Regenerative Urbanism:
Using the New Capital of Indonesia to Restore the Forests of Kalimantan

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INTRODUCTION

In August 2019 the President of the Republic of Indonesia announced a plan to move the nation's capital from Jakarta. The decision was mainly driven by several facts. First, Jakarta is slowly sinking, due to both sea level rise and widespread underground water pumping. Second, the metropolitan region, with its almost 30 million inhabitants, is struggling with transport and other infrastructure shortfalls. The decision was also justified as an effort to relocate the new national capital to the center of the over 3,000 km long country and thus stimulate a more geographically balanced and inclusive economic development of the nation.

Based on their initial feasibility study, the government selected the location for the New Capital City (NCC) