the education system (Epstein 1995). Schools are expected to develop a sense of belonging (Anderman 2003) and build community pride (Beaumont 2000). The physical characteristics of a school are required to be small in size, ensure walkability (Beaumont 2000), and provide a safe environment and positive culture inside the campus (Good & Weinstein 1986; Roeser et al. 1996). Furthermore, in order to represent a community investment and to fit in the over-congested urban spaces, the school building should be able to serve other facilities in the after school hours (Dryfoos 1999). All these qualities can be truncated into three major points of small size, community centeredness, and good location.

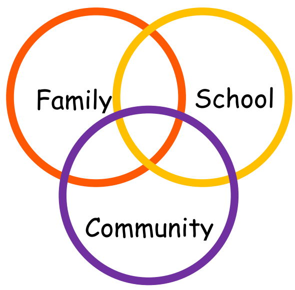

Figure 2:Theory of overlapping spheres

6.3. Roles of a facilitator

The Beetham and Sharpe 'pyramid model' developed to illustrate the progress of digital literacy (Northumbria University on behalf of Jisc 2014) is used to comprehend the different stages in the education development of a student. The same model is perceived in terms education development in general, inferring that there are four phases in education development viz. acquiring access to an institution, learn important skills, be able to practice those skills in life and finally to build an identity with the help of the gained skills and life experience. Also, Mount, Brown and Hibbard prepared a facilitator's manual for planning facilities for people suffering from traumatic brain injury (TBI). However unrelated it may seem, the main aim of these facilities is to lead their clients towards a more qualitative life (Mount et al. 2003), similar to that of a school service provider. The figure shows the superimposed concepts of both the interpreted model of Beetham and Sharpe's literacy development and the different stages of a facilitator's role. It is very interesting to note that all the stages could be directly linked to the four phases of education development of a child. Therefore, an efficient facilitator requires to enhance his responsibility from mere providing accessibility to a more specific provision of services answering to the needs of the diverse consumers.

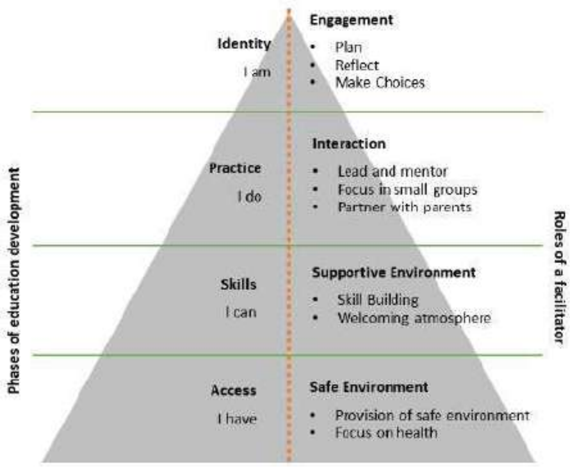

Figure 3: Superimposed concepts of education development and the roles of an education facility provider

6.4. Understanding need

There are five different types of needs, with specific attributes and each having its own source of information, illustrated in the table below:

Table 3: Types of Needs of a population

Types of need	Description	Information source
Felt need	What people say they need	Feedback from the community through meetings, forums, interviews, etc.
Expressed need	Actual demand	Evaluated through waiting lists, number of requests for services
Normative need	Expert analysis	Calculates by analysis of demographic and social trends
Comparative need	Comparable rates of provision	Comparative assessment of existing rates of supply against common rates of provision in other similar communities
Latent need	Needs that user are not yet aware of	Demographic analysis and growth analysis of research and public/ social policy

7. Identification of Gap

A review of works on location techniques of schools was done to identify the parameters used. Most of the studies have used optimization techniques with parameters like school capacity (Schoepfle & Church 1989; Amaya et al. 2016; Church & Murray 1993; Antunes & Peeters 2000; Antunes & Peeters 2001), addresses of students (Church & Murray 1993; Antunes & Peeters 2000; Antunes & Peeters 2001; Robertson 1977; Schoepfle & Church 1989; Teixeira & Antunes 2008), costs of teaching and operating (Amaya et al. 2016), socio-economic characteristics of the students (Schoepfle & Church 1989) and so on. On the other hand, the factors on whose basis parents make school choice decisions are in terms of location, academic performance, shared values, community involvement, personal interests, building condition and child preference (André-Bechely 2007; Cucchiara & Horvat 2014; Goldring & Phillips 2008; Goldring & Hausman 1999; Bosetti 2004; Maddaus 1990; Hanushek et al. 2007). Clearly, there is no relation of the school choice factors to the parameters used for schools also suggested by Pride and May (Pride & May 1999).

8. Way Forward

Literature clearly suggests the importance of neighborhood schools. However, the current trend of school siting confirms some gap in the policies made for neighborhood schools. The reason identified is that there is a lack of connection between neighborhood schools with school choice. Further spatial studies, in educational context, will need to consider social, economic and cultural aspects too. This will help the facility providers to advance their responsibility from providing universal accessibility to a more specialized provision which is customized to the needs of the diverse knowledge seeking population.

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Urban Ecological Planning
Principles, value positions and application in practice

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Synopsis

The paper presents the principles of Urban Ecological Planning - an approach of urban practice that challenges and supplements outdated technocratic urban planning methodologies that are still dominant in many developing countries. The value positions of this paradigm are illustrated with examples from an extensive fieldwork in Pune, India.

Introduction

Over the last few decades, the need for a radical shift in planning frameworks has been increasingly addressed by development specialists and researchers, who argue that traditional technocratic urban planning methodologies have proved ineffective in rapidly changing social, economic, cultural, political and environmental contexts. This momentum culminated at the Habitat III conference in Quito in 2016, where the international community agreed on taking a new path, as expressed in the New Urban Agenda and the so-called Quito Papers (UN-Habitat, 2018). Yet, an approach and set of principles of urban practice that addresses this need, challenges business as usual and supplements the outdated planning schemes has already been developed.

This paper aims to unpack Urban Ecological Planning (UEP) as it has been conceptualized and operationalized through practice based research and education activities at the Norwegian University of Science and Technology (NTNU), around an International Master of Science program under the same name.

The term “ecological” refers to both the social and environmental ecologies and their interaction within human habitats. The UEP approach has its roots in the Urban Ecology approach at the Chicago School (Park et al., 1925), which focuses on studies of urban social structures and their evolution based on a solid empirical knowledge. This includes investigating how urban management and politics shape the social and physical urban environments, and vice-versa. It can be said, therefore, that the main components of the UEP paradigm are social ecology, political ecology and urban planning. UEP further builds upon the research and participatory work with underrepresented and marginalized communities by such practitioners as John F. C. Turner (1972, 1976), Nabeel Hamdi (1995, 2010). The UEP study program has also been inspired by the action planning approach as taught and practices by Prof. Hamdi at the School of Architecture at Oxford Brookes University.

Table 1 outlines the main value positions in Urban Ecological Planning in contrast to traditional urban planning discourses. Originally, the UEP approach has been developed primarily as a response to challenges faced in informal settlements in low-income countries, but due to globalization and the rapidly increasing socio-economic inequalities in the capitalist West, examples of its applicability in the so-called “developed” countries are becoming more evident (Healey, 2012; Kaika, 2017; Speer, 2016; Watson, 2009; Watson, 2014a). At the same time, it is important to note that we do not see UEP as a panacea for all urban problems and replacement for traditional planning methods, but rather a supplement and redirection that addresses the shortcomings of “business as usual”.

Table 1

	Position in traditional Urban Planning	Position in Urban Ecological Planning
1	Sectoral planning / Functionalism	Area-based and Territorial planning
2	Top-down vs. Bottom-up	Bottom-Top
3	Problem / Issue based	Value based and Developmental
4	Comprehensive and Rigid	Strategic and Contingent
5	Standardized and Generalized	Contextual
6	Formal vs. Informal	Formal-Informal continuum
7	City as a mechanism	City as an organism
8	Instrumentalism / Structuralism	Social constructivist
9	Planner as an executor / implementer	Planner as a facilitator

Value positions in traditional Urban Planning and Urban Ecological Planning.

Integral to the UEP Master program are extensive student fieldworks (between 6 and 12 weeks), which have been taking place in Nepal (1988 - 2005 and 2009), Uganda (2007 - 2013) and India (from 2015). In each of these fieldworks, students learn about how planning is done by the different levels of government within the jurisdictions of the chosen –most of the time informal and/or marginalized– city neighbourhoods, and then study how, and if not, why does planning fail to contribute to an improvement of the local conditions and quality of life of the communities living there. After involving the residents in participatory planning exercises and conducting intensive situation analysis, students then attempt to come up with alternative, more realistic proposals for physical, environmental and/or policy interventions in these areas. While the tasks undertaken in the earlier fieldwork trips focused on urban upgrading of specific sites and settlements, today students are challenged to consider all the different aspects of urban and community planning at local level, focused on, but not limited to: housing, land, property, water, sanitation, health, education, energy, mobility, infrastructure, environmental sustainability, public space, local economy and livelihoods.

The UEP research and teaching activities at NTNU have been ongoing since 1980s and this paper is not the first attempt to conceptualize this field of knowledge and practice. However, just as other frameworks and approaches, UEP has also been evolving and reshaping to adapt to the economic, technological, demographic and environmental changes and transformations. This evolution can be traced down by looking at previous articles on UEP written by NTNU researchers and teachers who have been connected to the study program.

Basing on their experience in Nepal, China and India, Bjønness and Corneil (1998) emphasized the importance of local cultural, environmental and physical contexts in the urban planning process, and explained how the enablement and empowerment at the community level contributes to a positive change. Work by UEP students in Uganda has also been documented in articles by teachers who led these excursions. Skotte (2014) highlighted the depth of stakeholder engagement of the foreign students and the impact they had on capacity building of the members of local communities, NGOs and academic institutions they interacted with. Archipovaite (2015) focused on the value of context-based teaching for the development of skills and capacity of the fieldwork participants themselves through an in-depth analysis of their reflection notes, which are integral to all UEP excursions.

This paper draws on examples from the project and research work undertaken by 22 UEP students and three staff members during the fieldwork in Pune, India, which took place between September and December of 2017. The empirical data used in this article consist of fieldwork notes by UEP staff and three project reports elaborated by students (Akavarapu et al., 2017; Awusie et al., 2017a and Baracho Teixeira et al., 2017). Each of these reports corresponds to a different settlement chosen for an in-depth study. Besides that, students visited various other sites and projects around Pune to get a broader perspective of the current issues and challenges in urban development in the city.

The three selected areas are located in the central part of Pune (a city of around 3.4 million people) and have qualities of 'formalizing-informal' and 'informalizing-formal', which reflects the different trajectories which built environments can take. Shirole Vasti is a small self-built settlement, which is officially recognized as a slum by the local authorities. It plays an important role by providing different kinds of services to the surrounding middle- and high-income residential neighbourhoods as well the nearby universities and colleges. Kasba Peth is the oldest settlement in Pune and today constitutes a mixture of traditional low- and mid-rise buildings called "Wadas", modern high-rises and makeshift shacks. The third settlement, Raviwar Peth is located in the busiest part of the old town and its predominant use is specialized retail. There are also clusters of housing and street vendors in the area. The locations of these three settlements is shown on Figure 1.

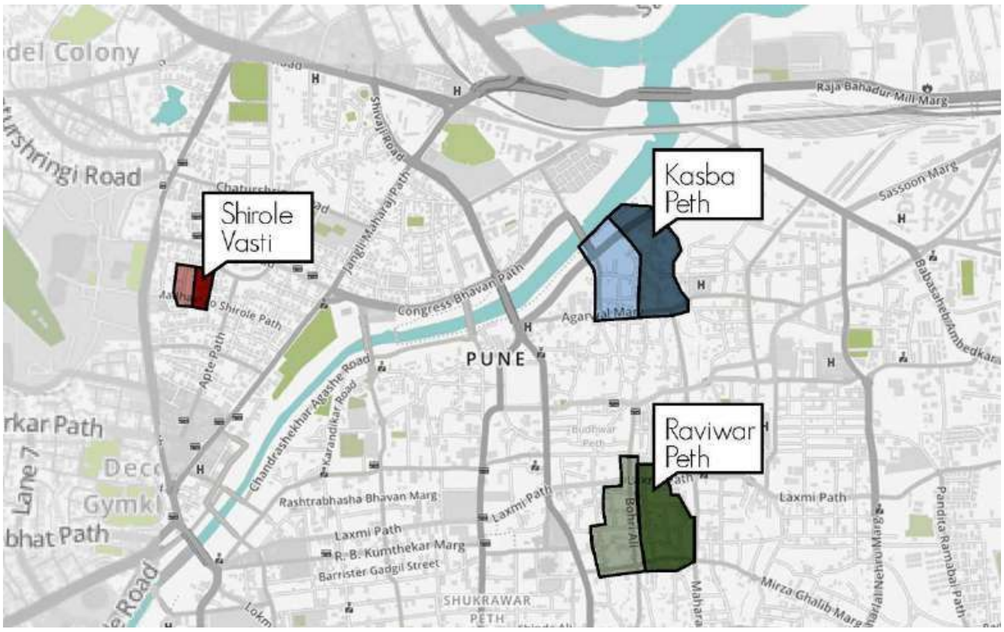

Figure 1. Location of the three selected settlements. Elaborated by Julianti Putri Setiawan.

Value positions in UEP and examples from Pune

In this section, each of the value positions outlined in Table 1 will be elaborated further and illustrated with real-life examples from the 2017 UEP Fieldwork in Pune.

1. Sectoral planning / Functionalism vs. Area based and Territorial planning

Finding the adequate size of planning units remains an open question in planning theory. In principle, we agree with Leung (2003), who claims that planners need to work at different scales from metropolitan to census wards or what he called "zones" as the most local. However, in practice, planning is usually performed at the municipal scale, which is too broad to address real local needs and makes it difficult for planners to comprehend the real urban complexities. The response to this challenge was 'breaking down' of cities into sectors, masterplanning, and the artificial separation of uses for different 'functional' areas. Implementing projects and performing interventions within a particular sector (housing, industry, public space, etc.) or infrastructure network (water, electricity, public transportation, etc.), without considering the context of the surrounding areas and its other uses, may solve the initial problem or challenge, but at the same time it may create many other unforeseen issues. For this reason, the UEP approach proposes that planning for urban interventions should be area-based and territorial, as opposed to sectoral. This requires planners to work not only across different scales, but also different specializations and professions. As Blanco et al. (2009, p. 236) argued, "there is a growing realization that the complexities of large and rapidly growing cities (...) require new knowledge generated by the coming together of different disciplines to solve common problems".

The scale level that is most often omitted or undervalued in urban planning is that of neighbourhood or community. According to Kunstler (1998, p.115), "the basic unit of planning" is a neighbourhood "defined as a five-minute walking distance (or a quarter mile) from the edge to the center". This allows a truly participatory planning processes and makes it possible for planners and decision makers to develop face-to-face relationships and a sense of trust with the people they are planning for (or, as will be argued later, planning with).

Like in many other cities in India, planning in Pune is performed at the municipal level and, sporadically at the metropolitan level. Some decision making is being made on the Electoral Ward level, yet these are still too large and heterogeneous to address local issues in an efficient and truly participatory manner. Even within the selected areas of study (ranging from approx. 0.5 to 6 hectares), students found different and more appropriate ways to define boundaries: by mandals and/or landlords (Shirole Vasti), by professions, kasts and communities (Kasba Peth – see Figure 2) and by streets or street blocks (Raviwar Peth). This allowed them to get a better understanding of functional 'clusters' and find out the interdependencies within and across these areas.

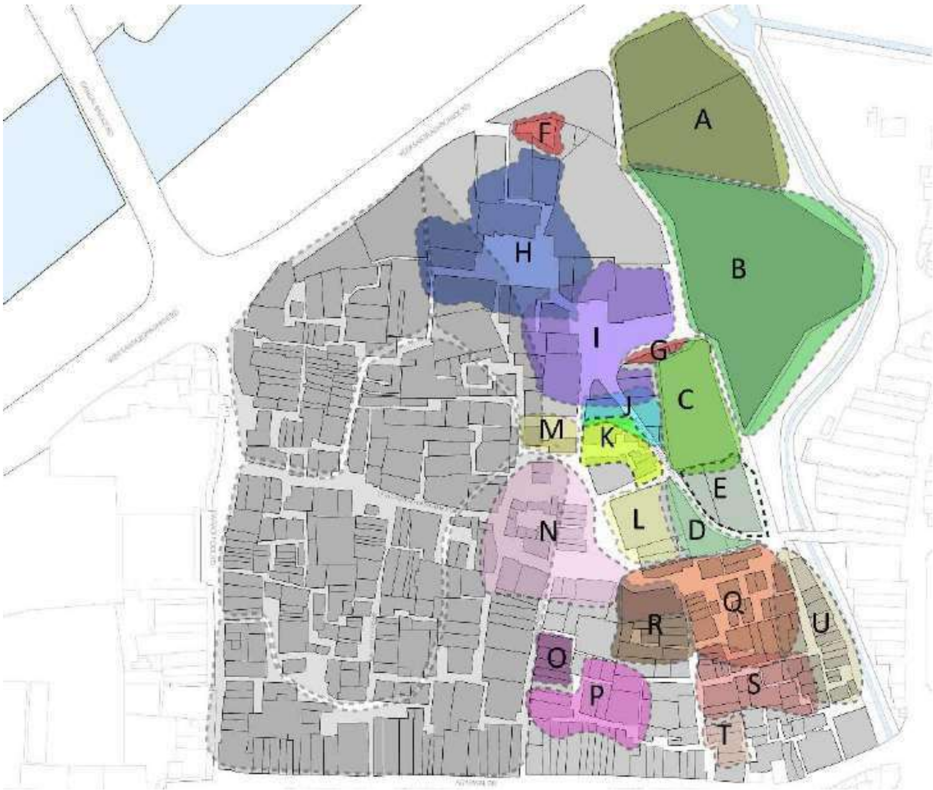

Figure 2. Demarcation of community boundaries in the Eastern part of Kasba Peth, based on participatory mapping performed by the students and local residents. Source: Awusie et al., 2017a.

An example of an issue that requires both multi-sectoral and localized approaches is that of solid waste. In Pune, solid waste and recycling policy and management are centralized at the municipal level and implemented by different levels of garbage collectors - from large automatized trucks to street sweepers. The garbage, however, remains uncollected for longer periods of time in too many areas, and as students discovered - for many different reasons that require inter-sectoral cooperation and localized solutions. Depending on the particular local context, these solutions might range from better solid waste awareness and hygiene education, more attractive incentives for recycling and composting, stricter law enforcement, better placement of garbage and recycling containers on public and private lands to increased involvement of communities in maintenance of shared public spaces (Baracho Teixeira, et al., 2017; Akavarapu et al., 2017; Awusie et al., 2017a).

2. Top-down / Bottom-up vs. Bottom-Top

Mainstream planning theory has recognized a duality of urban processes: top-down (government-driven) and bottom-up (community driven). This oversimplification of development leads to conflicts when plans imposed from the top are perceived as harmful, wasteful or inappropriate by local communities, or, on the other hand, when local demands are rejected by authorities, mainly because the government institutions are either incapable to implement them, or they see these community proposals as incompatible with the overruling existing plans and regulations.

The UEP paradigm rejects this vertical duality in which communities are always disadvantaged, and proposes a more collaborative approach in which a more horizontal partnership between actors in all levels –from the decision makers on top to the most marginalized and underrepresented on the bottom– work together towards the same goals. As Jane Jacobs (1961, p. 238) nicely put it, “[c]ities have the capability of providing something for everybody, only because, and only when, they are created by everybody”.

Urban interventions in such framework can take forms of scaling up and scaling down, which according to Hamdi (2010, p. 224) are “complementary practices”. He argues that

> the best way of scaling up the impact of projects is to scale down the size of units or organization, of management and decision making to make sure that accountability is held locally and that success or failure is measured by those who are affected most. Scaling up then is about federating or networking lots of small relatively autonomous units of organizations (network governance) and not about making entities bigger.” (Hamdi, 2010, p. 223-224)

Many scholars have recently emphasized the importance of decentralizing and scaling up urban interventions, instead of enforcing programs and policies from the top. Kaika (2017) explained how local and community-driven initiatives have a greater potential to address global challenges of social inequality, climate change and economic uncertainties than top-down indicators and ‘remedies’, such as SDGs (Sustainable Development Goals), Smart City programs, etc. While examples from crisis-driven Spain and Greece mentioned by Kaika show autonomous initiatives that emerged from strong community mobilization and common dissensus (ibid.), there are also similar scaling up processes facilitated by specially established government institutions and local or international NGOs, whose role is usually to coordinate joint efforts and provide professional advice to local communities, particularly in slum upgrading projects (Archer et al. 2012; Boonyabancha, 2005; Das & Takahashi, 2009). These initiatives are in line with the ideas put forth by Turner (1972, 1976), who argued that households should have control over housing, both as a commodity and a process (of housing), while the role of the government is to provide support for housing construction, provision of services and regulation of the commons.

One of the most known example of a simultaneous scaling up and down is the Orangi Pilot Project (OPP) which provided sanitation infrastructure to around 300 informal settlements in Pakistan since 1980 (Hasan, 2008). Planning, financing and construction of the local sewer connections was done by residents organized in lane committees and supported by professional engineers, while the trunk sewers and other supporting infrastructure beyond the settlements was financed and implemented centrally by the OPP (ibid.).

Students performing their fieldwork in Pune observed how bottom-up approaches and initiatives in their respective areas, such as providing basic services, extending urban infrastructure, running saving groups, transforming of underutilized common spaces and organizing religious festivals, create additional benefits of community building. They recognized that there is a great potential in exchanging ideas and scaling up such initiatives. Most of the students' proposals for interventions were therefore also based on the ideas of decentralization, community ownership and local initiative. Some examples include a community trust model for land ownership in Shirole Vasti and a community toilet operated by local residents and users themselves under a "Sanitation Company" in Raviwar Peth (Akavarapu et al. 2017). This last proposal will be elaborated later in this article.

3. Problem / Issue based vs. Value based and Developmental

Thinking of urban planning as an unbiased, problem-solving oriented exercise is utopian and wishful thinking. The ambitious goal for urban ecology to seek balance, equity and improvement (Bjønness and Corneil, 1998) requires planners and decision makers to take value stances on behalf of those who are disadvantaged by the dominating economic, political and environmental regimes, such as ethnic minorities, immigrants and refugees, indigenous people, LGBT communities, unemployed, homeless, women, children, etc. Considering that natural and financial resources, land and livelihood opportunities are scarce, these stands may necessarily place limits on property rights and prosperities of the privileged classes. This principle does not only require planners and practitioners to act ethically and compassionately, but as argued by Barry et al. (2018), to change in the way planning knowledge is produced and applied and to reconsider how we define and regulate property.

The UEP framework subscribes to the above statement and the preposition put forth by Blanco et al. (2009, p. 235), who argue that

> [b]uilding an alternative planning praxis rooted in the South demands a progressive value base that is both social and ecologically informed. The concept of universal socio-economic and environmental rights offers a profound moral base for planning, but its application in cities of the global South needs interrogation.

Oftentimes planners and decision makers face difficult choices which require making compromises and innovate, always taking into consideration the factual local necessities and aspirations. Ideologically, many urban and environmental planners are divided based on what McGranahan and Satterthwaite (2000) called the "green" and "brown" agendas. The green agenda focuses on ecosystem health, environmental sustainability, nature protection, climate change mitigation, as well as responsible and reduced consumption. Its main target are future generations, therefore emphasis is placed on long-term planning and education. The brown agenda, on the other hand, is centered about human health and well-being, satisfaction of basic needs and equal access to resources. The prioritized groups are low-income communities who urgently require better services and housing (or shelter) options (ibid.). Considering how the contemporary world becomes increasingly globalized, unequal and unpredictable, the mainstream viewpoint that the more prosperous countries can and should focus on the green agenda, while poorer states should first take care of the basic services to ensure a dignified quality of life through prioritizing the brown agenda goals, is oversimplifying the problem. Therefore, we argue that planners and environmentalists need to work together to go beyond this divide and seek creative solutions that can reconcile both agendas to pursue a world that is not only environmentally sustainable, but also provides good quality of life and opportunities for all.

Middle- and high-income capitalist countries are also facing rapidly growing problems of poverty, homelessness, discrimination, marginalization and oppression, all of which are partly attributed to a planning system and policy making that serve the capital accumulation and private property owners (Harvey, 2013; Mitchell, 2003/2014). Western cities (especially in post-WTC USA) have been characterized by an increasing limitations on freedom of speech, brutal repression of protests and strikes, escalating surveillance measures to control behaviour, privatization of public space, criminalization of homelessness, gentrification and touristification, and other forms of socio-spatial exclusions (Albert & Benach, 2017; Beckett & Herbert, 2010; Blomley, 2004; Harvey, 1989 and 2013; Mitchell, 2009, 2011, 2003/2014, Speer, 2016; Staeheli & Mitchell, 2008).

Scholars and activists who oppose these processes are united under the slogan of the “Right to the City” (Attoh, 2011; Blomley, 2004; Harvey, 2013; Marcuse, 2009; Mitchel, 2003/2014), which originates from the works of French philosopher Henri Lefebvre (1996 [1968]), who called it “a cry and demand” and constant struggle for more democratic and open cities in which all citizens participate. The right to the city is not only about access to public space, but also a universal right to adequate housing, basic services and a generally to inhabit and co-create the city (Attoh, 2011; Mitchel, 2003/2014). Since the early works in 1980s in Nepal, the right to the city principle has also been central to the UEP approach.

UEP takes a stance to first and foremost represent and improve the situation of the marginalized and poor communities, as they are usually the ones that are left out in the mainstream urban planning. Unlike many other universities and colleges performing fieldwork in India, we refused to making proposals in greenfield location or work in more prosperous areas which receive funds from the “Smart City” Program, but instead we chose to work with communities that are below average income and areas that are for different reasons problematic (Figure 3). Students, however, have been taken for short excursions to some of the most prosperous areas and gated communities to see, and compare, the existing inequalities and to learn why and how planning frameworks fail to mitigate them.

Figure 3. Precarious living conditions and overcrowding in Shirole Vasti. Source: Baracho Teixeira, et al., 2017

4. Comprehensive and Rigid vs. Strategic and Contingent

Comprehensive and rigid planning attempts to envision, define and/or regulate a wide range of sectors (housing, transportation, infrastructure, land-use, public space, etc), covering large geographical areas and within a long-term time horizon. Comprehensive plans often take forms of master plans or detailed general plans that are supposed to guide development in a specified area in one and only possible direction. These principles have shaped planning frameworks in many developed and developing countries. However, they rarely achieve the expected results. In times defined by political, social, economic and environmental uncertainties and emergencies, such as natural and man-made hazards, financial crises, armed conflicts, forced displacements, infrastructure breakdowns, epidemics, combined with chronic issues of inequality, poverty and resource scarcity, making rigid plans based on long-term predictions and projections is simply unrealistic.

Cities, similarly to other kinds of ecosystems, function like organisms, which react to shocks and emergencies by attempting to combat their effects within themselves. Bjønness and Corneil (1998, p. 63) wrote about the "carrying capacity" and "the ability of a city as a social system to accommodate social demand and stresses". However, the role of planners should not only be limited to support and maintain the institutional, social, environmental and economic structures which facilitate the recovery and rebuilding processes, but also to seek solutions to resist and prepare for the different kinds of uncertain scenarios in the future.

The alternative we propose is strategic and contingent planning. Nabeel Hamdi (2010, p. 65), who has written about Strategic Action Planning (SAP) defines the principle of strategic planning as "to meet the needs of now, while working toward the aspirations of soon and later". Similarly, contingent planning recognizes that urban development requires incremental and flexible approach, which can respond efficiently to the rapidly changing situations (Rondinelli et al. 1989). In contrast to static policies, contingency planning facilitates adaptive policymaking, interventions and management (Bloemen et al. 2017). It does not follow a predefined, rigid framework and is context-dependent.

The main difference between these value positions is that a comprehensive and rigid plan often starts with defining how space should function and look like at the end of the process, and then seeks ways to achieve it. Strategic and contingent planning, on the other hand, starts with the situation analysis and the definition of main issues to address, and then seeks which interventions, step-by-step can contribute to gradual recovery and/or improvement. It is usually a circular process in which intermediate interventions are followed by monitoring, learning, reflection and evaluation, before deciding for another round of interventions.

Two proposals from student groups working in Raviwar Peth reflect strategic thinking in planning, as opposed to a typical, top-down comprehensive planning. One group identified sanitation as the main and most urgent issue to be addressed in their corresponding area. As a starting point for their proposals, they acknowledged that the city-wide sanitation plan from 2011 lacked sufficient resources to ensure proper provision and maintenance of the toilets it provided, and that toilets are generally maintained better when there is a feeling of ownership of these facilities among communities that use them (Akavarapu et al. 2017). From that, they developed a proposal for a sanitation block not just as a piece of infrastructure, but as a financial model (called a "Sanitation Company"), which would ensure generation of funding for maintenance and further improvement of the toilet block (ibid.). This is not a completely new proposal, as the NGO called Shelter Associated has been doing similar projects in Pune before.

The second group in Raviwar Peth focused on solving traffic issues in their area (Figure 4) and proposed making the streets more pedestrian friendly. They realized, however, that streets cannot be simply closed for cars overnight, because that would seriously interrupt the circulation in the area and in particular, the delivery of goods to the local retailers (ibid.). Therefore, the students suggested a gradual, step-by-step interventions, starting with temporary and partial traffic restrictions for specific festivals and days in a monthly or weekly basis. Only if these pilot-projects prove successful and gain support of the local residents and shop-owners, more traffic restrictions can be tested later (ibid.).

Figure 4. Busy street in Raviwar Peth. Source: Akavarapu et al. 2017.

An example of a contingent behaviour are community saving groups, which help residents mobilize funds for strategic investments and to respond to crisis situations. Existence of these was observed in different forms in all the three studied areas. In Shirole Vasti, where the majority of the working-age population is involved in precarious informal work, women saving groups are supported by the Pune Municipal Corporation (PMC) through the Nagarvasti Vikas Yojana and the City Slum Redevelopment Scheme. Among the incentives are free bicycles for children, financing for entrepreneurial activities for the residents and revolving funding schemes offered to women's self-help groups (Baracho Teixeira et al., 2017). Saving groups in Kasba Peth provide 'crisis' credits and loans for income-generating activities for women. They also help fund housing improvements or construction of new housing for member households. Money is collected on weekly basis and deposited to a bank account (Awusie et al., 2017b). In the Durjan Singh Paga settlement in Raviwar Peth, saving schemes are also managed by women, which operate them at three different levels: personal, small group and community. Money collected by the small saving groups are given monthly to the woman with most needs and when there are no particular needs, the choice of the recipient is made through lottery. Community savings operate in the Janlaxmi scheme. The money is stored in a bank account and is used to fund initiatives and respond to problems at the settlement level (Akavarapu et al., 2017). All these are bottom-up initiatives that are occasionally supported by the local governments and financial institutions. Through savings, the communities invest in assets and increase their resilience and preparedness for different kinds of uncertainties.

5. Standardized and Generalized vs. Contextual

The UEP approach rejects the application of standardized and generalized solutions to urban problems and emphasizes the importance of local contexts. Various authors argued how replication of the same ideas in places defined by different demographic, climatic, economic, environmental, political and/or social urban conditions leads to disasters and wastefulness of resources (Hall, 1982; Healey, 2012; Lieto, 2015; Watson, 2014b). A classic example of this are the disastrous impacts of the Athen's Charter's ideology on cities around the globe, which is among the main themes of the Quito Papers (UN-Habitat, 2018). Planners should be very careful when applying 'good practices' in much different contexts from the ones in which they have been initially tested.

One example of illustrating what we mean by this contradiction is explaining two different approaches to slum redevelopment in Pune - one being more institutionalized and mainstream and the other more experimental and context-based.

Housing conditions and the quality of built structures vary drastically not only between different slums in Pune, but also within the same informal settlements. It is very common to find solid structures made of concrete or bricks with all the modern amenities next to precarious, makeshift shacks built of wood, metal sheets or plastic.

However, these particularities of Pune's slums have not been taken into account by the local and regional authorities under the Slum Rehabilitation Authority (SRA) scheme established in 2005. This scheme is based on assumption that all slum dwellers deserve "better" (or rather "different") housing conditions and the way to do it is through redeveloping the entire plot on which the slum is located and re-house the residents into new high-rise blocks. This is done in cooperation with private developers who get increased development rights that allow them to construct additional residential units that are then sold on market. The same standardized scheme is being applied across the city and similar schemes are functioning throughout the state of Maharashtra. Such redevelopment projects have been implemented in Kasba Peth and have been proposed in Shirole Vasti.

As the students have found out, the actual condition of the housing stock is rarely taken into consideration in the SRA scheme and the slum dwellers are not involved in the planning process, beyond merely giving the majority consent for the developer to proceed with the rehabilitation project (Baracho Teixeira, et al., 2017; Awusie et al., 2017a).

In Shirole Vasti, the SRA development takes long time to materialize, because of a mismatch of the SRA regulations and the local realities, especially in terms of the complex and unclear land ownership and tenure situation. Another unresolved question is that of eligibility for new apartment units for households of different sizes and those who rent in the settlement (Baracho Teixeira, et al., 2017). In Kasba Peth, one slum pocket surrounded by already completed SRA buildings is ineligible for SRA scheme because of the small plot size that does not meet the minimum land coverage requirements (Awusie et al., 2017a).

A radically different scheme to the SRA has been tried in the Yerwada settlement, where the local population rejected the proposal for total redevelopment. Architect Prasanna Desai and his team were invited to come up with an alternative solution. They initiated a participatory process in which residents as well as local and international NGOs developed an in-situ housing improvement project (Desai, 2010), which they later called "Tailor made Slum Transformation" (Figure 5).

In the first step, the team performed extensive surveying of the slum and established links with the community. The structures were then classified into permanent/solid (pucca) and temporary/precarious (kutcha) according to their physical condition. In the next phase, architects in consultation with the residents developed design proposals to replace the kutcha structures with solid housing. Due to the irregularity of the plot sizes and shapes, as well as different preferences of the residents, each site was proposed a customized design. The alternatives varied from cluster developments with apartment units in a larger structures built on up to 3-4 joint plots to individual row-houses on separate plots. Funding for the project was provided in the now discontinued JNNURM program and the beneficiary households had to contribute 10% of the costs (ibid.).

Figure 5. Example of a redeveloped house in Yerwada, Pune. Source: Desai (2011).

Contextual solutions did not only provide a better response to the real needs and necessities of the slum dwellers, but they proved more, or equally as efficient as the standardized solutions, such as the SRA. The apparent advantages of the SRA scheme, which are to cut costs and reduce time in the implementation of the projects have not materialized in Pune. The participatory in-situ slum upgrading initiative in Yerwada was a lengthy and complicated process, but the bureaucracy around the SRA scheme and the challenges in applying the rigid and vague standards and regulations to particular context in our study areas made this scheme more difficult, and in some cases impossible to implement. Therefore, it was not surprising that various student groups referred to Desai's scheme in their proposals for upgrading of the studied settlements.

6. Formal / Informal vs. Formal - Informal continuum

The framework for understanding the relationships between formality and informality in UEP was provided by Uwe Altrock (2012, p. 186), who argued that the "close links between more formal and more informal modes in everyday life have shown that one should speak of an informality-formality continuum, hybrid arrangements and co-production by formal and informal actors rather than a dichotomy".

Altrock explained how the degree of informality can be measured in two dimensions: the strength of imposed regulations and the rigidness of negotiated agreements. Due to the complexity of cities as social ecosystems regulated by a set of laws and policies, most urban activities lay somewhere in in the scale between formal and informal. Informality supplements processes in which formality does not work and complements those where it does not reach (ibid.). Informality, therefore, is not an obstacle in development, but an integral part of it. "Hybrid formal-informal arrangements" –he argues– "are closely related to the regulative self-conception states" (ibid, p. 171). When discussing urban development and architecture, Marshall Berman (1982), argued that modernization attempts to impose a utopia of a total control over the built and social environment, which is impossible to achieve due to the prevailing spontaneity and informality of everyday life. Yet, despite the growing body of literature highlighting the formal-informal dichotomy (for examples, see Hansen & Vaa, 2004; Jenkins, 2004; Koster & Nuijten, 2016 and McFarlane, 2012), the traditional viewpoint that planning should eliminate the informal sphere and/or work only within the formal, is still prevailing in many countries.

While many scholars writing on urban planning in the Global South highlight the process of formalization of formerly self-help and makeshift settlements (De Soto, 2000; Fernandes, 2011; Guevara, 2014; Lall et al., 2009; Nakamura, 2014; Oldfield, 2002), this process also works in reverse. In our previous research, we have demonstrated how land-use in formally planned subsidized housing projects in Delhi, India (Aranya and Ulset, 2016) and Barranquilla, Colombia (Sliwa, 2017) has been gradually informalized and altered by the residents who were seeking better livelihood opportunities and attempted to fill the gaps in service provision.

The Shirole Vasti slum, for example, provides housing for families who could possibly never be able to afford shelter in the formal sector in such a good location, close to their jobs (Baracho Teixeira, et al., 2017). At the same time, its informal economy provides more affordable services to many of the students who attend the numerous local universities and other academic institutions, as well as labour to the residents in this predominantly middle- and high-income area.

An interesting example of formal-informal arrangements can be observed in Kasba Peth, where the Maharashtra Rent Control Act has kept their rent at artificially low levels for many years. The downside to this policy is that property owners have no incentives to maintain theie buildings and invest in upgrading (Figure 6). As a response to this problem, one household negotiated with the landlord and agreed to pay more rent than it is stipulated according to the Act. That way, both sides are satisfied - the owner has reasonable payment for maintaining the property and the tenant has increased security of tenure and higher living standards (Awusie et al., 2017).

Figure 6. Informality and the unsafe living conditions in Kasba Peth. Source: Awusie et al., 2017a.

In another case, the legal status of the Durhan Singh Paga settlement in Raviwar Peth has been unclear for many years, which resulted in a growing informalization of activities happening there. The site is formally owned by the PMC and has connection to the grid of all the basic infrastructure. However, the rent has stopped being collected from the households and the structures have not been updated in official maps for many years, mainly because the municipality gave up their claims to the land when it lost a legal battle with the residents to evict them to redevelop the plots for public facilities in 1960s (Akavarapu et al., 2017).

By including these and other informal structures and aspects in their research projects, students proposed much different solutions to everyday problems of the communities they worked with than the planners and other policy-makers in Pune. Everyday life in India (and beyond) provides many examples where the informal "penetrates" the formal and where formal and semi-formal emerge from informal arrangements. This coexistence of formal and informal is magnified by the fact that the chronic weakness of formal institutions in India spoils their capacities to implement the ambitious, long-term plans which they are required to pursue.

7. City as mechanism vs. City as an organism

As we indicated before, within the UEP framework, a city is not perceived as a functional and static mechanism, but as an organism in constant and complex social, political and environmental interaction. Those who practice comprehensive planning and modernist architecture often like to see their proposals as final products that by no means should be altered or changed by its users. Cities, however, benefit from their abilities to adapt to the changing circumstances and have capacities to react to unforeseen circumstances just like living organisms, which mature, gain strength and develop response systems to 'illnesses' and shocks.

Jane Jacobs called the city an "organized complexity", which simultaneously deals "with a sizeable number of factors which are interrelated into an organic whole" (Jacobs, 1961, p. 432). Planning, therefore should respect the organic nature of the city and support development that maintains human scale, enhances communities and make places safe. This includes, for example, recognizing the 'natural' emergence of a mix in land-uses and the coexistence of old and new (ibid.). Like in an ecosystem, the natural tendency in cities is to grow more complex, as opposed to separating into clearly defined functions.

The aspect of change over time is key to understanding this principle in practice. Mehrotra et al. (2017) challenge the notion of permanence of the built environment and point out the benefits of integrating more temporary, elastic, incremental and reversible (or as he calls them "ephemeral") spaces and uses in contemporary cities to better accommodate different social, cultural, economic and environmental functions, and to increase their preparedness for the uncertain futures.

While these principles gained widespread accepted among scholars and practitioners in recent years, the extent of impact and intervention of planners and architects in the built environment remains a point of debate. As Nabeel Hamdi (2004) frames it: "How much structure do we design before the structure itself interrupts the natural process of emergence?" (p. 73). Performing a proper diagnosis of a particular area and understanding its local context are key to answering this question.

The informal housing development in Shirole Vasti and the establishment of commercial uses in strategic locations in the settlement (Figure 7) show how a multi-functional urban area can emerge organically without any top-down masterplanning. In contrast, the SRA scheme pays little or no attention to the human and social aspects of living environments, but instead it only focuses on the durability of the structure and efficiency in space distribution (Baracho Teixeira et al., 2017). The gradual replacement of the traditional Wada-style buildings in Kasba Peth with their public, semi-private and private spheres by concrete high-rises is also divorcing the human scale from the built environment (Awusie et al., 2017).

Figure 7. Land use map of Shirole Vasti. Source: Baracho Teixeira et al., 2017.

Interesting patterns that resemble organic evolution of spaces and its uses, where interruption by formal planning was limited, has also been observed in the marketplace in Raviwar Peth, where retailers selling similar products cluster along the same streets and street blocks, while many smaller shops and street vendors are selling different products depending on the upcoming festivals, seasons and crops (Akavarapu et al., 2017). Many street vendors also chose locations to compliment the offer of the established retailers in the buildings behind, for example vendors who sell spices and vegetables often set up their carts in front of shops selling kitchen utensils (ibid.) Like in Mehrotra's Ephemeral City (Mehrotra et al, 2017), common spaces in all three settlements served multiple functions, accommodating social and religious events, playing children, community meetings, parking etc.

8. Instrumentalism / Structuralism vs. Social constructivist

The epistemological underpinnings of UEP are social constructivist as opposed to instrumental or structuralist basis of mainstream planning. Social constructivism is a sociological theory of knowledge according to which human development is socially situated and knowledge is constructed through interaction with others. The phrase was coined by Peter L. Berger and Thomas Luckmann in *The Social Construction of Reality* (1966). Instrumentalism on the other hand suggests that theories are tools or instruments able to identify reliable means-end relations found in experience, but not to identify realities beyond experience (first attributed to Dewey, 1925 and Popper, 1956). Structuralism suggests that elements of human culture must be understood by way of their relationship to a larger, overarching system or structure. It works to uncover the structures that underlie all the things that humans do, think, perceive, and feel (first suggested by de Saussure et al., 1916). The last two positions are more characteristic of mainstream physical planning where the emphasis is on finding solutions to measurable problems within the framework of city wide systems – such as traffic networks, water supply and land-use planning.

UEP on the other hand is dependent on the socially situated analysis of local areas, to find both locally relevant and socially contingent solutions for issues which are prioritized by residents in the identified area for engagement. This approach is essential in order to ensure that the needs and priorities of even marginalized groups are represented in the plans, and those that one is planning for actually feel ownership of the plans being made. Consequently, the methods used in UEP are borrowed from disciplines such as sociology and social anthropology, relying heavily on participatory and socially interactive means of evincing knowledge.

These principles in UEP defined fieldwork methods in Pune and previous trips. This has always resulted in a much greater depth of the collected information and greater trust among the participating communities. While traditional planning attempts to ‘operationalize’ data by seeking concrete answers to narrowly-defined questions and assumptions using primarily quantitative methods, surveys and closed-end questions, the UEP approach enables planners to get a holistic overview of the situation with all its complexities and interdependencies. Identification of real needs and necessities and the discovery of alternative paths is possible only when the community is treated as equal partners in the planning process and gets a chance to “unfold” the story through answering open questions and making proposals or suggestions about their own environments. This is not to say that qualitative methods and exploratory research should detach from larger structures and systems, but that the human factor and social processes at local level are at least equally as important in the planning process.

9. Planner as an executor / implementer vs. Planner as facilitator

The final, and perhaps the most important principle that characterizes the UEP approach is the positionality of urban planners in their profession. In too many places, planners assume that people they plan for do not know what they need and what they want, because of their apparent lack of knowledge and understanding of their environments. Such thinking leads planning professionals to a common perception of community participation as unnecessary; which explains why it is so often replaced by manipulation, therapy or in the best cases, ‘consultation’ sessions, which in reality are barely one-way information channels (Arnstein, 1969). These kinds of planners still see their professions as executing and implementing plans.

When tracing the history of the planning profession, Michael Lennon (2017) explained how it evolved from a primarily design-oriented, ‘artistic’ ideology, into a more scientific and technocratic discipline of mapping and predicting urban complexities, to finally reach the current stage where planners advocate “on behalf of those who live, work and use the spaces being planned” (ibid. p. 148). The last stage, however, has not yet become the mainstream, at least not in certain countries, where planners either refuse to give away their status as experts in their professional fields, or follow outdated and obsolete education curricula that still promote the idea of planners being ‘designers’ of spaces, ‘creators’ of plans and ‘implementers’ of their own ideas (Siame & Muvombo, 2016).

The UEP approach is grounded by the principle that planning should be done by the people directly affected by the planning decisions. The planner, therefore, should not plan ‘for’ the people, but 'with' them, as equal partners. In other words, a professional should not be making decisions for communities, but instead facilitate a process in which they can take the best choices for themselves and access resources to improve their own lives and livelihoods. This is based on the (rather banal) idea that the communities actually know their situations and aspirations better than anyone else. As Hamdi (2010, p. 145) argued, "the expert comes to be seen as a special kind of person, rather than that every person is a special kind of expert". He further claims that planners and policy makers who 'provide' actually do more harm than help, because they increase the dependency of the communities on institutions, while a more 'enabling' approach actually increases the capacities and opportunities for them (ibid.).

The application of a participatory and exploratory approach to planning applied by the UEP students in Pune was perhaps what brought the most lasting positive impacts in their respective areas. The most evident was the change in mindset of households and communities in the studied areas. At first, it was clear that local residents were initially discouraged and disappointed by the failed promises of their representatives at the different levels of government, the ineffectiveness of public institutions, and the time-consuming surveys made by students and interns from local universities and NGOs. However, after spending some time with the UEP students, the residents seemed (at least to certain extend) to have restored their faith in planning, collaboration and collective decision making. This was especially visible in Shirole Vasti, where over 50 local dwellers came to participate in the final community meeting organized by the students (Baracho Teixeira et al., 2017; Figure 8).

Figure 8. Community meeting in Shirole Vasti organized by the students. Source: Baracho Teixeira et al., 2017.

Students also practiced a multi-stakeholder approach, where the information and ideas they gained was shared, reconfirmed and compared with other project partners, such as the local NGO Maharashtra Social Housing Action League (Mashal), the Indian National Trust for Art and Cultural Heritage (INTACH) - Pune Chapter, as well as other local architects, planners, politicians and researchers. The result of this collaborative work was that the proposals of most groups were much more localized and different (or directly opposite) to those proposed by the local authorities.

Conclusion

This paper discussed the role urban planners should play in relation to the nine value positions of the Urban Ecological Planning approach as opposed to traditional urban planning. Through examples from urban governance and development work in Pune, we argue that in complex contexts where social, political and environmental issues play out in the interface between the formal and the informal, planners need to stop thinking of their job as executing and implementing plans. They should rather act as facilitators, coordinators and enablers who connect the different actors and stakeholders together. Particular focus should be on the Right to the City and on addressing the needs and aspirations of marginalized communities who are normally underrepresented and excluded from the formal planning and development processes. This exclusion is to a large extend a result of the 'wishful thinking' of technocratic planners who give too much faith in social engineering, while at the same time underestimate the power of communities in shaping their own living environments.

By teaching the above mentioned values to our students and exposing them to some of the most challenging urban environments, we attempt to supplement and fill the gaps in planning education. While the UEP approach and the study program have been evolving to keep up to date with the contemporary issues in urban development, the idea of shaping the right 'mindset' has remained unchanged. Therefore, we propose to end this paper the same way, which Bjønness and Corneil (1998, p. 66) ended their article on UEP principles twenty years ago:

> If we teach students about change and complexity and give them tools and methods to operate effectively in this dynamic context, we can prepare them to have a practical approach to local problem solving, grounded in the deep understanding of urban transformations and the implications of their actions to the direction of future change.

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Sustainability planning for small border towns entering the global tourism market

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ABSTRACT:

Although set in a very different geographic and cultural setting, Mestia in Georgia and Ha Giang in Vietnam make for revealing cases of small border towns that try to reap the benefits of alternative tourism sectors as a driver for their economic development. Due to their location in remote mountainous areas, far away from larger urban agglomerations, service centers, and their capital city, the demands and prospects of development planning for Mestia and Ha Giang pose a number of challenges, while also providing for excellent opportunities in attracting people to seemingly untouched, natural, and traditional destinations.

The case study aims to position Mestia and Ha Giang in a growing global tourism market, analyzing their unique potentials and discussing their challenges and threats with regard to their border location (to Russia and to China, respectively), comparative small size, limited financial and human capital (including issue of migration), as well as increasing climate change risks.

The case study is based on the author's own planning work in these towns as part of larger international development projects in the area of livable city development and integrated regional planning. This allows for a comparative perspective on Mestia and Ha Giang with regard to other, larger cities in Georgia and Vietnam with similar development visions, but vastly different situations in terms of resources and strategic opportunities.

The objective is to show the interlinkages between a globally-oriented tourism-focused economic development policy and the local needs for social and infrastructure development, as well as natural resource management. Embedded in the particular setting of international development urban planning assistance and infrastructure finance, the case study critically reflects on the relation of different actors, including development organizations, consultants, national governments, local decision makers, private sector, and civil society within Mestia and Ha Giang.

The case study will investigate in how far innovative participatory planning approaches can go in cities that have previously been hardly exposed to less traditional planning methods or international good practice. The concepts of sustainability planning – including aspirations for prosperous, inclusive, green, or livable cities – will be contrasted with realities on the ground, affected by local development priorities, power relations, budget constraints, planning traditions, and other internal and external factors.

These aspects will all be presented through a spatial lens, mapping and illustrating the social and physical implications from Mestia's and Ha Giang's development, for instance with regard to periurban growth, real estate development, infrastructure deficiencies, and regional connectivity.

Towards World-class Lakeshore City from Edge County Seat: Wu Xuan's Over-taking Development Strategy accompanying the Construction of Da Teng Valley Reservoir

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Abstract：Promoting regional development by means of major projects is a developing path that China frequently adopts and should shed light on the over-taking development strategy in less developed regions or economies. Wu Xuan County is a small county in Guangxi Zhuang Autonomous Region in Western China. Due to the construction of a regional infrastructure project——Da Teng Valley Reservoir, Wu Xuan have to deal with the pressure of immigrant resettlement and supporting infrastructure construction, however, Wu Xuan also faces the opportunity to implement an over-taking development strategy at the same time. With the active operation of the local government and the multi Lake situation brought by the storage of water, the development vision of "World Lake City " is put forward. The unique landscape, cultural landscape, cultural tourism development and industrial economic transformation and upgrading of the local areas are linked up, and four characteristic development strategies are constructed to seek the development path of the global market with the characteristic value, and the systematic planning and design has been compiled. Working through the process of this planning and design, this paper holds that, with major projects to promote local development in China, there are relatively superior institutional conditions, centralized leadership is convenient for the implementation of major projects, and can indeed promote the breakthrough of local development in a short time. However, because there are great differences between major projects and the less developed areas in terms of talent reserves and resource calls，the process of promoting major projects may encroach resources and space for local development.
Keywords：major projects; local development; over-taking strategy; Wu Xuan; China

1. Introduction: major project development and Wu Xuan cases with Chinese characteristics

Promoting regional development by means of major projects is a developing path that China frequently adopts and should shed light on the over-taking development strategy in less developed regions or economies.

Western scholars have paid much attention to China's rapid urbanization and its internal mechanism (Ma, 2002, Zhang, 2004, Friedman, 2005, Huang, 2010), but still rarely targeted research and interpretation on the new urban area development, which has played an important role among the urbanization.

Especially since the 2008 financial crisis, Chinese traditional approach of large-scale projects development is increasingly being challenged, such as resources and environment impressing, social fair and stable, policy adjustment, and many other issues become increasingly prominent, indicating that the path may face a major transformation of mechanism. At this time, the reflection and analysis of this development model is very necessary and urgent.

Wu Xuan county is a typical case of development in areas affected by large projects. Wu Xuan County is a small county in Guangxi Zhuang Autonomous Region in Western China. Due to the construction of a regional infrastructure project——Da Teng Valley Reservoir, Wu Xuan have to deal with the pressure of immigrant resettlement and supporting infrastructure construction, however, Wu Xuan also faces the opportunity to implement an over-taking development strategy at the same time.

Through the analysis and arrangement of the main contents of the series planning and design of Wu Xuan county, this paper explores the dual influence of large projects on the local development and provides a reference for the optimization of such development models.

2、Overview of major project development since the founding of the People's Republic of China

Chinese government promote the large-scale regional development has a long history. In the contemporary era, it can be traced back to the period of planned economy.

In the 1950s,156 large projects built with help from the Soviet Union ,the 1960s "Three-Lines" large projects construction and the 1970s complete sets importing large projects ,were some of the projects implemented under government lead(mostly for industrial development).

Since the Reform and Opening up begin from 1978, China has gone through four rounds new large-scale development boom: the experiment of Special Economic Zone in the 1980s, the Industrial Development Zone in 1990s, the development of the new urban area in the early 21st century, and the national big strategies since 2008. (Table 1)

Throughout 7 rounds of the urban development booms, central government’s control of resource has remained at a high level, but local agents participated in the developments differently. In the early period of planned economy, the government implements large projects directly, its agents operated on a relatively simple technical tasks. For instance, the factory director is only responsible for production management, rather than product marketing and profitability. Since the Reform and Opening-up, practice from Special Zone to Development Zone, have formed a new policy driven regional development pattern. In this case, local agents have transitioned into operating semi-independently for profit entities, which functions included project introduction, implementation and so on.

The driving effect of large projects on local urbanization and urban development is reflected in: 1) to break through local resource level and form scale rapidly; 2) bring a large number of non-agricultural population and non-agricultural construction, and rapidly change the appearance of local urban and rural areas; 3) as a result, local urban facilities and urban functions have been significantly improved.

But big projects often focus on their own economic missions, with some adverse effects on local development: 1) most of them are limited to the urban area, but not obvious to the surrounding area as a whole, which often leads to unbalanced local development; 2) large-scale development of large projects brings great pressure on local environment; 3) the dominant pressure of big projects will restrict the development of local diversified creativity, forming a crowding out effect, which makes local governments have to rely on big projects; 4) big projects are often arranged from their own perspective, which is not completely in conformity with the local urban functional order or even leads to big conflicts; 5) excessive reliance on large projects may lead to a single urban economic structure, which may lead to a weak ability of multiple innovation and economic risk resistance.

TABLE I. SEVEN ROUNDS OF THE GOVERNMENT LEAD LARGE-SCALE DEVELOPMENT BOOM SINCE THE FOUNDING OF NEW CHINA

	Times	Backgrounds	Contents of development	Manners of development	Effects	typical representative
Planned economy period	1950s	aided by the Soviet Union, early planned economic system built	156 large projects (effectively 150 projects)	The country investment and operation directly	New industrial urbanization	YTO Group Corporation
	1960s	Implementing “Three- Lines Construction” prepare for the International war clouds	approximately 1100 large projects：military，hemical，machinery manufacturing, etc.	The country investment and operation directly	located scattered across the area and the development later turn into many industrial cities and town	Shiyan Motor City
	1970s	The normalization of Sino-US	Introduce complete set projects from western countries, 26 in 1972; 22 in 1978	The country investment and operation directly	Enrich part of industrial urbanization	Shanghai Baosteel Group Corporation
Reform and Opening up period	1980s	Investment structure reform in initial stage of reform and opening up	Put four special economic zones(SEZ) and 12 development zones into trial	promote local develop dynamic by government’s policy	SEZ develop into new city, development zones are phased in	Shenzhen SEZ
	1990s	the reform and opening up push greatly ,Development Zone policies promote extensively	thousands of national, provincial and local development zone	Under national policy-driven, local introduce and operate projects actively	Development Zone rapidly develop, industrialization and urbanization speed up	Pudong New Area, Suzhou Industrial Park
	early 21st century	reform and opening up systemic, new urban areas large expansion	topics of new urban areas	local plan projects for national policy support	urban and rural areas change, Real estate economy inflate, exacerbating the society imbalanced	Tianjin Binhai New Area, Zheng Dong New District of Zhengzhou
	After 2008	economic crisis, expand domestic demands, develop the middle and west	more than 10 national regional development strategies, several new SEZs, lots of new development zones	Under national policy-driven, local introduce and operate projects actively	the middle and west development, eastern transformation, urban regionalization	national strategy of Wanjiang City-Chain

At present, the development dominated by big projects is still common in all parts of China .Based on the above analysis, it can be seen that large projects can indeed bring effective impetus to regional development, but there are also many adverse effects, which is a development direction worth striving for rather than relying too much on.

In recent years, large projects in some cities in the central region have gradually decreased their share of local economy, which is reflected in: 1) large projects have gradually formed independent industrial clusters.2) in the development of a new type of economy with industrial parks, on the one hand, it absorbs more and more industrial transfer; on the other hand, it absorbs various investments including large projects to form new enterprise groups.3) the rise of urban economy driven by the development of new cities has supported the local fiscal revenue, thus promoting the improvement of local urban public environment .This reflects the direction of local economic structure optimization in the new era, and the rise of new economic forms, which has formed a good remedy and optimization for the traditional large project economy.

From the perspective of the trend of economic globalization, no matter the national capital, civil capital or foreign capital, large-scale economic organization is an important trend to participate in global competition, so big projects are still of great significance .However, only by strengthening the social responsibility of major projects, opening up and stretching the economic chain, cultivating the surrounding small and medium-sized enterprises, and strengthening the environmental impact monitoring of major projects, can the large projects complement the local social and economic development.

3. Wu Xuan county development strategy innovation under the influence of big project

Wu Xuan county is a small county town in Guangxi Zhuang autonomous region of western China. Because it is located on the shore of Qian Jiang river, it is affected by the great Teng Xia water conservancy project, a major project of the Zhu Jiang – Xi Jiang river basin, which not only has to bear the heavy pressure of resettlement and supporting the project, but also brings the opportunity of breakthrough and development.

3.1 development conditions and basis

(1) there are certain characteristic resources, but the economic foundation is weak

Wu Xuan county has world-class natural landscape resources, thousands of years of heritage cultural resources, unique local characteristics of local products and mineral resources, and a growing population resources; However, the economic development foundation is weak, the industrial structure is unbalanced and the economic growth speed is slow.

Wu Xuan county has rich population dividend resources .There are two main trends in the population development of Wu Xuan county .On the one hand, during the 10 years from 2006 to 2015, the growth of the registered population in all areas and counties of Wu Xuan showed a slow rising trend in the fluctuation, at a relatively high level, and there will be a small peak of population fertility .On the other hand, the age structure of the population in Wu Xuan county tends to be younger, and the proportion of the working-age population is increasing, which is at the peak of the labor supply .The construction of the great Teng Xia reservoir will also bring a certain amount of immigration, that is, it is still in the demographic dividend period.

Wu Xuan county has outstanding landscape cultural resources .With the southwest side of the city across the river, the Wu Malan river is beautiful, beautiful and beautiful .In addition, the eastern side of the city will soon form the water surface of Qi Xing lake, covering nearly 10,000 mu. Moreover, the local government intends to connect the water system around the city to form the overall landscape pattern of mountain and lake city, laying a foundation for building high-quality urban areas and expanding the new space for urban space development. There are also unique Pan Gu culture and manor culture, including more than 20 modern manors represented by Huang Zhao Xi manor, the largest courtyard building in Guang Xi, Liu Bing Yu manor combining Chinese and western styles, and Guo Song Nian manor in an elegant form .At the same time, it has formed the shijing dock culture and the characteristic Dato gorge culture supported by Qian Jiang shipping.

In addition, there are abundant material resources in Wu Xuan. The reserves of dolomite and limestone are more than 10 billion tons, and the reserves of lead, zinc and manganese ores are over 10 million tons. The sugar production accounts for 1.87 percent of the national total.

But Wu's economic base is weak. The GDP index is lower than the national and regional average. Investment in fixed assets accounts for 80% of GDP, showing the characteristics of investment-driven development. The proportion of primary industry is high, mainly traditional agricultural production. The development level of the tertiary industry is low, mainly in the traditional service industries such as wholesale and retail, accommodation and catering. The secondary industry has a certain foundation, mainly in mining and processing of agricultural and sideline products. The product processing depth is limited, the added value is not high, the industrial structure is relatively simple, and there is no big enterprise brand.

(2) there are certain location conditions, but the regional support is weak

Wu Xuan county is located in the geographical center of Guangxi province, bordering Liuzhou and Lai Bin. However, it is difficult to effectively attract industrial transfer in large regions due to lack of conditions and basis for economic exchanges with foreign countries.

Around large and medium-sized cities including Liu Zhou, guests, your port, Gui Ping form a "diamond" prismatic area, the area of the total population of 15.5 million people, has great market space, surrounding and Wu Xuan is in the geographical center of the area, through the north-south, east-west closely linked to the two highways and surrounding formation, type hub traffic location characteristics, ease of use of breakthrough in the surrounding market development.

But the overall economic level of the surrounding areas is relatively low. GDP, per capita GDP, total tourism revenue, and the number of domestic tourists are all in the relative depressions of the two regions. The low overall economic level of the surrounding areas restricts the utilization of the surrounding market, requiring Wu Xuan to seek a broader market space through the opportunity of large projects.

(3) Facing major development opportunities, but lack of breakthrough projects to grasp

The new technological revolution, the geopolitical pattern and the deep regional transformation have all brought the opportunity to directly connect with the global first-tier market. Guangdong, Hong Kong and Macao bay area strategy, Bei Bu gulf economic zone strategy, Zhu Jiang – Xi Jiang economic belt strategy will be Wu Xuan and the pearl river delta connected. The development of Dato gorge project has brought the development opportunity of deep transformation for Wu Xuan county.

At the same time, in the new era of consumption, tourism consumption will become a strong driving force for county economic growth. Wu Xuan county is located in the tourism economic circle around Da Yao mountain. Its unique natural and cultural resources will become the growth engine for the development of the tourism industry and promote the development and transformation of the county's economic structure.

In addition, under the condition of the development of new and high information technology, Wu Xuan county and other geographical marginal areas will be able to directly connect with the development strategy of economically developed areas, directly integrate into the global economic system, and realize the leapfrog development of service industry and science and technology industry on the basis of the traditional path of agricultural transformation and industrialization accumulation and development.

However, the local economic foundation of Wu Xuan county is weak and there is no major project to coordinate the economic development. From the perspective of the 13th five-year plan of Wu Xuan, the planned major projects lack the engine projects and breakthrough projects that affect the overall situation, and fail to fully explore and utilize the major change opportunities brought by the major projects in the great Teng Xia.Further planning and planning are needed to seek breakthrough development of large projects.

(4) comprehensive judgment

The basic conditions of Wu Xuan county reflect the common characteristics of underdeveloped counties and cities in western China.

3.2 major projects bring opportunities for strategic breakthroughs

The Da Teng Xia water conservancy hub project is a flood control and control hub project in the pearl river basin approved by the state council. It is also a landmark project for infrastructure construction of the pearl river delta Xi Jiang economic belt and the "west river billion tons golden Water way". The project dam is located at the outlet of the great Teng Xia gorge (namely, Nuo Tan village, nanmu town, Gui Ping city, Guangxi province) in the Qian jiang river section of the pearl river basin, about 6.6 km away from Gui ping Qian jiang bridge and 50 km away from Wu Xuan county town.

According to relevant plans, the normal storage water level of the Da dong xia water conservancy project is 61.0 meters, the total storage capacity is 3.43 billion cubic meters, and the reservoir channelized 279 kilometers of the waterway, enabling the vessels of Liuzhou, Lai bin and Gui Ping of Guangxi to sail over 1000 tons. The number of people affected by the flooding was 9,882, and the number of people relocated and resettled at the planned level was 20,351, covering 113,693 mu of land of various types. Although the dam site is located in Gui ping city, the main flood area and settlement area are located in Wu Xuan county.

One of the most prominent changes is that Qi Xing lake, about 9 square kilometers in the east of the county, has greatly changed the geographical environment and landscape pattern of Wu Xuan county, and provided an opportunity and possibility for Wu Xuan county to find a new development space.

Specifically, the influence of Da Teng gorge on the development of Wu Xuan county is reflected in the following aspects:

Bring about a series of new development opportunities :(1) bring about the immigrant population agglomeration;(2) bring opportunities to the shipping industry;(3) bring opportunities to the tourism industry;(4) bring about great changes in county and city appearance and opportunities for large-scale renovation and construction;(5) great changes in investment.

At the same time, it also brings certain impact and pressure.(2) the impact of large-scale construction on historical and cultural resources and natural ecological fabric;(3) the crowding out of local excellent resources and space by large projects.

Facing the great changes brought by major projects, Wu Xuan county needs to actively grasp the opportunities of major projects, draw on the strengths and avoid the weaknesses, strictly adhere to the bottom line of resources, enlarge the driving effect, and seek breakthroughs and improvements in regional development.

3.3 major adjustments in strategic direction

(1) functional reconstruction: from industrial city to scenic tourism city

In the general plan of the previous edition, the city nature of Wu Xuan was defined as: taking industry as the leading role, vigorously developing landscape garden cities of tourism, logistics and other modern service industries.

In the overall planning of Lai bin city, the urban function of Wu Xuan is defined as a comprehensive town mainly consisting of sugar manufacturing, metallurgy, processing of mineral products, processing of agricultural products, light textile, shipbuilding, commerce, logistics and other industries.

Industrial dominance is the main definition of the development direction of Wu Xuan city. However, under such major changes as the great Teng Xia project and the water storage of Qi Xing lake, the advanced information transportation technology is used to highlight the scenic and cultural value of Wu Xuan, align the trend of the era of tourism consumption economy, and transform the development strategy of Wu Xuan city into a scenic and tourist city.

(2) pattern reconstruction: from a small county town in the west to a lakeside city in the world

Further thinking, to build a scenic tourism city in the new era, it is necessary to break through the relatively weak regional economic pattern around Wu Xuan with the help of modern developed information and transportation technology, and seek the direct connection of large markets in a wide area. Therefore, from the strategic perspective of urban development, it is necessary to change from the western small county town standard to the characteristic tourist city facing the world. According to the resource characteristics of new Wu Xuan, it is an important choice to set up the development vision of "world lakeside city", which echoes this strategic orientation and pushes Wu Xuan to take advantage of the situation.

3.4 path analysis based on the new strategic direction

(1) case study: small cities win the world with their characteristics

Based on the major adjustment of the above two strategic directions, the internationally influential scenic tourism city will be the important target for the further development of Wu Xuan. According to analysis and arrangement, from a global perspective, there are mainly three types of cases of small and medium-sized cities with similar scale and referrability, including:

Industry leaders: Lego city Be Lon, Audi's Ingolstadt, Nestle's Vo we, and glass, the perfume capital of the world. Such cases are all key industries that grasp the characteristics in the process of development and achieve international influence and height of key industries, thus laying the foundation for the world's scenic and tourist cities.

Landscape driven: the lavender home of Provence, the combination of technology and landscape Bozeman, Europe's retirement heaven saint Sebastian. This kind of case is to grasp the opportunity industry from the beautiful scenery, develop the tourism and vacation industry and relevant industries of science and technology, sports and so on, and form the global influence of specific industries and landscapes, so as to realize the development across the globe.

Activity oriented, such as the world economy BBS permanent residence in Davos, Switzerland's water sports mecca Spitz, the world's alpine outdoor sports destination Sha Mu Ni, etc. The breakthrough point of such cases is to hold symbolic activities to attract a large number of people to enter and continue to consume, so as to form a broad influence and sustainable market.

(2) carding path

It can be seen from the above three cases that it is a common feature of such urban development to grasp prominent feature elements as core identification and Engine. This characteristic element may be an IP, an activity, a class of industries and products, but its extension can cover the upstream and downstream industry chain, and link the development of landscape, activities, industry and space at multiple levels.

With characteristics, on the basis of three kinds of cases have different key kinetic energy, respectively is embodied in three aspects of industry, space, activity, the kinetic energy of the three aspects of support is not a single role, but can combine each other nested, and other surrounding elements form a composite, end of the formation of regional development.

Summarizing its experience, the key strategic path is embodied in: constructing the strategy system of characteristic driving, industry-space-activity three-dimensional support.

3.5. The strategic framework of "one feature, three hands" of Wu Xuan was established

(1) a feature driven

As the space carrier that can bear the characteristics of Wu Xuan, the manor garden has the unique cultural spirit. Wu Xuan manor culture dates back to the early Qing dynasty, the Qing dynasty from Hunan, Jiangxi and other places of a strange culture and Wu Xuan local traditional culture blend mutually, makes Wu Xuan ideological culture become more civilized, gradually formed the Wu Xuan people both Geng Dou family heirloom and economy concerning the use of the thought idea, teachers and respecting culture tradition of making Wu Xuan in such aspects as politics, military, business has outstanding talent, and by the Qing dynasty, some struggle, pleasantly surprised, outside Wu Xuan people started in hacienda-style home built residential courtyards, after decades of gathering, form the old China Gui Zhong region during the period of a community is relatively concentrated, the famous estate.

With the change of The Times, most of the manor houses have lost their own living function, but they have left their unique manor spirit :willpower, perseverance, commitment and innovation, and also shaped the manor culture with unique characteristics of martial arts propaganda. At present, there are more than 30 manors in Wu Xuan, mainly distributed in villages around Dong Xiang, Tong Ling, Er Tang and San Li, among which the famous ones are Huang Zhao Xi manor, Guo Song Nian manor, Liu Bing Yu manor.

Based on the manor culture of Wu Xuan, two distinctive manor IP can be built: world manor cultural exchange BBS, world manor residential experience. BBS is a regular BBS which specializes in the world manor culture. It not only discusses the manor culture of Wu Xuan, but also explores the manor culture of other regions of China and even all regions of the world.

In the manor world cultural exchanges on the BBS, invited several different types of institutions or organizations, including the relevant organizations or groups included manor culture society, writers' association and so on, university and scientific research institutes included manor culture research association, universities and research institutes and so on，international organizations or national included leaders, the world organization, the foreign experts and so on, investment and financing institutions, investment institutions, companies and trading firms and so on, through these institutions or organizations, to upgrade the manor world cultural exchange BBS style, should be through online and offline two channels at the same time, all-round display communication BBS, Offline activities include research, communication, social interaction, investment promotion and investment. Online activities include online communication, webcast, e-commerce, online education, etc.

BBS plays an important role in promoting the influence of Wu Xuan and showing the manor culture of Wu Xuan.

Another estate IP is the world's manor living experience, with the development of economy, people's living standards improved rapidly, but the life pressure also increased gradually, pastoral yearning for comfort and leisure gradually strengthen, manor culture combined with rural life, can form a unique experience activity -- world estate living experience. Relying on the space carriers such as the world manor city and the rural complex, the human settlement experience activities of the world manor are carried out, with a focus on making people experience the tranquility, comfort and tranquility of rural life through a series of facilities and activities, including rural activities, parent-child activities and picking activities.

(2) three strategic grips

Key industries - one with two wheels. The main characteristic of the key industry strategy is that "one special apparatus has two wheels". " one special apparatus " refers to a featured cultural activity of the manor, and "double wheel" refers to the strategy of "existing industry upgrading and new industry introduction" of the industry. A featured cultural activity of the manor is based on the cultural activity of the manor by Wu Xuan. In the two rounds, the upgrading existing industries include sugar industry, calcium carbonate industry, commercial logistics industry and agriculture and forestry industry. In the advantage of existing industrial upgrading paths, characteristic farm culture activities can pull the existing advantage in multiple industry upgrade, for example, sugar cane processing products include sugar, wine, rum, sugarcane and condiments such as paper, and these foods or beverages are manor world cultural activities as a source of food; The products of calcium carbonate industry include building decoration materials, stone carving crafts, etc., which can be used as the main materials for the construction of manor city in the world. The world manor cultural activities a large number of logistics, people flow activities, will certainly promote the development of Wu Xuan trade logistics industry; Deep processing of agricultural and forest products can be used as a food source for cultural activities of manor around the world. On the other hand, the introduction of "new industries" mainly includes the introduction of modern service industry and high-tech industry. The modern service industry will introduce the "culture and sports industry, tourism industry and scientific research education industry". The high-tech industry will introduce the "information technology industry, high-tech manufacturing industry and new energy industry".

Scenic towns - urban areas are scenic spots. The core of the strategy of scenic town is the integration of urban landscape and urban area is the scenic area. Landscape, as a carrier of a new way of life, will be integrated with the town to form the strategic content of scenic town: new ecological value, new utilization of landscape, new urban space. From "static protection" to "dynamic utilization", ecological elements should be landscaped, and "ecology", as a static resource, should be utilized as an important landscape in the city. At the same time, landscape should reflect new utilization methods, from "seeing the scenery" to "using the scenery", to reflect the unique "education, sightseeing, experience and production" function of landscape. The landscape and urban space will be integrated to create an ecological space layout of "landscape four flowers with five leaves and seven veins and multiple gardens". The estate cultural activities held in the world, will be the implementation of the strategy of effective drive Wu Xuan scenery town, can create a manor culture characteristics of scenic town, the world garden city itself can become a town and the integration of landscape space carrier, and unique scenery will provide manor world cultural activities "education, sightseeing, experience, production".

Iconic activity - world manor habitat experience. By learning from the development experience of many special towns in the world, the popularity of small towns can be effectively enhanced through the detonation of iconic activities, so as to Wu Xuan has its own characteristics. However, the existing activities such as "March 3rd folk festival, Confucius ceremony" have yet to be improved in terms of popularity, influence and connotation, etc. It is hard to become a symbolic activity to explode the Wu Xuan market at present. Based on the unique manor culture and the rural scenery of Wu Xuan, the cultural activities of manor around the world are built. The cultural activities of the manor can enhance the influence of Wu Xuan, promote the emerging tourism, cultural creativity and information technology market of Wu Xuan, and promote the characteristic scenery of Wu Xuan. Manor world cultural activities mainly includes rural living experience, world estate culture expo, world estate, estate foreign affairs activities, through "BBS" manor world cultural exchanges to promote to the world of Wu Xuan cultural features, landscape features, through the "world estate living experience on" Wu Xuan landscape rural characteristics. Expand the event platform and display the grand event through online and offline channels. The participants include not only local governments, tourists and people, but also various associations and groups, investment and financing institutions, universities and research institutions, national organizations and countries.

3.6 Plan construction of urban spatial layout

(1) the spatial development strategy pattern of "advancing east, expanding north, crossing south, controlling west and upgrading China".

Adhering to the concept of co-existence between city and nature and building a landscape city, this paper puts forward the overall image of urban development integrating landscape with city, rural surrounding city, blue and green weaving city and production and tourism city.Create multiple ecological corridors. In the multi-center banded spatial structure, in order to maintain the urban ecological pattern, we should make good use of and protect the original landform and traffic corridor. Each group should be separated by mountains, rivers and ecological green Spaces, and ecological corridors should be constructed with mountains as the background, and serve as the basis for group spacing, so as to prevent the group from blindly expanding and eroding the ecological green space, and limit the size of each group.Waterfront space is the core area of urban landscape. With the advance of the old city reconstruction and the new district construction, the waterfront space is gradually filled. Efforts should be made to protect the waterfront ecological space.The spatial development strategy of "advancing east, expanding north, crossing south, controlling west and upgrading China" was proposed.

Eastward advance strategy: cross the Qi Xing river to the east and develop the land along the Qi Xing river to the expressway.

North expansion strategy: north along the main road north expansion, development of urban north area.

South crossing strategy: to the south, Wu Xuan county is adjacent to Qian Jiang river and Wu Ma Lan river scenic area, which needs to be protected and controlled in a key way. However, to cross this area, a large area of available space along the Qian jiang river can be grasped.

Western control strategy: control urban expansion in the west, optimize the ecological environment and urban functions, relocate or renovate Hexi industrial area, sugar factory, high-voltage corridor and so on, and form a high-quality development zone.

China's promotion strategy: optimize the spatial pattern of central cities in Wu Xuan district and inherit the historical and cultural space. Protect the historical and cultural blocks with the ancient city as the main place to highlight the historical characteristics of the city. For the old urban areas, we should adopt the strategy of remediation and renewal, improve the living environment and facilities, and create a charming old urban area.

(2) overall layout structure of "four mountains and waters, three cities, seven districts,

four veins and 19 gardens"

Landscape ecological structure: four mountains and waters landscape.

Painting mountains and waters landscape: as the opposite view of the city, the Wu Malan river, Bu Yu peninsula and Qian Jiang river echo the landscape of the waterfront city to form a picturesque landscape.

Urban mountains and waters landscape: with Xian hu lake, Gao Li Shan and ma 'an Shan as the landscape nodes, urban green belt and water network are connected to create exquisite urban green space landscape.

Lake island mountains and waters landscape: with Qi Xing lake and lake island as the core of landscape features, create a clear waterfront lake landscape; Urban and farm mountains and waters landscape: the ecological green belt along the river, the low-density urban functional group, the dock village and other rural complex are integrated to create a landscape with urban rural characteristics.

Urban layout structure: three cities and seven pieces

The three cities, which have different leading functions, are the three major urban areas of the central construction area of the city, namely, the main city of Wu Xuan, the tourist city and the industrial city.

Seven pieces are urban function and construction agglomeration, which can be divided into seven urban areas based on the three urban areas:

Area south of the city: the original old city, north to the south of An shan road, Chao Yang road on the east, south to the Qian Jiang, contains the ancient city of ma on Shan, Wu Xuan, Bin Jiang dock, etc., is a major city Wu Xuan existing activity area, planning for residential activities as the main function, to take advantage of regulation style, Bin Jiang development, history and culture, as the main content of life.

Eastern zone: the main area of the former east new area of the city, from Chao Yang road to Chao Yang road to Chao long road to Cheng Bei road, from Xing Hu west road to Xing hu road in the east and Anning road in the north, is the new city area under large-scale construction by Wu Xuan. The planning is based on the development of modern new city, with human settlement service and landscape environment construction as the main Content. This round of planning should take into account the influence of substations and high-voltage corridors in the region on the construction of world lakeside city, and suggest the land replacement of substations.

The west part of the city: the former sugar factory area, from the north of the city road to the north of the city road – Chao long road – Chao yang road, Qian-jiang road to the west, Anning road to the north, Anshan road to the south, combined with the relocation of sugar factory and the relocation of high voltage substation, planning to take the old industrial base transformation and the construction of new ecological living environment as the main content.

Northern urban area: a new development area extending along the west bank of Qi Xing hu lake to the north, from Anning road to the south, to the man-made river to the north, with good land conditions, the new urban area of Wu Xuan will be formed with the theme of information and electricity industry facing the future and e-commerce industry serving the rural areas, supplemented by high-quality waterfront human Settlements. This round of planning should take into account the influence of the substation and the high-voltage corridor in the east of the city on the construction of the world lakeside city, and suggest the land replacement of the substation, so as to avoid the influence of the high-voltage corridor of the substation on the region.

He Dong district: Qi Xing He area, south of east, seven Xing hu existing farm, Taiwan industrial park regulation reform, combined with the construction of seven Xing Hu, using both close to seven Xing Hu and near the highway portal advantage, at the same time in the future information industry and the rural service oriented electric information industry and the world estate culture as the theme, to build international tourist town, and in Qi Xing He, fairy lake park, the confluence of seven Xing hu, Qian Jiang, brigade CBD planning of modernization.

Hexi district: planned to relocate the former Hexi industrial zone, transformed the original industrial building and mine environment, combined with the winding characteristic landscape environment of the nearby Wu Malan river and Qian jiang river, to create an outdoor sports town.

Industrial city area: depending on the original planned industrial areas of east Gui Zhou and Qian Xi, combined with port construction, the industrial construction of Wu Xuan county and city will be centrally arranged to form the core industrial area of Wu Xuan.

(3) urban landscape structure: four veins 19 gardens

Four veins of lake and river: Qian Ding jiang river and Qi Xing hu lake are the main bodies, and Qi Xing He river is connected with artificial harmony. Four major water veins in the urban area are infiltrated to form a rich and diversified regional water environment System. The water environment system is also a green environment System. Among them, the urban "green corridor" formed by the protection and greening of the city such as the green corridor in Xian hu park forms the open space of the city, with emphasis on greening ecological construction. The width of the green belt is controlled at 50-100 Meters. The "water ring", with the Qian jiang river, Qi Xing lake and the man-made river in the north of the city as the framework, plans to control the open space of about 20-225 meters on each side of the river, and forms the main outer open space ring.

Park 19: urban park green space is divided into urban park, district park and group park, with a total of 23 planned. It plans 3 city-level parks, 7 district-level parks and 13 group parks. At least 19 of the parks should have the reproduction of cultural elements of a certain manor in Wu Xuan county, which can be represented by landscape sketches, architectural imitation, cultural souvenirs, etc., so that the manor culture scattered throughout the county can gather in the urban areas.

4, endnotes

There are relatively superior institutional conditions for promoting local development with major projects in China. Centralized leadership is convenient for the implementation of major projects. Due to the great difference in ability between major projects and relatively underdeveloped areas in talent reserve, resource utilization and other aspects, it is necessary to take a dialectical view and prudent use of local development resources and space in the process of major projects.

Wu Xuan local governments actively operating, combining with big cane gorge project of water lake, put forward the vision of "lakeside city of the world", the local unique scenery, human landscape and cultural tourism development, the industrial transformation and upgrading of economic linkage to build four characteristic development strategy, seek to characteristic value of integration into the global market development path, is a classic case of grasp the big project opportunities actively operating, driving the development of local offers for similar large projects can draw lessons from the experience.

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Railway hub area development in Arth-Goldau (Switzerland)

Wirz, Nicole; Schneider, Andreas, BASEL, RAPPERSWIL, Switzerland

ABSTRACT:

Part 1 Stakeholder Process: Prof. Andreas Schneider

Part 2 Urban Design: Nicole Wirz, owner raumplan wirz

Switzerland will finalize its new trans-alpine railway lines in 2020, allowing super-fast passenger traffic and heavier freight trains on the European Corridor 21. Arth-Goldau is the place, where the Rhine-Genova corridor and the Munich-Zurich-Milano corridor merge to one. Therefore, even more than already now, this will become the main public transport hub for the inner part of Switzerland. The municipality of Arth and the canton of Schwyz have the ambition, to make the best out of this, and to reorganize this entrance point for commuters and tourists, to recycle the brownfields south of the station and to redevelop the neighbouring housing areas (total approx. 70 ha).

Since planning in Switzerland is a highly democratic process, information and participation plays an important role in such developments. Therefore there is a long tradition of involving population in planning processes with more or less success. In Arth-Goldau for one of the first times in such developments in Switzerland, a technique that was developed in commercial business during the last decade was applied: The stakeholder process. Compared to widespread “every one interested” participatory approaches, it shows a much deeper involvement of the stakeholder groups into problem analysis, solutions evaluation and masterplanning. It needed more time in getting the masterplan finished compared to more conventional approaches. But in implementation it now shows that it makes political consensus building and planner’s life much easier.

The Masterplan and urban design has been developed in a stakeholder process. Property owners, neighbours and different public groups of interest had been involved in developing the urban design, public spaces, uses and density of the area. One of the most important topics, which was discussed, was the development of high-rise buildings as landmark for the new urban development. Finally the project aims to provide spaces for housing, offices and industry 4.0. A relevant high density and a mix of uses – 120’000 m^2 ground floor area are arranged in different plots aligned along a new main street axes and fixed in the masterplan. For designing the urban development, smart city technologies had been used.

Planning and Construction Practice for Sponge City in Shanghai: Experience and Reference

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1. Introduction

With the frequent occurrence of extreme weather, various cities in China are facing severe rainstorms and waterlogging threats, which bring strict tests to urban security. According to the survey carried out by the ministry in 2010 about 351 cities' urban waterlogging situation in 32 provinces, there has been more than 60% of urban waterlogging since 2008, and even the northern cities (such as Xi 'an, Shenyang), where there is a lack of rain, have a similar situation; the maximum time of water accumulation in 57 cities exceeded 12 hours[1].The rainstorm water has had a significant impact on the operation of urban public transportation, the safety of residents' travel and public health. Heavy rain in Shenzhen and other cities has often paralyzed subway operations, hampering urban traffic. On July 21st, 2012, severe rainstorms in Beijing even killed 79 people and made a direct economic loss of nearly 10 billion yuan [2]. In the 21st century, Shanghai urban waterlogging occurs almost once a year (even more than once in some years), and causes serious damage to urban ecological system, having an adverse impact on urban operation and residents.

In this background, The Chinese government launched pilot projects of domestic sponge city construction in 2015, aiming to comprehensively improve the resilience of cities in dealing with rainstorms. Shanghai, as one of pilot cities in the second batch, has taken a series of measures related to planning and construction, including the specialized planning at the overall urban level, the compilation of technical guidance, the specialized planning of pilot areas, and the project implementation of the sponge city concept and technology in specific cities, etc. Taking Shanghai as an example, this paper systematically introduces the practice and beneficial experience of Shanghai under the background of sponge city construction in China.

2. Urban water environment and sponge city

Urban development and construction should be based on the natural logic of the water cycle, from the macroscopic hydrology water area to the whole city system and to the specific block, places, as well as the construction of water planning and design. This is the core idea of sponge city construction, involving a series of concepts, working frameworks and technical methods to improve the water system in sequential manners (fig.1).

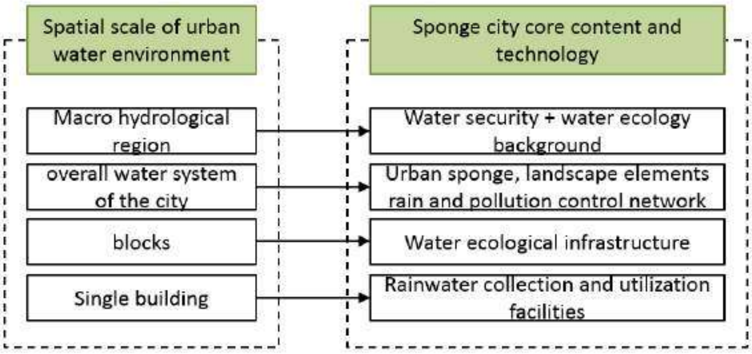

Figure 1: Multi-Scale Sponge City system
Source: Drawn by the author

2.1 Urban water environment system

The construction of urban water environment system needs to consider the comprehensive influence of multiple scale and regional water elements.

At the macro level, we should consider the large rivers, wetlands, the reservoir areas and ecological forests which have an influence on the urban hydrological environment, including water supply, rain flood ecological control, flood control and storage, etc. The construction of the good regional hydrological environment is an important basis for ensuring urban water security.

For the whole city water environment, surface landscape elements, such as river courses, lakes, wetlands, parks, and protective green land, along with the rain sewage drainage pipe network system jointly promote urban development to become ecological "sponge". Among them, the pattern and interrelation of surface landscape elements constitute the water ecological foundation framework of urban "sponge body", which is the infrastructure of ecological rain and flood management. As a traditional drainage engineering facility, the rain sewage pipe network plays a positive and important role in ensuring the sound operation of ecological water infrastructure(fig.2).

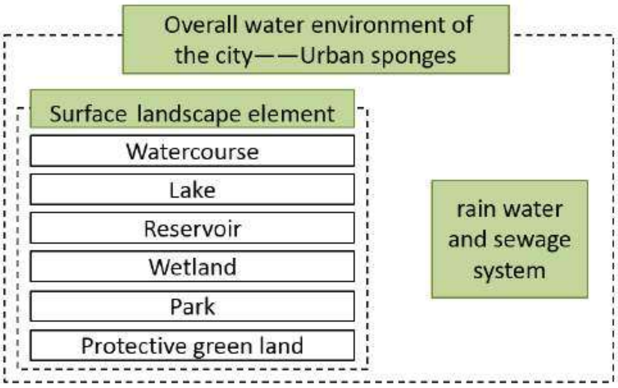

Figure 2: Constituent Elements of Urban Sponges
Source: Drawn by the author

The inner-city blocks are just like the cells of the city's "sponge body", which holds the key to the management of urban rain and flood. Urban green land places which are represented by parks and wetlands have a significant influence on water storage and water purification, while river channels mainly play the role of water catchment and drainage in the construction of urban water environment. Urban construction land (such as land for residential areas, education and industry) and streets have become the rainwater infiltration with low levels of soil suction areas, due to the construction requirements and street activities features; the water environment of these blocks needs to be refined and constructed, improving the capacity of these places' rain-flood management by means of maximizing the infiltration area and designing integrated rainwater collection and drainage facilities.

The collection and reuse of rainwater from roof and window eaves of urban buildings can promote the drainage and storage of rainwater and effectively reduce the occurrence of waterlogging in urban blocks. The construction of water environment at the micro level has a fundamental and elastic influence on the construction of urban water environment system.

2.2 "Sponge city" concept and technology

2.2.1 Concept and connotation of "sponge city

"Sponge city" is to strengthen the construction of urban planning management, to make the most use of ecological systems such as buildings, roads, green areas and water systems in absorbing, storing and releasing rainwater, to effectively control the stormwater runoff, and as far as possible to achieve natural accumulation, natural penetration and the natural purification of sponge city [3]. On the other hand, it is also emphasized to strengthen the capacity of rainwater removal during rainstorms by strengthening the construction of traditional infrastructure drainage facilities. The safe management of urban rain and flood is one of the important factors for comprehensive urban security.

The idea of "sponge city" is essentially similar to the idea of low-impact development (LID) in the United States, Australia's water sensitive city, UK sustainable urban drainage system and Germany's decentralized rainwater management system, which emphasize the realization of "smart" management of rain and flood through comprehensive urban green infrastructure construction and reduce the risk and harm time of urban waterlogging disaster. Sponge cities should pay attention to not only the influence of macro water environment and conform to nature, but also the construction of rainwater storage and drainage system and ecological purification system at different spatial scales to achieve urban rainwater natural accumulation, infiltration and purification.

2.2.2 Core technologies of "sponge city" construction

The core technologies of "sponge city" construction involve multiple spatial scales, such as macroscopic hydrological region, overall city level, block level, and single building. Based on the background and key points of multi-scale sponge city construction, the core technologies adopted in practice are different[4-5].

1) **Macroscopic hydrological level.** Construction of "sponge city" requires detailed water security pattern analysis and fragmentation degree of conserving forest land and wetland analysis, which will lay the regional space foundation of the city "sponge body". The main core technologies include water resources ecological plaque analysis, comprehensive identification of water resources protected areas, space control based on ecological elements, and water network system combing and hydrological water quality analysis.

2) **The overall level of the city**. Constructing city "sponge" needs to systematically plan ecological landscape and promote traditional drainage infrastructure configuration on the basis of the comprehensive analysis of precipitation, catchment, collection of water, water storage, distribution or control, and comprehensively solves the problems in the urban rain flood control. Its main technologies and analytical methods include the analysis of water junction, water network system planning and analysis, green network system planning and analysis, and overall control of ground hardiness rate.

3) **The block level.** The technology at this level is mainly achieved through the design of water ecological infrastructure (including urban design and landscape design), including interception of rain water, rainwater infiltration and rainwater storage. Rainwater interception is mainly to reduce the rainwater runoff rate through the slope of the site and the use of materials. Rainwater infiltration promotion technology mainly refers to the enhancement of water infiltration capacity through the establishment of site infiltration facilities or the non-hardened land area. Rainwater storage is mainly through some massive water bodies, in cooperation with urban rainwater pipe network to control the use of rainwater during rainstorms and drought.

4) **The architectural level**. Rainwater control is primarily achieved by green roofs which build sponge, including green vegetation, water purification and absorption, gentlely slope roofs which can accelerate the rainwater collection, sewer and rainwater tank setting, and so on.

3. Progress in China's pilot sponge cities

3.1 Background of pilot work

In recent years, as one of the important urban development policies, the construction of sponge cities has been highly praised and emphasized by the state and local governments to improve the urban water environment and to alleviate urban waterlogging. In 2013, the central government clearly indicated the importance of building sponge cities. In 2014, the state issued the technical guide for sponge city construction – the notice on the construction (trial) of the low-impact development rainwater system, which further guided the sponge construction in cities at all levels. In 2015, in order to assess the performance of sponge city construction, the ministry of housing and construction issued the notice of sponge city construction performance evaluation and assessment methods (trial), and in 2015 formally started the construction of the pilot sponge cities. By the end of 2016, a total of 30 cities in two rounds have become pilot cities for sponge city construction (the first batch of 16 cities and the second batch of 14). At present, the third batch of sponge city declaration is under way.

3.2 Pilot city distribution and project type and operation

At present, distribution of pilot sponge cities in China covers different regions of the country, but it is mainly concentrated in the east, south, northwest and southwest of China (fig. 3). Among them, there are 10 pilot cities in the east of China (Zhenjiang, Jiaxing, Chizhou, Xiamen, Pingxiang, Jinan, Qingdao, Ningbo, Fuzhou and Shanghai); there are four pilot cities in the south of China (Nanning, Shenzhen, Zhuhai and Sanya); there are four pilot cities in the northwestern region (Xi'an new district, Qingyang, Xining and Guyuan); the Southwestern area has Chongqing, Suining, Guizhou guian new district and Yuxi four cities. A wide range of sponge city pilot projects will be carried out in areas with different natural conditions and rainfall conditions, and this will be conducive to the promotion of sponge city planning and construction experience in the future.

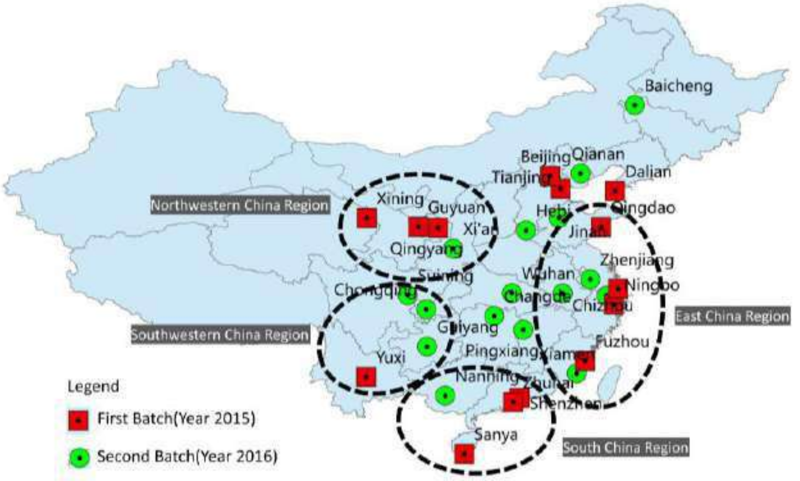

Figure 3: Location of Pilot Cities in China
Source: Drawn by the author

The project types of pilot cities not only involve the macro pattern of water ecological levels and the micro sites and buildings, but also pay attention to the platform of sponge city informatization construction. Different pilot cities choose important pilot projects according to their own conditions. In summary, there are 9 major types and 20 specific types(tab.1).

Tab.1 Pilot Project Category and Types

Pilot project category	Specific types of pilot projects
Water security and water ecology	Lake and river water environment improvement projects
Water network	River ecological restoration project, wetland ecological protection project, ecological corridor construction
Flood control engineering construction	Flood control facilities construction projects, mountain flood protection projects
Sewage network and facilities	Sewage network upgrading and renovation project, rain and sewage diversion project, sewage treatment and construction (reconstruction) project
Road design adapted to water	Sponge road design (including pipe network layout, water seepage and drainage design)
Functional plot construction (transformation)	Sponge community, sponge park and greenbelt, sponge square, sponge school, sponge hospital, water culture tourism hydrophilic project
construction	Roof greening works, rainwater collection and reuse work
New area complex	-- (sponge design with various elements)
Control platform construction	-- (mainly refer to construction supervision, rainstorm and flood control, and coordination between departments)

Source : Pilot City Documents

From the point of project operation, the pilot project has both special funds from the central finance or local government financial support, also have through the Public - Private Partnership (PPP), Refactoring Operate Transfer (ROT), Build Operate Transfer (BOT) model.

3.3 Results of the promotion of pilot work

By making sponge city specialized planning, strengthening financial and policy support and promoting the building of infrastructure sponge and the renovation of green infrastructure in old cites, the promotion of the construction of pilot sponge cities has achieved remarkable results in 2-3 years. Some cities did not experience urban waterlogging after a short period (1-2 years) of sponge city construction. The China economic weekly pointed out that in the summer of 2016, there were 10 sponge cities (Qianan, Xiamen, Hebi, Suining, Guian new district, Xixian new district, Shanghai, Qingdao, Sanya, Guyuan) which did not suffer waterlogging, accounting for one-third of the total pilot cities[6].

4. Shanghai sponge city planning and construction practice

Due to the unique situation of Shanghai city, it is faced with more complicated and difficult rain-flood management conditions (fig.4 and fig.5). Firstly, Shanghai's geographical location dictates that the city have to be subject to frequent typhoons, sudden extreme rainstorms and the effect of tidal waves which pose a great challenge to the management of waterlogging in cities[6]. In addition, Shanghai is characterized by the high groundwater level, the high density of urban development, large impervious surface areas and low soil permeability, which increase the difficulty of sponge city construction.

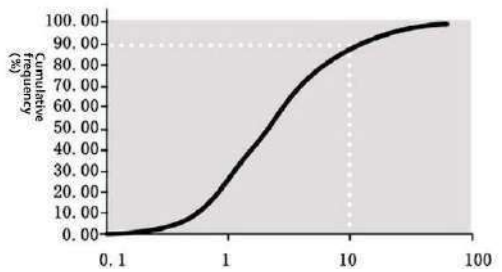

Figure 4: Maximum instantaneous rainfall intensity(mm/h)
Source: "Technical guidelines for sponge city construction"

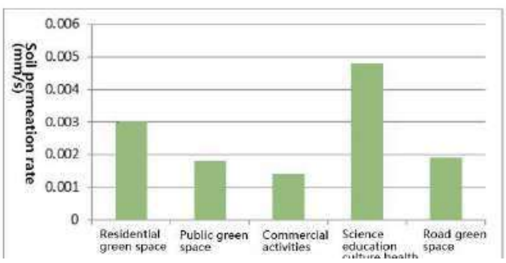

Figure 5: Green space types in Shanghai
Source: "Technical guidelines for sponge city construction"

Since 2016, Shanghai, as one of the important cities in pilot projects of the second batch, has carried out a series of planning and practical work related to the construction of sponge cities, including the specialized planning at the overall level of cities, compilation of technical guidelines, the specialized planning for urban pilot areas and implementation of sponge city concept and technology in specific urban projects, which have played an important and positive role in alleviating urban waterlogging problems and improving urban water environment.

4.1 Sponge city specialized planning

The planning and construction of sponge city should not only consider the construction of green infrastructure, but also strengthen the operational flexibility of traditional "grey" infrastructure in the case of abrupt rainstorms. In recent years, the municipal land and resources department in Shanghai has compiled the specialized planning related to sponge city at the overall level of urban construction, guiding the city partition or sponge-block specific planning and construction work. Relevant plans mainly include Shanghai sponge city specialized planning (2016) and Shanghai urban rainwater drainage plan (2017-2030).

4.1.1 "Shanghai sponge city specialized planning "(2016)

The plan has clear overall goals and sub-goals, the reasonable control structure, highlighted recent development and strong feasibility.

1) First of all, the plan clearly defines the specific goals of Shanghai's construction of sponge city: in the long run (2040), it will build resilient cities that can adapt to the global climate change trend and resist the rain and flood; it will buid a water harmony city where the water environment is of good quality, water ecology and urban landscape coordination, and the water landscape provides open space near water for the public; it will build a green and livable eco-civilized city with sufficient peripheral ecological space and complete ecological corridor in the main urban area and the new city; the main control targets are proposed for the comprehensive ecological, water environment, water resources and water security. Among them, the important target adopts the method of quantitative value control. (tab.2)

Tab.2 Sub-goals of Shanghai Sponge City Construction

Type	First grade	Second grade	Target value
Integrated ecology	Annual total runoff control rate	————	Centralized new area, the reconstruction area 80%
	Ecological shoreline restoration	River and lake water system ecological protection ratio	80%
	The proportion of green space in the centralized community in the construction land	————	≥15%
	Rate of the river	————	≥10.5%
Water environment	Surface water environmental quality	Water quality standard rate of surface water	100%
	Water quality at groundwater monitoring point	————	No less than III standard, and better than sponge city before construction
	Urban non-point source pollution control	Annual runoff pollution control rate	The new area 80%，the reconstruction area 80%
Water resource	Rainwater utilization rate	————	≥5%
	Leakage control rate of pipe network	————	≤10%
Water safety	Prevention and control of urban rainstorms and waterlogging disasters	Design recurrence period of rain water pipe canal	The main urban areas and new urban areas shall not be less than once every 5 years, Other areas are no less than once every three years; the underground passages and the lower city squares are no less than every 30 years
		Regional waterlogging design recurrence period	20-year return period
		Recurrence period of waterlogging prevention and control design	100-year return period
	Flood control standard	————	Meet planning requirements
	The levee's standard rate	————	95%
	Drainage rate	————	95%

Source：Pilot City Documents"Shanghai sponge city specialized planning "

2) Secondly, the spatial structure of Shanghai's urban sponge city is determined by the planning; on this basis, the management and control zones of Shanghai's sponge city are

defined, and mandatory control indicators of sponge construction are proposed for each district. In the spatial structure of sponge city, ecological restoration area and low-impact development area of ecological protection area have been delimited. (fig.6, fig.7 and tab.3)

Figure 6: Shanghai Sponge City Space Constructure
Source : Pilot City Documents"Shanghai sponge city specialized planning "

Figure 7: Shanghai Sponge City Control Division
Source : Pilot City Documents"Shanghai sponge city specialized planning "

Tab.3 Shanghai Sponge City Compulsory Index

Compulsory index projects for central area		Index
Water ecology	Annual total runoff control rate（%）	70%
	Ecological shoreline reconstruction rate(%)	75%
Water safety	Recurrence period of waterlogging prevention and control design	100-year return period
	Distribution network standard	5-year return period
	Flood control standard	100-year return period
Water environment	Water quality goal	Target rate of key water functional areas 100%
	Annual runoff pollution control rate（%）	≥70%
Water resource	Rainwater utilization rate（%）	5%

Source : Pilot City Documents"Shanghai sponge city specialized planning

3) At the same time, the plan has also set the goal of building a sponge city of 200 square kilometers by 2020, and implemented the key sponge city construction area (project) in space (fig. 8). Recent construction of key projects involves some important central city parks, green space, protective space and waterfront space, including important new city districts, industrial parks, ancient towns and villages.

Figure 8: Shanghai Sponge City Recent Construction
Source：Pilot City Documents“Shanghai sponge city specialized planning

4.1.2 “Urban rainwater drainage plan of Shanghai (2017-2030)”

"Shanghai urban rainwater drainage plan (2017-2030)" was compiled and published by Shanghai water authority in 2018. The plan realizes the construction of a complete urban drainage system in Shanghai by means of "control of source runoff, combination of process storage and drainage, coordination of the two networks at the end and scientific control of risk". (fig.9 and fig.10)

The plan puts forward: 1) the flood control standard of the main urban area and the new city is not less than once every 5 years and the standard of once every 100 years for the recurrence period of the design of waterlogging prevention; 2) the control rate of rainwater runoff is greater than or equal to 75%, the control rate of rainwater runoff pollution is greater than or equal to 55%, and the utilization rate of rainwater resources is greater than or equal to 2%. The plan also emphasizes the combination of the construction of sponge city through the comprehensive storage, infiltration, stagnation, purification, use and discharge to reduce runoff pollution effectively.

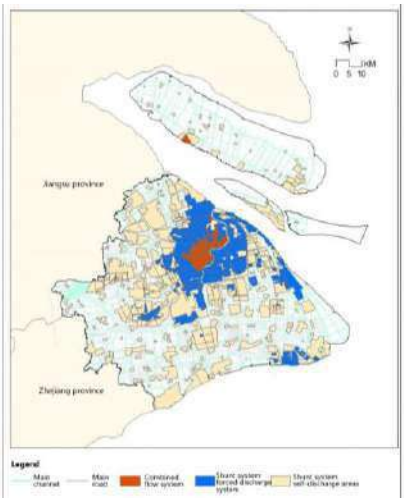

Figure 9: Shanghai Sponge City Drainage System and Patterns
Source: Urban rainwater drainage plan of Shanghai (2017-2030)

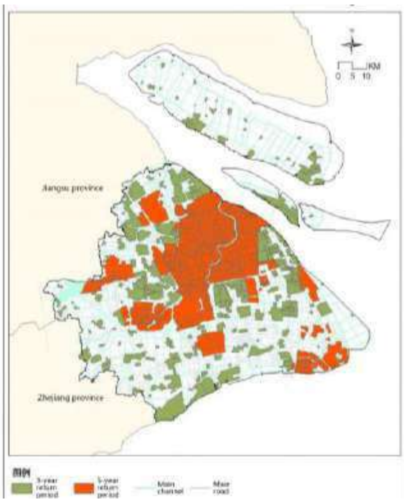

Figure 10: Shanghai Sponge City Drainage Standard
Source: Urban rainwater drainage plan of Shanghai (2017-2030)

4.2 "Technical guidelines for sponge city construction"

National level promulgated the sponge city construction technology guide, the urban waterlogging prevention and control technical specifications and the urban rainwater storage engineering technical specification; Shanghai also compiled the sponge guidelines for the urban construction technology as the guide the concrete practice of Shanghai guide file

This guide puts forward the key technologies and methods of sponge city construction of five aspects of planning, the design, project construction, maintenance management and implementation effective evaluation. The planning level includes three levels: general planning, detailed planning and project implementation plan; the design level includes building and community green roads and square water utilities and facilities scale; the construction part of the project is to further refine the control details of rainwater on the basis of design; the maintenance management section emphasizes the specific operation, control and maintenance of different types of projects; implementation effect evaluation is a comprehensive evaluation of the program implementation effect through several key indicators (including annual total runoff control rate, annual runoff pollution control rate, rainwater utilization rate).

This guide covers multiple planning and design levels, and provides detailed and practical ideas and technical tools for Shanghai sponge city construction by integrating the concept of sponge in macro planning, giving specific guidance to detailed design (fig.11), controlling and evaluating quantitative indicators.

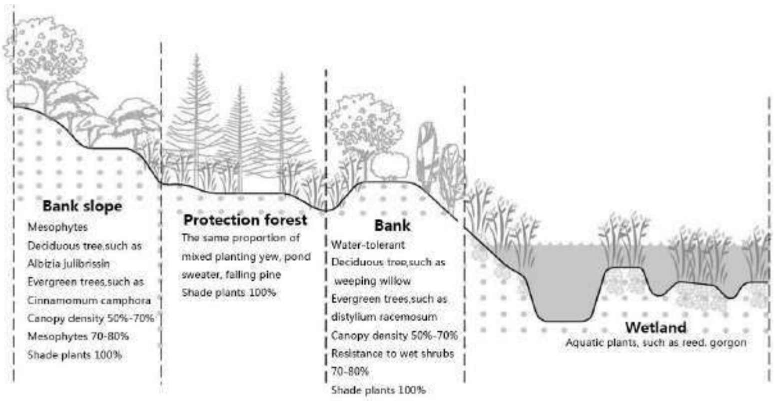

Figure 11: Typical structure of vegetation buffer zone
Source:"Technical guidelines for sponge city construction"

4.3 The specialized planning of the pilot area and sponge technology application: Lingang New District in Shanghai

4.3.1 Overview

Lingang New District is located in the coastal area in the southeast corner of Shanghai(fig.12). It is the hinterland of Shanghai free trade zone. The new district is more than 50km from the central city and about 20km from Pudong International Airport (fig.13). The total area of Lingang New District is about 315 square kilometers, and the planning includes the heavy equipment area, the logistics park, the main industrial area, the comprehensive area, the Fengxian park, Nanhui new district and other functional.

Figure 12: Location of Lingang New District
Source: Drawed by author

Figure 13: Function Plan of Lingang New Distric
Source: Linggang New District Plan

In order to carry out the pilot project of Shanghai sponge city, Lingang New District, as an important pilot area, formulated specialised planning of Shanghai sponge city in Lingang pilot district and three-year implementation plan in 2016. The planning defines the specific scope of sponge city planning and construction, the objective and concrete strategy of sponge city construction, overall sponge city construction space structure and construction division and 15 pilot projects from 2016 to 2018.

4.3.2 "Shanghai Lingang pilot district sponge city specialised planning" [7-8]

The planning puts forward that :1) the construction of sponge city is mainly achieved by ecological conservation, ecological rehabilitation and low-impact development; 2) consider the distribution of ecological resources, the ecological sensitivity of land use, the risk of waterlogging and topographic elevation in the planning area, and form sponge city natural ecological space pattern——"one core, two rings, six wedges and several areas" (fig. 14); 3) according to the research and exploration of different construction needs and characteristics of sponge cities, the plan delimited 7 different types of demonstration areas— the ecological protection of the typical lake, business district sponge construction, rainwater storage and purification in the ecological corridor, sponge reconstruction in the urban build-up area, sponge construction in the new urban district, ecological protection and utilization in reclamation area, reconstruction of water accumulation in old urban areas and water comprehensive treatment, and it also puts forward clear requirements for the key content and direction of sponge city construction in different areas, including the optimization of ecological vegetation community on the lake, collection and discharge of rain water in commercial areas, upgrade of rain and sewage pipe networks in old residential areas, soil improvement and mobile forest construction.

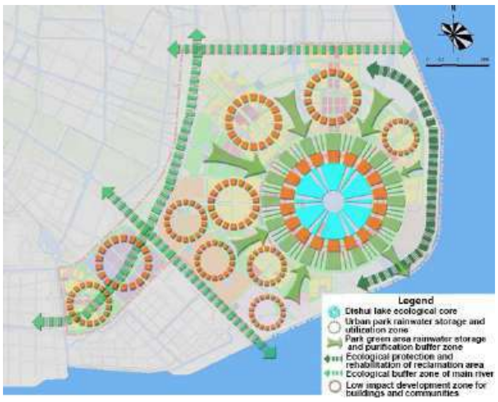

Figure 14: Overall Layout of the Pilot Area of Sponge City Construction
Source： Shanghai Lingang pilot district sponge city special plan

4.3.3 Action plan for 2016-2018

From 2016 to 2018, pilot projects of sponge city construction in lingang include15 project packages, such as the lake water ecological protection and purification projects, main urban river comprehensive improvement projects, old city sponge reconstruction projects, sponge construction projects in the urban build-up area, the expansion projects of the Lingang sewage treatment plant, regional capacity improvement projects, ecological protection, rehabilitation and utilization project in reclamation areas, sponge city park projects in the second ring zone, which can guarantee the attainment of planning objectives and targets effectively.

4.3.4 Construction[9]

a) the lake landscape around Dishui lake

Dishui lake landscape mainly adopts technologies such as permeable paving, permeable blind pipe, ecological wetland and ecological revetment in order to meet the sponge city requirements of local rainwater infiltration and absorption, effectively reduce surface runoff and purify water during rainfall. The specific node spaces, such as squares, footpaths, are laid exposed concrete, permeable asphalt paving, ecological ceramic permeable brick paving and gravel paving, and sets up 150mm wide grass planting belt separation every certain distance (6m), to promote facilitate rapid infiltration of rainwater (fig. 15 and fig.16).

Figure 15: Water permeable green space design
Source: Literature [9]

Figure 16: Water permeable pavement design
Source: Literature [9]

b) Sponge renovation project in area F, Xinluyuan district, Chaogang community

The sponge reconstruction of Xinluyuan in Chaogang community mainly starts from the perspective of public space and construction facilities, including three main ways: ①carry out water quality purification and reduction for initial rainfall; ②disconnect the building pipe in the community, and let the rainwater enter the municipal rainwater drainage pipe after being purified by grass planting ditch and other plant purification, and filtered through the soil media such as pebbly slope protection ; ③ help store some rainwater and reduce runoff by reconstructing inferior fovea through landscape. (fig.17)

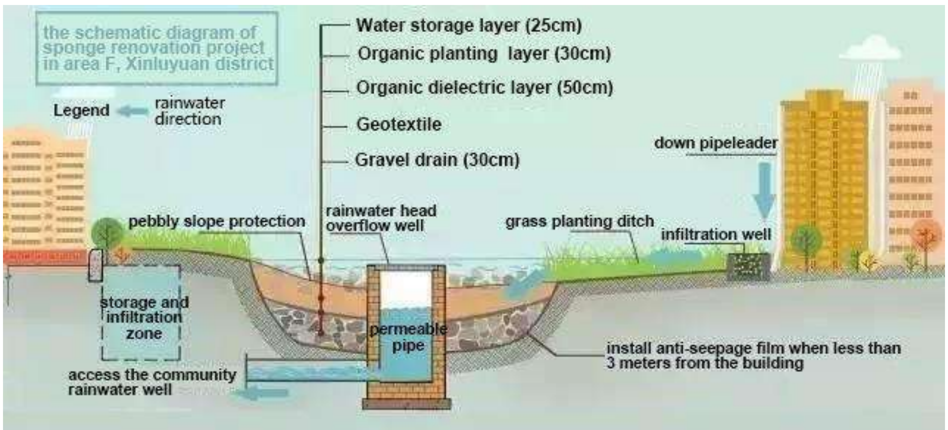

Figure 17: Sponge Community Project
Source: Literature [9]

Through the planning and reconstruction, there is no obvious water accumulation in the community activity square and parking lot (fig.18 and fig.19).

Figure 18: Comparison before and after Square Transformation
Source: Literature [9]

Figure 19: Comparison before and after Parking Transformation
Source: Literature [9]

5. Experience and reference

The construction of sponge city requires comprehensive consideration of the ecological sponge element system at different spatial scales. At the same time, it is necessary to consider the characteristics of precipitation, confluence, water collection, drainage and rainwater reuse and adopt different technical means to build green infrastructure. At present, Shanghai has accumulated rich experience and achieved good results in the construction of sponge city, mainly including macro-level planning guidance and detailed implementation plan (specific project), sponge engineering technical support and indicator control and the demonstration effect of specific pilot areas and projects. From the general specialised planning to the pilot regional specialised planning, from zoning control to specific implementation plans, from technical guides to demonstrations of technical applications, Shanghai is moving towards the goal of "sponge Shanghai" through such a perfect planning control and implementation.

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The planning methods of Chenjia Town international ecological residential area in Shanghai based on the ecological security

(The planning methods of Chenjia Town international ecological residential area in Shanghai based on the ecological security)

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1. Research Background

China has always been in the period of rapid development of urban construction since the reform and opening up, and the level of urbanization has increased from 17.9% in 1978 to 57.4% in 2016, with an average annual growth of 1-2 percentage points(Li,2017). However, in the same time of rapid development, the urban construction activities have also caused a series of ecological security problems, such as environmental pollutions, crowded, waste of land resources, natural disaster, and other ecological damages. These phenomena make people gradually realize the importance of changing the way of urban development, and exploring a road to balance of the quality of ecological and environmental, the benefits of economic and social, and the environmentally sustainable development(Wang,2006). Because of the residential area is not only the closest place to our daily life, but also the key factor of restricting urban ecological security, and can reflect the contradictions and challenges of the urban ecological security crisis caused by the urban construction activities(Huang,2010), the paper tries to explore a planning method of residential area based on the ecological security, and in the process of solving the "urban diseases" and other ecological security crisis, to creating a kind of harmony livable environment between man and nature(Teng,2006).

2. An Analysis of the Concept of Ecological Security

Ecological security is an emerging research field of ecology, and its definition was first proposed by the International Institute for Applied Systems Analysis in 1989, meaning that there are no threaten in human's life, health, well-being, basic rights, source of living, necessary resources, social order, adaptation to environmental changes and so on(Fang et al.,2001). Nowadays, the analysis of the definition of ecological security mainly including general and narrow two levels both at home and abroad. The generalized ecological security is an ideal state, meaning that the city will not have an ecological crisis, nor is it threatened by any potential ecological risk factors. The ecological security in the narrow sense is mainly for a specific research object, focusing on the key factors that constrain its ecological harmony, and by regulating the significant constraints that affect the specific objects, to improve the level of ecological security(Wang,1997).

Based on this, the article systematically combs the existing research results, founding that most of the studies focus on the construction of ecological security evaluation index system and the application of ecosystem management of built residential areas at present(Sun et al.,2012; Yang et al.,2013; Shao,2002), lacking systematic research on the planning theory and method of ecological residential areas under the concept of ecological security. So the paper takes the planning of the Chenjia Town international ecological residential area in Shanghai as an example, by establishing the four in one planning strategy of the compact residential areas, the green travel residential areas, the environment-friendly residential areas, and the low-carbon environmental protection residential areas, to explore the planning theory and method of ecological residential areas under the concept of ecological security. On this basis, the plan tries to make a further subdivision, and to establish the planning system of ecological residential areas, including four secondary indicators and thirteen third-level indicators, and try to combine the concept of ecological security and the planning subsystems of residential areas, and to guide the development and construction of ecological settlements.

Table 1: The planning system of the residential area under the concept of ecological security

The planning system of the residential area under the concept of ecological security	*the compact residential areas*	*Group size*
		Enclosed neighborhoods
		public Utilities
	the green travel residential areas	*Road density*
		Walking system
		Bicycle system
	The environment-friendly residential areas	*Bus system*
		Water system
		Green layout
		vertical greening
	the low-carbon environmental protection residential areas	*Low - carbon housing*
		Low - carbon public buildings
		Green facilities

3. the planning of the Chenjia Town international ecological residential area

3.1 Development background and current characteristics

In 2008, Shanghai was selected as the first low-carbon pilot city in our country, and then Chongming Island, Lingang, and Hongqiao business district was selected as three low-carbon demonstration areas of Shanghai . The planning area locates in Chenjia Town, and covers an area of about 4.4 square kilometers, which is the key area of development of Chongming Island. The status quo is mainly paddy field and irrigation channel, and the existing planning is difficult to meet the development requirements under the new context in terms of land use, road traffic, green landscapes and public service facilities, urgently needing to construct the international advanced level of ecological residential area under the concept of ecological security. Shanghai Tongji urban planning&design institute undertook the planning and design work of the project, and I had the honor to participate in part of the work. If the relevant date in the article is no references, then they are from the project.

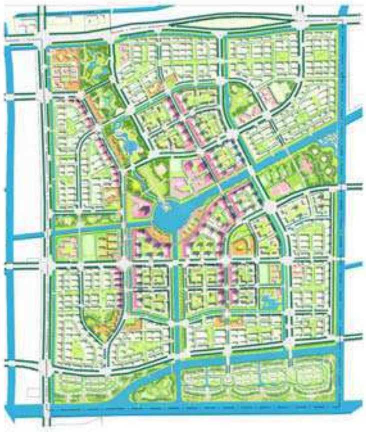

Figure 1: *The land layout planning* Figure 2: The u*rban design*

3.2 The concept of planning

The planning takes the concept of ecological security into the subsystems of the residential area, and propose a more natural, healthier and more enjoyable way of life, specifically including: a compact residential area, the green travel residential area, the environmentally friendly residential area, and the low-carbon residential area.

3.3 The compact residential area

A high density and multi-type residential area.

Reasonable residence density. By drawing on the number of living units on the residential land in the famous ecological residential area at home and abroad, the plan determines the number of living units on the residential land under different volume ratios in reasonable, and achieve a high density of living residential areas, such as the Hammam Newcastle, the Burlington Eco Village, and the Chongming East Beach.

Table 2: List of Recommended Residential Density

Floor area ratio	*Living density (unit / ha)*
1.6	*100-130*
1.2	*70-80*
1.0	*60-70*
0.6	*＞40*

3.3.1Enclosed neighborhoods.

Jane Jacobs once said: “If a city's streets look very interesting, the city will also be very interesting(J.Jacobs,1993).”.Because of the street is an indispensable place for residents' daily life activities, such as pass, neighborhood contacts, shopping, leisure, and entertainment, the plan uses the layout of the neighborhood. Through the enclosed house, the plan creates a street atmosphere, a multi-level communication space, and a vibrant residential street space, and achieve the person car branch at the same time.

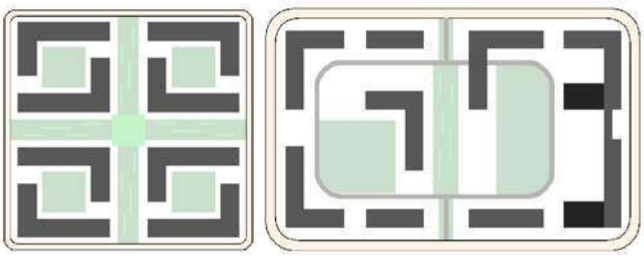

Figure 3: The layout of the enclosed neighborhoods

3.3.2Diversified residential building types.

The plan taking account of the residential needs of residents of different ages and types, including the core family, the single young professionals, and the elderly, etc, and providing a variety of residential building types, such as old - age apartment, micro apartments, affordable housing, SOHO, and townhouses, etc.

Figure 4: The statistics of different types of residential households

3.3.3A Convenient and complex public service network.

By combining the layout of the neighborhood, the plan set up a well-distributed public service facility along the streets, and formating a comprehensive public service network, creating a vibrant residential neighborhood. Also, through the layout of public service facilities, the plan can further increase the residential employment opportunities, and form a sustainable development of living networks.

Figure 5: The layout of the Public service network

3.4 The green travel residential area

3.4.1Walking friendly street network.

Compared with the large-scale neighborhoods, the small-scale neighborhoods have significant continuity and permeability in space form, suitable neighborhoods and street scales, suitable walking and vibrant public spaces and so on. So the plan combines with the core living circle, commercial and residential mixed land and residential land, forming three different types of street scale. In the core life circle to increase the density of street road network, the density of the street road network is 150 * 150m. In the commercial and residential mixed areas, the density of the street road network is 200 * 200m. In the external residential block, the density of the street road network is 300 * 300m.

3.4.2Bicycle friendly road network.

The planning layout different bike road systems in different areas. Firstly, forbidding the entry of motor vehicles and encouraging to use the public transport and bicycles in the scope of the core living environment. Secondly, allowing the bicycles and cars to be mixed, but the *speed limit at road for vehicle* in the general living area, thus encourage residents to use more bike travel, and create a bike movement characteristics of residential areas.

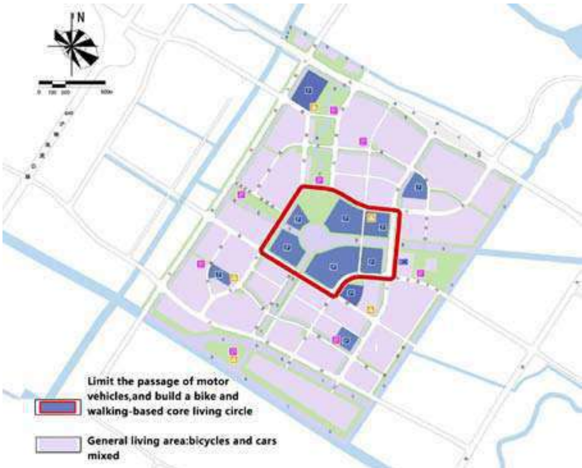

Figure 6: The sub-regional layout of the bike road system

3.4.3Hierarchical layout of the bike road system.

By building a hierarchical bike road system, the plan improves the bike-friendly road network, and by providing bicycle parking facilities, the plan provides bicycle rental, shower, and other services. Regional bike road, the ratio of the bicycle travel accounted for about 40%, the function of the Regional bike road is mainly to contact the residential area and the surrounding parks, commercial center area, and mainly to long-distance commuting, can also be used as a fitness bike lane. To ensure the increasing demands for motor vehicle trips after the floor area ratio increased, the plan tries to reduce the width of the green belt, and change the road section to four lanes, and set a single-sided bi-directional bicycle belt in the same time.! Through the isolated green belt between the bike lane and motor vehicle lane, to ensure the bike travels safely at a higher speed. Neighborhood bike road, the ratio of the bicycle travel accounted for about 60-70%. Controlling the enter of the motor vehicles in the core living area, and constructing the bicycles and walking-based road use system, and the road red line width of 12-15 meters, mainly for bike traffic, and as fire channel in the special case. Priority bike road, the ratio of the bicycle travel accounted for about 40%. Taking into account there are more cars in his part of the road, the planning tries to minimize the vehicles to turn right, and ensure the safety of the bike lane. So the planning puts the bike lane locates on the inside, and the right turn lane locates on the outside, and design protection isolation belt between the two lanes. General bike road, the ratio of the bicycle travel accounted for about 20%. The main roads within the residential area, and use the conventional road sections.

Figure 7: The hierarchical layout of the bike road system

3.4.4Bicycle channel section.

The main bicycle channel section: In order to ensure the increasing demands for motor vehicle trips after the floor area ratio increased, the plan tries to reduce the width of the green belt, and change the road section to four lanes, and set a single-sided bi-directional bicycle belt in the same time. The secondary bicycle channel section: Emphasizing the status of bicycle traffic in the secondary channel, and try to reduce the proportion of road traffic, in the case of Meeting the number of bike lanes and the width of the green belt. The bicycle dedicated section: mainly for bicycle and walk , and for the fire truck in a state of emergency.

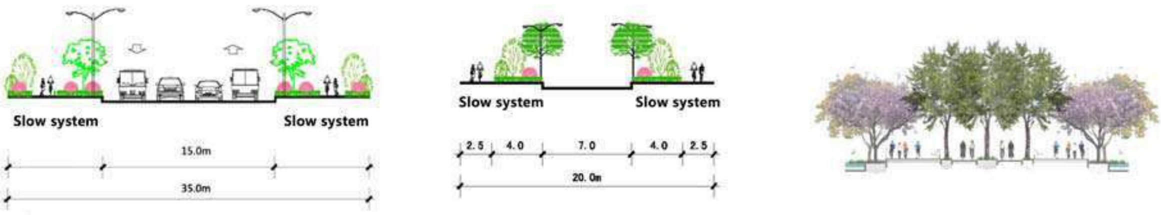

Figure 8: The different types of bicycle channel sections

3.4.5Bus sharing rate of 40%.

Combining with the status quo of the original bus lines, the plan layout a total of twelve bus lines, including one city long-distance bus lines, two island bus lines, seven regular bus lines, and two other bus lines. The layout of the bus station is one for every 600 meters, and the service radius of about 300 meters(5 minutes walk distance), and satisfy the requirement of covering more than 90% of construction land.

Figure 9: The layout of the Bus system

3.4.6Convenient transfer facilities.

Through the layout of the convenient transfer facilities, the plan provide facilities with good facilities. For example, to increase two bus transfer points on the basis of the existing bus terminal, and to provide adequate bike parking spaces and public bicycle rental in the transfer point in order to strength the bike and bus transfer, and finally reach the target of 5 minutes to reach the bus station, 15 minutes to reach the local work point and the transport hub.

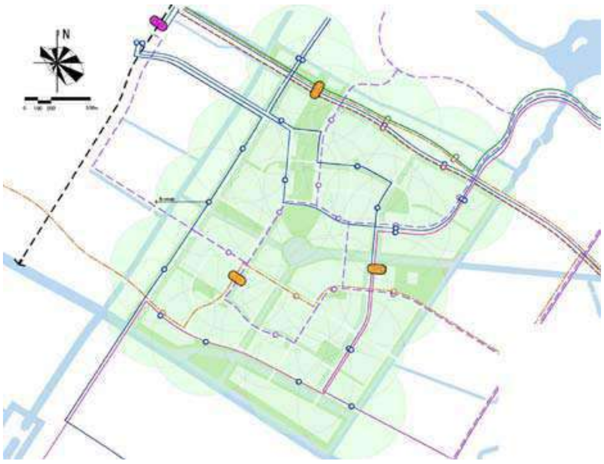

Figure 10: Transfer the layout of the facility

3.5 The environmentally friendly residential area

Take the water as an important part of the ecological and rainwater management system: As is known to all, the density of the river network can reflect the sparse degree of river distribution, and the higher the density, the more obvious the retention of rain, playing an important role in the retention of rainwater. While the water rate reflects the size of the river distribution area, and the higher the water level, the higher the capacity of rain and flood control, playing an important role in the rain and flood transfer. And the two interact with each other, reflecting the richness of river distribution and water storage and drainage and self-purification capacity. Based on the above analysis, the plan tries to promote the status quo of the water system,and the density of the river network is increased by 1.07 (km / km2) on the original basis, the water surface rate is increased by 0.53% on the original basis, and exceeds the average river network density and river network rate. In addition, through the expansion of the internal water ring, and convergence with the residential park, the plan formate the internal and external water ring, and strengthen the flood control and drainage capacity, and through the improvement of water network system, formate the experience of the Jiangnan water dwelling. And the new planning of the water network connected to the network, not only enhance the ability of rainwater storage capacity, but also reduce the urban surface run off.

Figure 11: The layout of river water system

Habitat into a network, strengthen the construction of diversified green space: The plan tries to strengthen the construction of a wide range of green space, and to improve the participation of green space, and to play the role of dot-like green space in a more efficient way. The final realization of the park green service radius of 500 meters, five minutes to reach.

Figure 12: The layout of green space system

Put the farmland as an important part of the open space: Green space is not only exist in the open space, the construction of epidermal planting is also very necessary. These vertical green patches through the green environment with the city as a whole, and can be a reasonable and effective expansion of the entire city's vegetation area, improve the city's comprehensive ecological benefits. In the residential building roof on the introduction of farmland, not only has the production function, as well as the ecological service function and the recreation function and the educational function, which reduces the pollution caused by the transportation of long-distance agricultural products. And can also be a green base for urban landscapes.

3.6 A low carbon green residential area

The research of low carbon green residential area is divided into three levels, including low-carbon housing, low-carbon public buildings and green infrastructure. Due to space constraints, the article only to do a brief introduction, and do not elaborate.

Low - carbon housing. The planning of the Low-carbon housing mainly including five aspects: the planning site and outdoor environment, having land and hydrological environment, Water saving and water use, Saving material and material resources and indoor environmental quality.

Low - carbon public buildings. The planning of the Low-carbon public buildings mainly including three aspects: saving land and hydrological environment, energy conservation and energy use and indoor environmental quality.

Green infrastructure. The planning of the green infrastructure including six aspects: energy, transportation, underground space resource utilization, regional environment, regional greening, and resources.

4. In conclusion

Nowadays, the planning method of the ecological residential area is still in the initial stage of development practice in our country. However, it is undeniable that with the deep implementation of the new urbanization in China, the ecological residential area will be the goal of planning and construction of the future residential area, and is of great significance for the sustainable development of urban economic and society and the construction of healthy, livable, safe eco-city(Chen et al.,2012). The paper take the planning of Chenjia Town international ecological residential area in Shanghai as an example, by establishing the four in one planning strategy of the compact residential area, the green travel residential area, the environment-friendly residential area and the low-carbon environmental protection residential area, to comprehensively explore the planning theory and method of ecological residential area under the concept of ecological security. In the area of the compact residential area, by establishing a reasonable living density, enclosed neighborhoods and diversified residential building types, the planning of the ecological residential areas advocates a different age and type of residents living together, and through the rational distribution of public service facilities, to create a compact and dynamic residential area. In the area of the green travel residential area, the planning of the ecological residential areas pay more attention on walking friendly and bike friendly, through the zoning of the layout of the public transport system, and the convenient transfer facilities, to make the share of public transport to reach 40%. In the area of the environmentally friendly residential area, the planning of the ecological residential areas takes water as an important part of ecological and rainwater management system. By making the water system into a ring, to construct a wide range of green space system, and by making the farmland as an important part of open space, to improve the city's comprehensive ecological benefits. In the area of the low-carbon residential area, the planning of the ecological residential areas pays attention to the low-carbon residential, low-carbon public buildings and the construction of green infrastructure, to achieve saving water, saving land, saving materials and saving energy.

The study of the planning of the ecological residential areas is a deepening subject, so in the process of planning and construction of ecological residential area, we should clearly understand that the development goals, the planning index systems and the planning requirements of the planning and construction of ecological residential area will be different with the difference of regional and the urban socio-economic development stage. Such as cold areas and hot areas, developed areas and underdeveloped areas an so on. Therefore, the planning method of the ecological residential area should also be combined with the development stage, development conditions and overall urban planning of the local cities, and put forward the practical planning and design strategies according to local conditions, which need further in-depth research and innovation.

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Chinese Rural Area Natural Resource Oriented Town and Village Cool Planning Practice

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Abstract

The research discusses the rural area's 'refrigerator' role to the urban area. And choosing two real Chinese town and village planning practices which are both natural resource oriented, but they have different methods and strategies.

Key words:
Natural Resource Oriented, Chinese Town and Village, Cool Planning Practice

1. Introduction

Recent years in China, more and more construction work and focus move from urban to rural area. In this process, town and village planning plays an important role. However, because of the rapid urbanization process China has experienced over the past years, urban planning with rapid industrial thinking is the mainstream in Chinese planning practices. But town and village in rural area have different situations from physical space to culture background. Unfortunately, at the beginning of the rise of town and village planning, because of the ignorance of the difference and rapid-develop requirement, planners still use the same methods and ways of thinking which has been proved to fail. Thus, this research is based on the character of town and village and their close relationship with rural area which actually act the cooling-temperature system or the 'refrigerator' role to the urban area where they surround. Two real Chinese town and village planning practice has been chosen. Both of them are natural resource oriented, but they have different methods and strategies in order to keep and strengthen their ecological function on one hand, and on the other hand to guarantee and promote the town and village's living and production purpose.

2. The Role of Rural Area

2.1 Supporting to the Urban Area

China has experienced a very rapid development process in the past more than 30 years. However, this process almost only happened in urban area. And the development of urban area is based on the support of large amount of Chinese rural area. Urban area cannot support themselves without the outside rural area. For example, food, the basic living source, is come from the rural area. And also the eco-system supporting about the fresh air circulation. To some extent, rural area play a 'refrigerator' role to the urban area. Without rural area as 'refrigerator', the urban heat island effect will more severe and worse.

2.2 Facing Problems

Furthermore, the support of rural area for cities is not only about natural resource but also including human resource. Numerous farmers left their land and moved to cities to join in the construction of urban area. Therefore, people who still living in the rural area are almost the aged and children who are not effective workforce. They are not capable to maintain and sustain the large-scale agricultural production and a lot of lands are not farmed and left there with weeds. This is one problem. Another problem is that people changed the function of the land for economy purpose. For example, many villagers who living in mountain area, Zhejiang Province changed their farm or forest land to plant landscape trees. We will have more details about this situation in the case study. And the third problem is the planning and construction problem under the misunderstanding of the rural area. Because in the past 30 years in China, almost all the planning and construction work are focus on cities, most planners do not have the experience of rural planning. So they use the same thoughts and ways in the rural planning without understanding the natural and ecological attributes of rural area and made some mistake to this area. The first case is mainly deal with this problem.

3. Case Study One: South Mountain Rural and Town Area Planning

3.1 Existing State of Affair

The first case is happened in rural area of Liyang City, Jiangsu Province, southeast of China. This planning scope is 113 square kilometers naming South Mountain Area, including two towns and eight villages (Figure 1). This area is most famous for their high quality of natural resource in Southeast of China and even in the whole nation. The local government want to use this advantage and give more impetus to promote this area's economic development, and the planning is the first step.

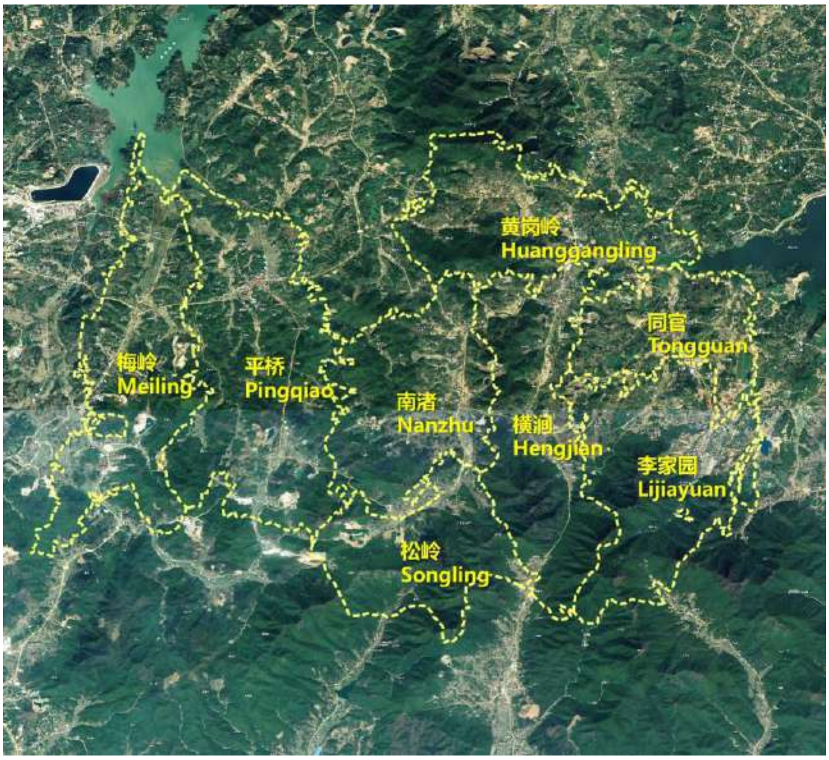


Figure 1: Location Area

3.2 Planning Process and Problem Identification

The origin of this planning is for economy concern and Up-Down push, the purposes of the government are very clear. But, what is the real and main problem of this area is still vague before the planning. Therefore, in order to find out the main problem of this area, the planning has been launched by bottom-up investigation and enquires.

So at the first step of this planning, a meeting has been hold to invite the representatives of the eight villages and two towns (Figure 2). And during the meeting, local people who live in this area gave the feedback that the economy problem is not the first problem they are concerning about, because they are facing the more severe problem of the flood. The whole area is facing very severe flood problem.

Figure 2: Representatives Meeting

Then through the discussion, inquisition and field investigation, it is shown that the flood problem is the result of the overdevelopment for tourism and wrong construction behavior. For this area is belong to the Tianmu Mountain and it is famous for its high quality natural mountain and water resources, especially the hilly terrain and the beautiful rivers and streams between the hills (Figure 3). And the temperature of this area at summer is much lower than the temperature in the cities around. So every summer many people who lives in the cities come to here to avoid urban area’s summer heat. Because of the need of city people, this area has developed tourism many years ago. And the people living in this area are the earlier group that has tourism income adding to their normal income. Therefore, the economy problem is not their first thinking.

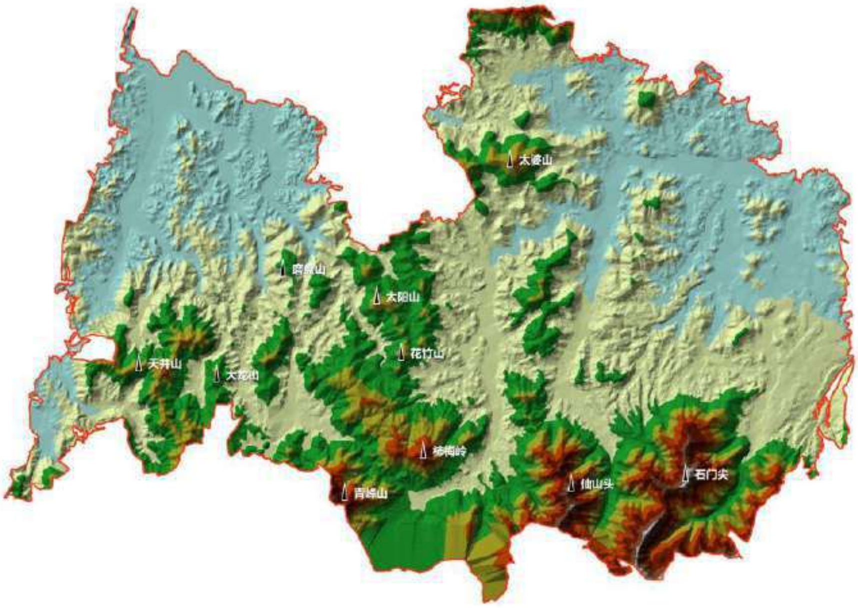


Figure 3: Mountain Topographic Analysis

To support the tourism, many construction has been hastily done without enough thinking which lead to the over-development of land use and mistaken-construction of the embankment. And the result is so many rivers and streams has been polluted, blocked and even disappeared (Figure 4). Without the enough rivers and streams to store and distribute water, whenever in the rainy season, flood began to torture this area. As every summer is the tourist season and is also the rainy season, the flood situation is getting worse in recent years that not only reduce the tourists' passion but also affect the people's normal lives who are living there. Even more, if this situation continues, this area's ecological system will be destroyed and not to mention the 'refrigerator' function.

Figure 4: Polluted River

3.3 Planning Strategies

Based on the survey before the planning and to deal with the flood problems at first, through several rounds discussions with local people and also the local government water resource department, planning strategies have been taken out which are adhere to the principle of natural resource orientation and focus on the water resource and river channel dredging. On this basis, the planning and design is carried out for the landscape and public facilities upgrading.

Strategy I: Keep Intact of the Mainstream Rivers and Basins
There are six main rivers in this area and they divide the whole area into seven basins (Figure 5). So the first step of the planning is to protect and retain the ecosystem pattern of the relationship between the rivers and the mountains. Forbid any constructive behaviors that will endanger and destroy ecological security in the basins. And prevent the different type of non-construction land into construction land through strict construction control by land and construction management department of local government. The planning provide a detailed land classification map to help the government to supervision and management (Figure 6).

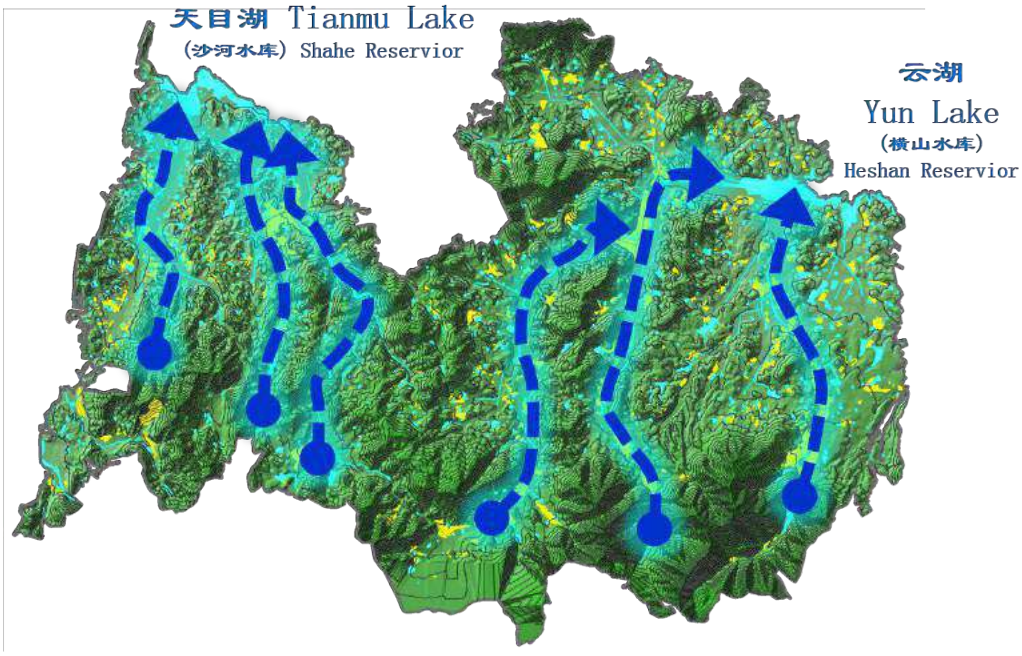


Figure5: Mainstream Rivers and Basins

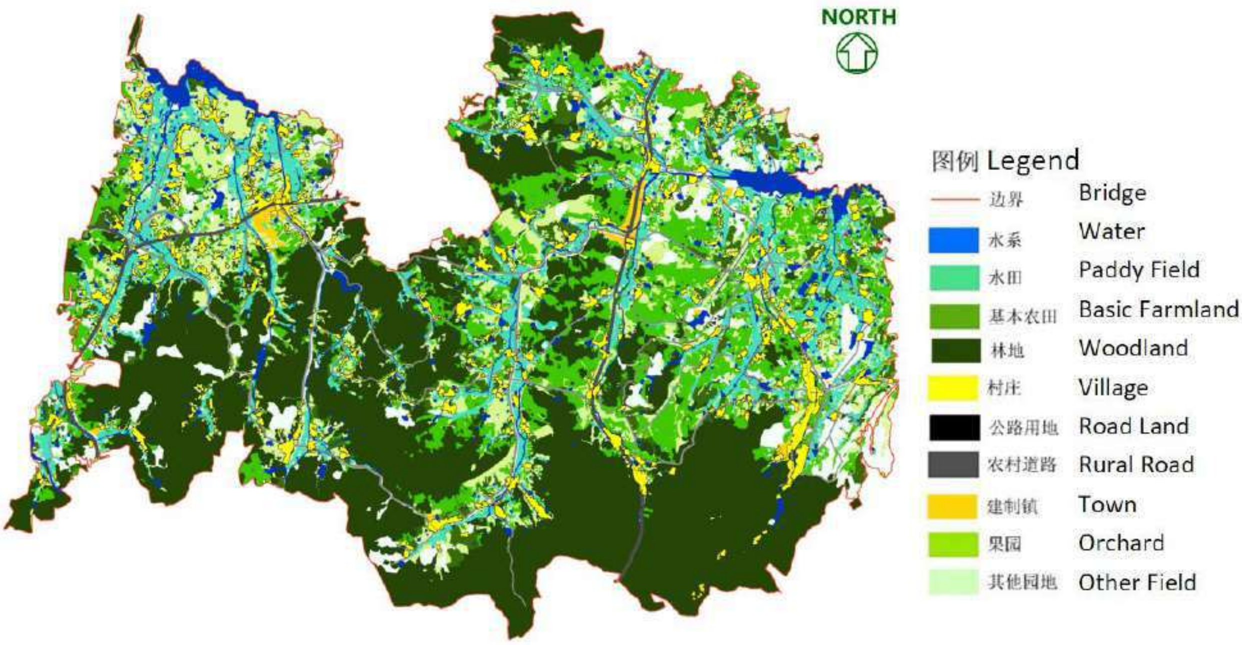


Figure6: land classification map

Strategy II: Core Area Resource Recovering

The whole scope of South Mountain Area is at the door of Liyang South Mountain Bamboo Sea Scenic Area which is an AAAAA national scenic spot, the top level in China's scenic spot rating standards. The east part of the planning scope area is nearer this scenic spot and as the pass way to the spot it attracts more city people than the west part of the scope. And also it has more construction without careful consideration. Its flood problem is also more serious than the west part. Therefore, this part of scope has been chosen to the core area to analyze and reorganize the resource (Figure7).

Figure 7: Core Area Site

Firstly, During the investigation, a special character of the landscape pattern has been found that not like the east China's Jiangnan Water Town, this area which along the river there is always the farmland or the field and it has a very important function that to become the flood buffer to avoid the village to be drowned (Figure8). But during the past years unthoughtful construction, some buffer area has been destroyed. So in the planning, recovering the buffer zone become the first step.

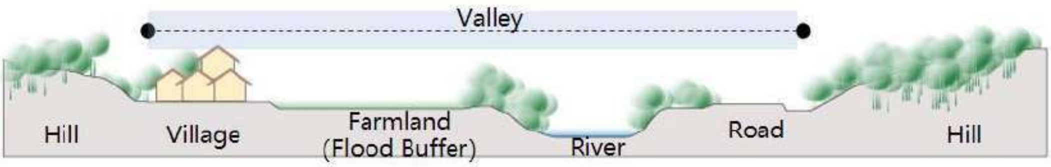


Figure 8: Flood Buffer Pattern

Secondly, recovering the natural river linear. In the past years' development, in order to more efficiency and having more land use, the construction has change the rivers' natural linear to more straight linear. Then, the water has not enough time and space to stay, that is why the flood happened. So, in the planning, the curved natural river linear need to be recovered to let the flood have more buffer space (Figure9).

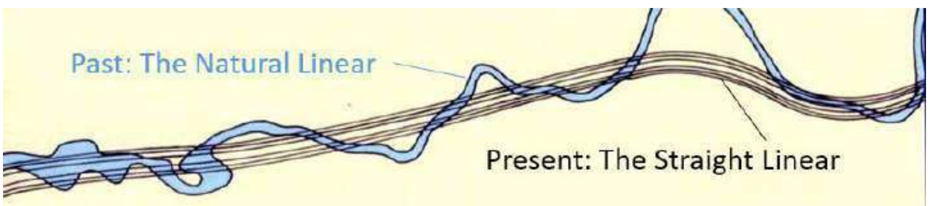


Figure 9: Natural River Linear Recovering

Strategy III: Embankment Detailed Design Demonstration
In the river buffer zone, is not the pure natural space that prohibit human entering. It can join to proper human activity which also can help people to more understand of this area's ecosystem and enjoy the natural landscape. Based on this idea, some detailed design near the river has been done. While recovering the character of natural rivers embankment, some riverside promenade has been added and change the straight line embankment to the resting slope that more people could safely close to the river and enjoy their time near the river (Figure10).

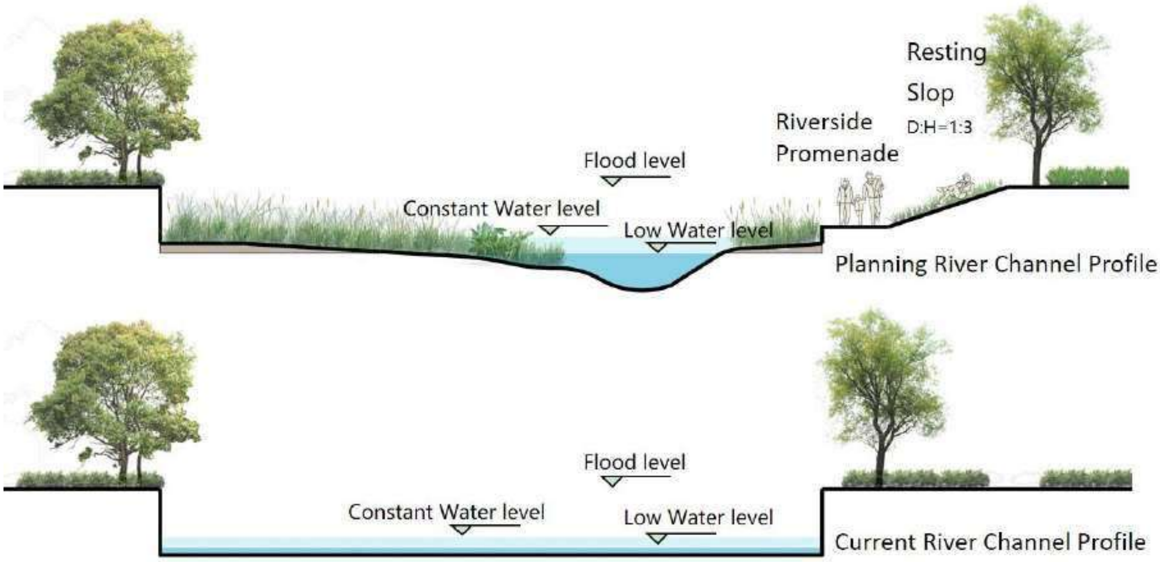


Figure 10: Embankment Detailed Design

4. Case Study Two: Tangxi Village Planning

Compare to the first case's large area, the second case study is specific on a small village which name is Tangxi and located in Siming Mountain area, Zhejiang Province, east coast of China. This village is almost at the top of the mountain, so in the summer, the temperature here is almost eight degrees lower than the average in the surrounding plains. It is a truly a 'refrigerator' village to the urban people. And also near the village only about six miles is the entrance of the Siming Mountain National Forest Park. Every summer, a lot of urban people come to the park and some retired people even live there for the whole summer about two or three months in order to escape the cities' summer heat. Some of these people even from Shanghai.

4.1 Planning Origin
The origin of this planning is bottom-up that is not from governmental will, but from the villager. They have strong willing to change their lives and to increase their income. Because in the last few years, this village has finished a transformation from agriculture to planting. But along with the downturn of Chinese real estate, their planting incomes begin to a dim view. The villagers want to find a new way to change their lives and adding their income. Also they have the wish to improve the living environment of their village.

4.2 Planning Process
Because of the bottom-up origin of the planning, the villagers are very enthusiastic and eager to provide a lot of information about their village. And some of them are not only familiar with the current situation but have abandon of historical knowledge of the village. Therefore, with the help of the villagers, through the planning survey and discussion with them, the village's

natural resource with deep culture heritage come out and become the main driving force for the planning.

4.3 Planning Strategies

The planning strategies making is not limited to village built-up area, but the whole village administrative area has been considered as a whole ecosystem. Its scope is about 14.6 square kilometers. And the village built-up settlement is in the center of the area which living about more than one thousand people. But about half of them are going out for work and not always living there.

Strategy I: Overall Forest Protection of the Whole Village Area

Seen from the area, the village built-up area is only a small part in the center of the whole village administrative scope. Beside and near the built-up village area, the west part is the agriculture planting area and the east part is the natural landscape area which including some small hills that people can climb up and also some reservoirs. And the faraway area is the forest area which people can hardly reach and climb, and also it is not allow normal persons to get into as the ecological protection requirements. So the overall Forest protection of the whole village area is on the basis of the different characters and functions. The build-up village is located and hold by the natural space. Just like in the Tai Chi diagram, only if the natural part be protected well, the whole system can be balanced (Figure 11).

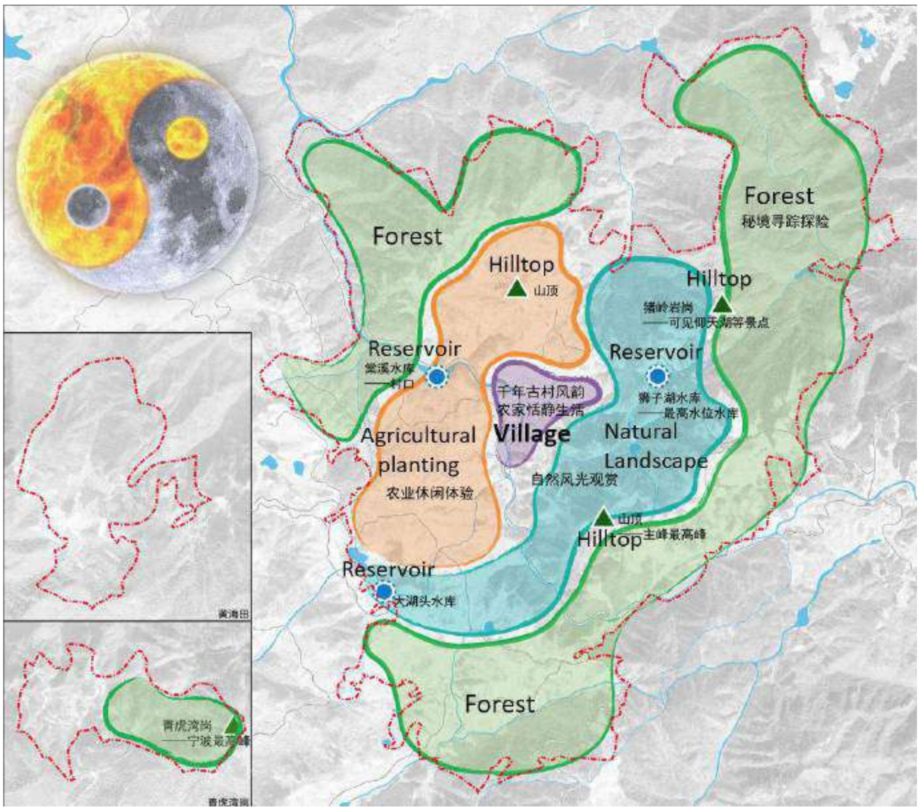


Figure 11: Village Whole Area Function Division

Strategy II: Maintain the Historical and Culture Meaning Landscape

The mountains around the built-up village are not only have the eco-function but also have a long historical meaning in Feng Shui, the deep and long-term China geomantic learning. It is not used very often today, but in the ancient time people use it to choose where they live. And this village been chosen here is because they found the snow in this place is easy to melt and it means it is warm here. And also there are several hills around this place, they give a very good protection from wind and cold air. Even now these hills which can be seen in the village, and the aged villager can call out the meaning names, such as dragon, phoenix and so on. Each hill's name has a symbolic auspicious meaning in Chinese culture. I think it is not superstitious, but actually reflect the relationship between the human and the nature. And shown the respect of the villagers to the nature. To continuation of the tradition, the planning advise to intensely maintain this, not only to protect the physical hills as landscape but the meaningful stories behind (Figure 12).

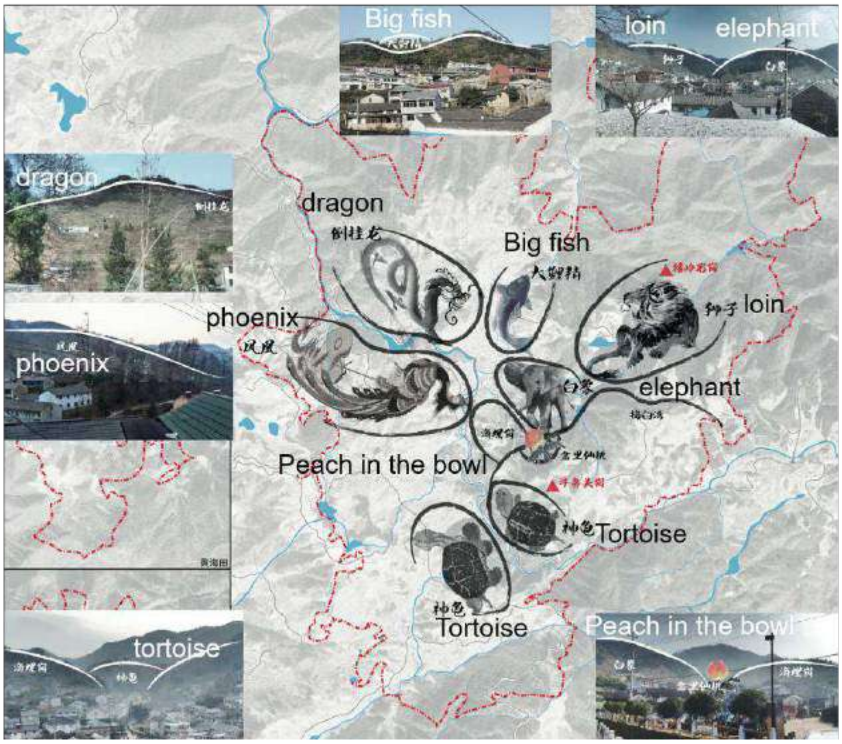


Figure 12: Historical and Culture Meaning Landscape

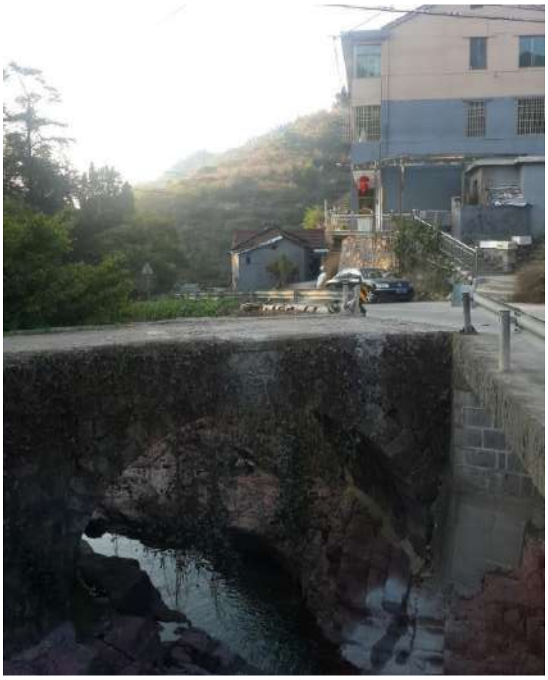
Strategy III: Details Design of the Village's Environmental Facilities

On the basis of the whole eco and natural structure protection and maintaining, the village's build-up environment is the next problem need to be solved. As the analysis before, the village has the natural advantage of temperature in summer and has the location superiority near to the hot scenic spot. And also, it has the accommodation living need of the urban people in the summer. If the village has a clean and characteristic built-up environment, the village will attract the urban people to live and the villagers will add another way of income which will not let them leave their home.

The detailed plan and design also follow the ecological and natural concept, avoiding to familiar with the urban construction and using the local material. For example, there is one place at the cross of the two main roads of the village, and it is upfront the entrance road as a signal place. But before the planning, this place seems like to be wasted, not even to say the landmark of the village. As the village is in the mountain area, it is full of rocks with different shapes. The detailed detail utilize this feature and build up a landscape with local rocks' characteristic (Figure 13). Another example is a public facility which is built on the bridge. Because most people living in the village now is the aged and children, they need some place to rest and talk together. The galleria is planned for this purpose and it is the idea of the village not the planner. We planners just help them to realize their idea and gave them some design advice (Figure 14).


Before Planning *After Planning*

Figure 13: Rock Corner Landmark




Before Planning *After Planning*

Figure 14: Bridge Galleria

5. Conclusion

China has a very rapid socio-economic development after the Reform and Opening up over the past 30 years. In this period of time, economy development has been emphasize too much to ignore the protection and maintaining of the ecosystem and natural environment, especially the support to the cities and careless with the rural area.

Nowadays, with the emergence of various environmental problems, people's consciousness has also begun to transform. From the simple focus on economic and material space development, it has begun to return to respect for the overall natural environment. And it has gradually come to realize that the stability of ecosystems in rural areas is also a guarantee for maintaining urban ecosystems.

Through two real planning practice cases, this study explores the planning strategies for restoring natural ecosystem functions in rural and town areas from system to detail by protection and maintaining the integrity and harmony of the regional system as a whole. In order to guarantee the role of the 'refrigerator' in rural areas will not be destroyed. In China, there is still a long way to do this aspect of work, this study is only a beginning of it.

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How Urban Morphology Can Be Optimized? Research on Interactive Mechanism Between Urban Morphology and Urban Micro Climate

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Abstract

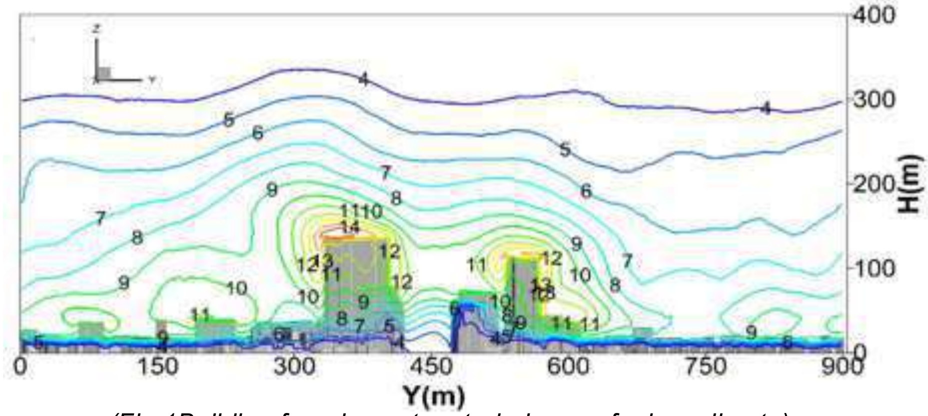
City is a space for people to live, the physical feeling of citizens is direct impacted by urban micro climate, which includes thermal environment, wind environment and acoustic environment. However, traditional urban development pattern, which is led by high-efficiency spatial use result high FAR (Floor Area Ratio), high density and high height urban morphology. Under this spatial development pattern and morphology, which is conducted by this pattern, urban physical environment is impacted negatively. In this study field, the most common research object can be considered is the UHI (Urban Heat Island) effect. Many previous researches have provided many consequences in this area, includes mechanism of UHI and possible resolutions. However, urban spatial is complex system, and UHI only can be believed as a part of urban micro climate. Meanwhile, due to data and analysis techniques limitation, many previous researches are considered lack of quantitative method in some extent. Thus, this research mention to study how to objectively and quantitatively measure the urban micro climate based on urban physical environment big data, and attempt to find out the interaction mechanism between urban 3D morphology and urban micro climate. In addition, attempts to provide possible way which can adopts the research results to guide urban design practice, optimize urban 3D morphology and construct a better urban physical environment.

Key words: Urban Micro Climate, Urban 3D Morphology, Morphology Optimization, Urban Physical Environment, Micro Climate Big Data, Urban Design

1. Introduction

The rapid progress of global climate change and urbanization has caused the city to face a series of city climate problems such as frequent climate extremes, hot summer temperatures, and increased air pollution (Carmin et al., 2012). Therefore, Explore the impact of urban spatial pattern changes on the physical environment of cities, the relationship mechanism between urban 3D morphology and urban physical environment, and use urban micro climate data and law behind these data to guide planning and construction can be considered is a hot topic for current planners, builders, and climatologists. Cities across the world are recognizing increasingly that they will face a growing variety of challenges related to global climate change, and a number of leaders in these cities are starting to adopt some measurement to optimize the urban micro climate (Pelling et al., 2011). However, any researches which keep away from urban 3D morphology to analysis and provide related measurement for optimize urban morphology or urban physical can be believed lack of rationality.

Because many previous researches such as Stathopoulos and Baskaran (1996) and Peter and Richard (1999) have conducted research on urban 3D morphology and urban micro climate, their research consequences prove that the building three-dimensional form is related with urban micro climate directly. The height, form and scale of building will impact on near-surface turbulence, and this effect will influence on urban thermal and wind environment, thus urban micro climate will be changed due to different urban 3D morphology. (Figure 1)



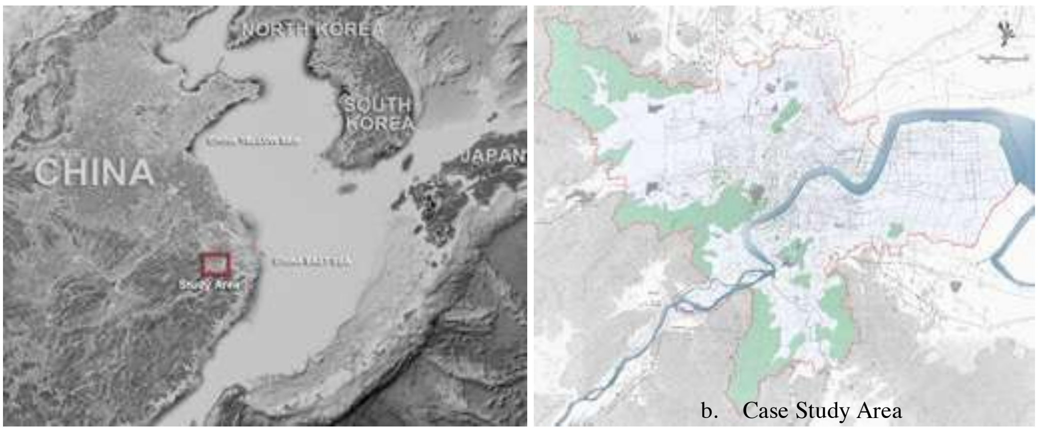
(Fig.1Building form impact on turbulence of micro climate)

Source: Author Made

Based on above expound, what is the interactive relationship between urban 3D morphology and urban micro climate? What is the inner influence mechanism between urban 3D morphology and urban micro climate? How to construct an urban 3D morphology optimization model based on urban micro climate? How to make a better balance between urban physical environment and urban spatial morphology, and to conduct an urban design scheme? These questions are needed answer through in-depth analysis of urban 3D morphology and urban physical environment, and find the law of interactive mechanism between urban 3D morphology and micro climate.

2. Case Study Measurement

According to the previous researches and current computer and urban big data analysis techniques, this research mention to base on urban physical environment big



(Fig.2 The Research Case Study Area)

Source: Author Made

data to measure both urban thermal and wind environment in a large-scale urban site.

2.1. Case study introduction

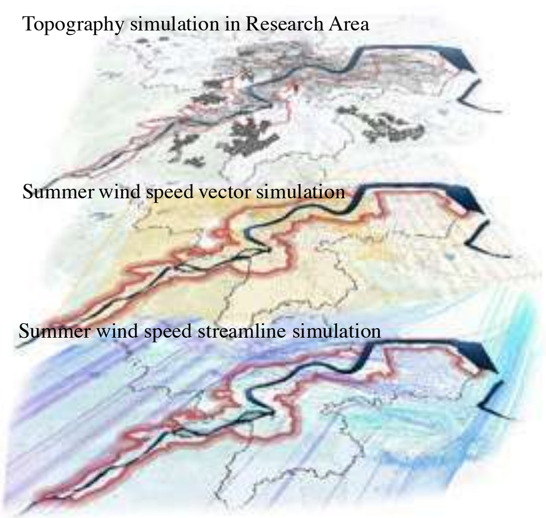
Because the urban micro climate is impacted by the different spatial factors, such as mountain, river, buildings and other urban 3D morphology factors. Thus, this research selected Hangzhou which is a large-scale city with river, mountain, lake and comprehensive urban environment in the east China as the research object in here. The reason for select Hangzhou as the case is there exist all major influence indicators in urban micro climate. Thus, the research consequences can be considered is reliable, effective, and reproducible. The major results of this case can be used to other urban micro climate study, and the core founds can provide positive guide for urban planners or designer to optimize urban 3D morphology globally.

2.2. Method for thermal environment measurement

During the research process, the thermal environment of research area is measured through two steps. Firstly, satellite remote sensing data of 1984, 1991, 2003 and 2015 was acquired through LANDSAT of United States Geological Survey (USGS). Then, Computer simulation technology was adopted to establish urban space model, and software such as ENVI-met, ECOTECT and RayMan were used to simulate and analyze the research area thermal environment. By analyzing the simulation results and comparing the differences of thermal environment under different urban spatial morphological indexes and spatial morphological types, the coupling correlation between urban spatial morphology and urban thermal environment is concluded. Afterwards, site investigation method is adopted to collect Surface temperature, air temperature, relative humidity and other meteorological data, and through combine the land function of the research area and various spatial morphological indicators such as sky visibility to analysis the interactive mechanism between urban 3D morphology and urban micro climate.

2.3. Method for wind environment measurement

Similar with the thermal environment measurement, the method of measurement the wind environment is includes three steps. The first step is Use field research method to calculate the space form indexes such as the scale of land use, number of building stories, density and floor area ratio in research area as the basis of wind environment case study. Afterwards, computer numerical simulation method was also used to establish the space model of the central area, and conduct numerical simulation for the wind environment at the mean wind speed of prevailing wind direction in research area with CFD software scSTREAM to generate the simulation results and comprehensively analyze



(Fig.3 wind environment measurement)
Source: Author Made

the space distribution characteristics of the wind speed at the pedestrian height and evaluate the merits of the wind environment. Then, conduct multivariate linear regression analysis on the wind speed parameters and space form parameters of blocks with data analysis software SPSS, and discuss the correlation between each space form index and the wind speed level at the pedestrian height, further evaluate the characteristics and causes by comparing the differences of wind environment in different types of space units, summarize the influential factors of urban space form on the wind environment and discuss optimization strategies for urban 3D morphology.

3. Measurement Results

Through above method to measure both urban thermal and wind environment in research area, the distribution and data analysis results can be fund. Meanwhile, through the superposition analysis of the elements in the urban 3D morphology, the interactive mechanism between the 3D morphology and the urban microclimate is further analyzed, and on this basis, the optimization strategies and methods of urban spatial form are proposed. According to the optimization strategies, two round urban design schemes have made to optimize the urban 3D morphology for batter urban physical environment.

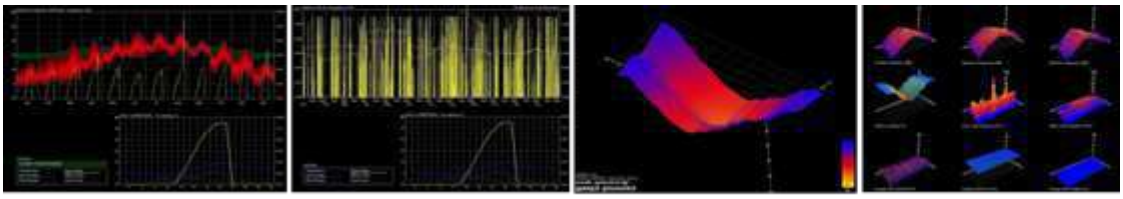
3.2. Thermal Environment

Based the thermal environment data which is acquired through LANDSAT of USGS, using GIS as the data processing platform, the temperature inversion of the satellite remote sensing data of research area in 2015, and the thermal environment in the urban area was simulated. Based on the measurement results, the high temperature period is concentrated between June to August. (Table 1) In summer, the temperature change is smoothly, (Figure 4) the urban thermal environment distribution different is impacted by urban 3D morphology mainly.

Table 1: The Average Data of Thermal Environment in Research Area

The Average Data of Thermal Environment in Research Area												
Month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
Extreme heat	23.9	28.5	32.8	34.8	36.5	39.7	40.5	41.6	38.7	35	31.2	26.5
Average heat	8.3	10.3	14.8	21.1	26.3	29.1	33.6	32.8	28.2	23.2	17.3	11.3
Average degree	4.6	6.4	10.3	16.2	21.4	24.7	28.9	28.2	24	18.8	12.9	7
Average cold	1.8	3.5	7	12.4	17.5	21.4	25.2	24.9	20.9	15.4	9.3	3.7
Extreme cold	-8.6	-9.6	-3.5	0.2	7.3	12.8	17.3	18.2	12	1	-3.6	-8.4
Precipitation(mm)	80.6	88.2	140.7	123.1	128.6	219.4	172.9	162.1	123.5	78.5	71.5	48.9
Relative humidity	75	75	75	74	74	80	76	78	79	76	74	73
Insolation duration	102	97.2	116.4	140.6	164.7	136.6	212.7	193	143.9	144.6	129	128.7

(Source: Author Made)



a. Daily Average Temperature in Summer b. Thermal Radiation in Summer c. Summer Weekly Average Temperature d. Summer Average Temperature

(Fig.4 Research Area Temperature Fluctuation in Summer)

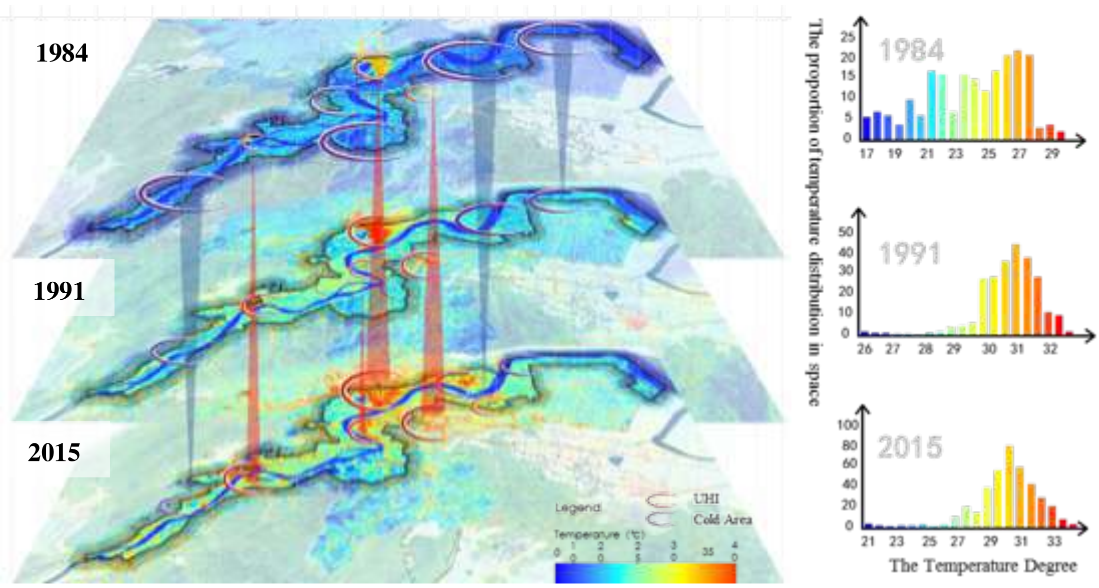
Source: Author Made

In addition, the study also based on the urban thermal environment data of 1984, 1991, 2015 to conduct land surface temperature retrieval through GIS data analysis platform. Based on this, the changing law of urban thermal environment and heat island effect in research area during the past 30 years can be dynamic analysed. As the most direct reflection of interaction between urban 3D morphology and urban thermal environment, the appears of UHI (Urban Heat Island) usually related with the change of urban Spatial. Through observation the measurement results, (Figure5-a) the UHI range in research area illustrates an extensive expansion during the past 30 years. Meanwhile, behind the extensive expansion of UHI, the average temperature in study area also increase 2 to 3 degrees than before. (Figure 5-b)

Through observation the phenomenon of thermal environment distribution transformation and UHI range expansion, the generation mechanism behind the phenomenon is interaction between urban 3D morphology and urban microclimate. During land expansion of urban space, the land surface condition has changed, it direct led the heat capacity of urban surface is changed. Meanwhile, enhancement of building height and density also exacerbated UHI effect. As the Figure 8-a illustrates the all UHI ranges in 2015 is the new developed urban area, the land surface is hardening in these sites. However, in 1984, these sites are all with natural surface.

3.3. Wind environment

Urban wind environment is high related with thermal environment, both wind and thermal environment together constitute the urban microclimate. Based on the computer simulation techniques and practice measurement of wind in research area,



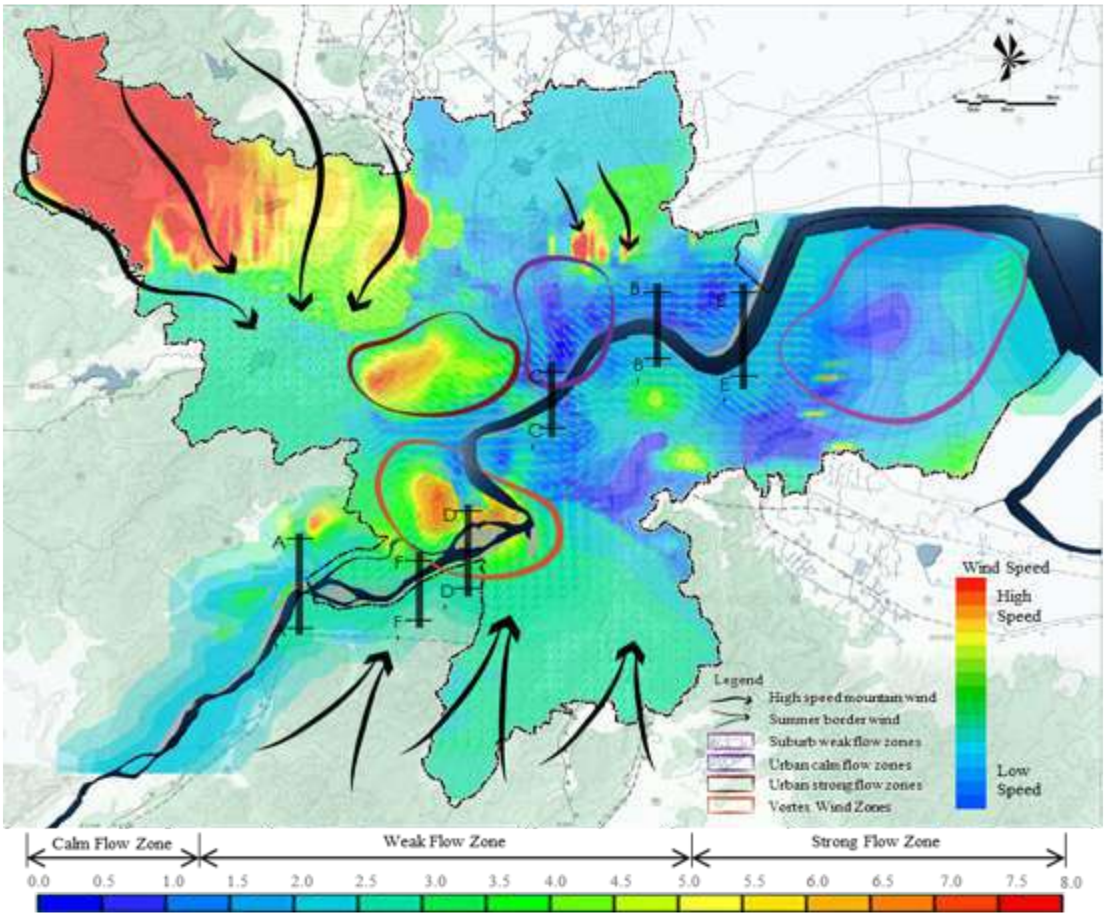
a. Thermal Environment Simulation Distribution b. Temperature Change

(Fig.5 Thermal Environment and Temperature Change in Study Area)

Source: Author Made

this research adopts Phoenics fluid calculation software simulation technology to measure wind environment. Before conducts urban wind environment simulation based on urban 3D morphology, statistical analysis of wind direction, wind speed and wind frequency is conducted in study area in June, July and August firstly. The results indicated that in research area, the dominant wind direction in summer is southwest wind, with a maximum wind speed of 7.2 m/s, an average wind speed of 2.6 m/s, and a minimum wind speed of 0.9 m/s.

According to the above wind environment basic analysis, the computer simulation techniques was selected to conduct the further in-depth measurement of urban wind environment in the area. Through CFD software scSTREAM to generate the simulation results and comprehensively analyze the space distribution characteristics, the wind speed in the study area is concentrated in the range of 2~5m/s, and wind environment illustrates the segmental variation characteristics. (Figure 6)



(Fig.6 Wind environment simulation results in study area)

Source: Author Made

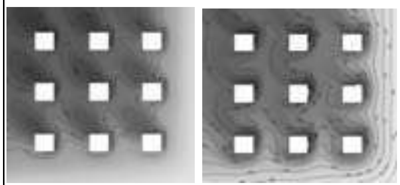
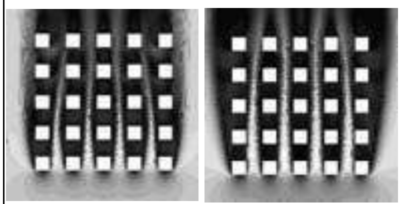
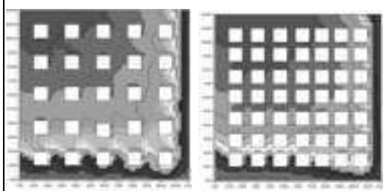
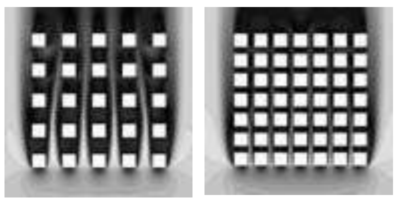
In this extent, the macroscopic wind environment situation in study area is already observed. Similarly, wind environment is impacted by urban factors in some extent, the figure 10 illustrates wind environment is different between urban area, suburb area and country side, thus, compare with thermal environment, the influences of urban 3D morphology on wind environment is more remarkable. (Berghauser and Haupt, 2010)

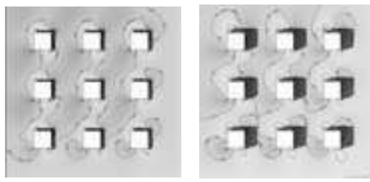
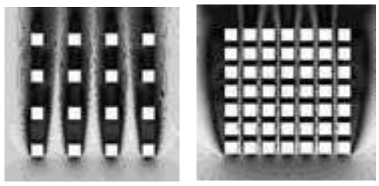
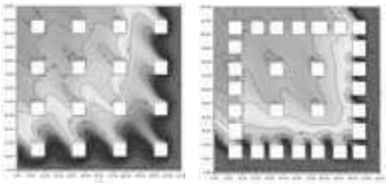
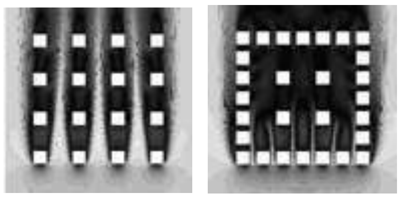
Based on above, both wind and thermal environment is impacted by urban 3D morphology, the comprehensive interaction between urban 3D morphology and urban physical environment will produce different micro climate. Therefore, based on the interactive mechanism between urban 3D morphology and micro climate, optimal microclimate oriented urban 3D morphology optimization way may be fund.

3.4. Interactive mechanism between urban 3D morphology and micro climate

Through above discussion, there exist some commonly influence indexes of both wind and thermal environment on urban 3D morphology. (Table 2)

Table 2: Common Measures of Both Wind and Thermal Environment

Index	Description	Graphical Representation
Height Index	Under the ideal simulation conditions with a wind speed of 1m/s at the height of 10m and not considering anthropologic heat factors, the surface temperature, mean radiation temperature and air temperature in daytime showed certain negative linear correlation in regular layout blocks within a height ranging from 20m to 60m, while certain positive linear correlation in daytime. For wind environment, the overall wind speed at pedestrian height is directly related to the average height in urban blocks, and there is a positive correlation between the two.	Different thermal environment between 20 and 60m building height  20m 60m Different wind environment between 20 and 60m building height  20m 60m
Density Index	Under the ideal simulation conditions with a wind speed of 1m/s at the height of 10m and not considering anthropologic heat factors, the surface temperature, mean radiation temperature and air temperature in daytime showed certain negative linear correlation in regular layout blocks within a density ranging from 16% to 49%, while certain positive linear correlation in daytime. Similarly, based on the simulation of wind environment in different urban density module, the overall wind speed at pedestrian height is directly related to the building density in urban blocks, and there is a negative correlation between the two.	Different thermal environment between 25% and 49% density range  23.75℃ 23.35℃ Different wind environment between 25% and 49% density  Density 25% Density 49% range

Intensity Index	Floor Area Ratio is usually used to evaluate the urban development intensity. Through simulation and analysis, for thermal environment in the previous section indicate that the mean air temperature at noon in summer will decrease with the increasing of FAR, and in the early morning will decrease with the increasing of FAR. However, due to the experiment, there is no direct correlation between the overall wind speed at pedestrian height and the FAR in urban blocks. But, reasonable combination of space forms is conducive to the optimization of the wind environment in urban blocks	Different thermal environment between 0.27 and 0.81 FAR  FAR 0.27 FAR 0.81 Different wind environment between 25% and 49% density range  FAR 1.1 FAR 13.1
Enclosed Index	Based on the experiment, the enclosure degree has a significant impact on the internal airflow in the block. The greater the degree of encirclement, the smaller the internal wind speed. Under static wind conditions, the heat is more dissipated through the thermal turbulence, and the degree of encirclement has no significant effect on the thermal environment inside the block. In hot and humid areas, proper wind direction in the summer to reduce the degree of enclosure can effectively alleviate the thermal environment inside the block.	Thermal environment between 40% and 70% enclosed degree  40% 70% Different wind environment between 40% and 70% enclosed  40% 70% degree

(Source: Author Made)

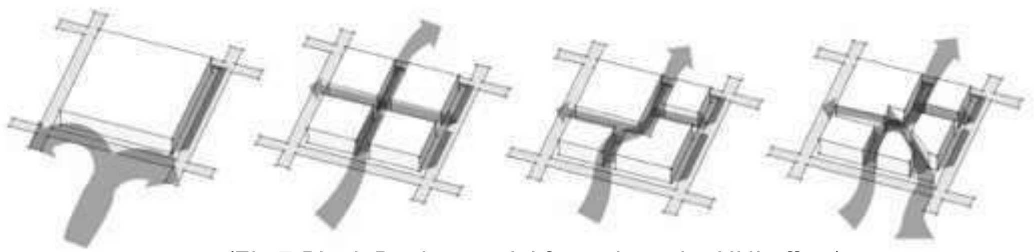
Through above analysis, the interactive mechanism between urban 3D morphology and urban micro climate is complex, the influence indexes are not only included above four indexes. The urban roughness, frontal area index, building slagered height and SVF (Sky View Factor) are also can be considered as index for evaluate the interaction between urban 3D morphology and urban micro climate. However, the urban built environment does not allow to conduct the comprehensive optimize action in each aspect in some extent and construct an absolute best urban micro climate.Therefore, for optimize the large-scale urban 3D morphology, these four indexes which are listed in Table 5 is the main aspect of optimization process.

4. Urban 3D morphology optimization practice

4.2. Thermal environment optimization strategies

Based on the analysis of the mechanism of thermal environment factors set forth in preceding parts, most of the measures for urban design are the guidance and control of urban 3D morphology. Thus, in urban area, street trees, arcades, pulling tent and other continuous shading facilities should be considered to improve body comfort of external space. in the overall design of the block, large volume of podiums should be crushed. Ventilation clearance should be reserved on the frontal area of the block to introduce external airflow into the block to the maximum thus to facilitate heat dissipation within the space. The opening should face the prevailing wind direction in summer (Figure 7).

for more enclosed building layout, the compact form is adverse for ventilation and more anthropologic heat will be generated. Therefore, it is encouraged to keep certain green space within the block for vegetation to release more heat via vegetation transpiration.



(Fig.7 Block Design model for reduce the UHI effect)

Source: Author Made

In addition, excessively low sky visibility or areas with excessively height-width ratio are adverse for air interchange at night. On the main rods, due to the large amount of traffic flow, pedestrian volume and anthropologic heat, building backing distance should be greater to ensure open sky visibility. While for secondary roads, there are less anthropologic heat, sky visibility should be reduced properly to facilitate sun shading and appropriate pedestrian scale.

4.3. Wind environment optimization strategies

Similarly, wind environment optimization strategies are also related with urban 3D environment. However, different with thermal environment, when consider the wind environment optimization, the regional factors may need be involved. Complete protection, restoring natural landscape pattern and establishing networked urban green space system are of great significance to the formation of a good urban climate. It will not only provide more cool and fresh air for the city, but also effectively reduce the urban heat island effect and create a pleasant urban wind environment and thermal environment by protecting and restoring ecological sensitive resources such as rivers, lakes, natural mountains and ecological wetlands, rebuilding the environmental basis of the regional natural background, establishing and preserving urban oases and interlinked green corridor networks, integrating urban artificial greening space with natural ecological space and establishing a complete green ecological network in the city. Thus, the macroscopic strategies for optimization of urban wind environment can be divided into three level, which is planning level, building level and landscape level. (Table 3) Based on the interactive mechanism between urban morphology and micro climate, detailed optimization strategies are detailed provided in these four levels.

Table 3: Macroscopic optimization strategies of wind environment

Optimization strategy of wind environment	**Planning level**	**I. Protect and restore urban landscape pattern and build a networked urban green space system**	
		II. Create large urban air corridor	II-1 Scale and direction of urban ventilation corridor
			II-2 Building method of urban ventilation corridor
		III. Street orientation and form control	III-1 Street orientation
			III-2 Street system mode
			III-3 Street canyon section
			III-4 Building interface along the street
		IV. Block form control	IV-1 Reduce building density of the block
			IV-2 Height design of ladder-type buildings
			IV-3 Reasonable layout of public open space
			IV-4 Enhancement and control of block permeability
	Building level	**V. Building orientation, scale and form**	V-1 Building orientation
			V-2 Form and scale of high-rise buildings
			V-3 Optimization of large mass platform type buildings
			V-4 Building permeability
		VI. Arrangement of buildings	VI-1 Guide of building in direction of air flow
			VI-2 Staggered arrangement of buildings
			VI-3 Relationship between high-rise building podiums and major pedestrian areas
			VI-4 Optimization of linear combination of high-rise buildings
			VI-5 Layout optimization of single high-rise building
	Landscape level	**VII. Greening and shading**	VII-1 Green coverage of land
			VII-2 Greening and distribution of recreational space and pedestrian areas
			VII-3 Roof greening and vertical greening
		VIII. Windproof measures against strong winds and winter winds	

Source: Author Made

5. Conclusion

Urban 3D morphology is considered as a comprehensive system, meanwhile, urban micro climate is also complex, it impacts by and on the different factors of urban 3D morphology, the any changes of factors belongs to urban 3D morphology are all results the different urban physical environment, and construct the different feeling of people who live in the city. A reasonable and scientific urban 3D morphology can build a comfortable urban micro climate, reduce the UHI and increase the urban ecological security. For this aim, this research through an urban design practice case to analysis the relationship between urban 3D morphology and micro climate through literature review and computer assisted micro climate simulation based on urban physical environment big data. Based on the measurement results, the interactive mechanism between urban 3D morphology and micro climate has been discovered, the analysis consequences indicated that urban micro climate is impacted by different index of urban 3D morphology. In these influence index, the urban height, density, intensity and enclosed index is considered as the major and common measurements impact on both urban thermal and wind environment. Afterwards, this research through these four major aspects to conduct an attempt in micro-climate led urban 3D morphology optimization. Through empirical urban design practice, some strategies are proved can promote and positive impact on urban micro climate, and these strategies are also suitable for other city or site around the world. Summarize above, the consequences of this research proved the interactive mechanism between urban micro climate and comprehensive urban 3D morphology based on digital measurement techniques and physical environment big data. Additionally, the optimization strategies in here are also contribute for further urban design practice. However, there also exist some limitation. Urban space is complex, there exist more potential index may impact on urban micro climate, these indexed should be analysis more detailed in further research.

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ISOCARP encourages the exchange of professional knowledge between planners, promotes the planning profession in all its forms, stimulates and improves planning research, training and education and enhances public awareness and understanding of major planning issues at a global level. The association's main event is the annual ISOCARP Congress, which focuses on a globally-significant planning theme and which takes place in a different country each year.

About Bodø

Few other Norwegian cities and towns have been gifted with such magnificent and spectacular scenery as Bodø. The town provides a fascinating mixture of superb nature and a modern, urban and vibrant lifestyle. Right at the heart of all this you will sense the informal and friendly atmosphere amongst its population. It is a vibrant town, excellent for shopping, cultural and sports and leisure activities.

The regional capital of the County of Nordland has apparently been reaching for the stars in recent years, rapidly closing in on citizen number 52,000. This makes Bodø the second largest town in the North of Norway, beaten only by Tromsø. Bodø is currently one of the fastest growing towns in the whole of Norway.

Bodø's location has put the town right in pole position when it comes to communication, trade and services. Travellers by air, rail and sea all meet in the heart of this city. This is, however, just one of the things that has made our town one of Norway's most popular locations for events, meetings, conferences and get-togethers of all kinds.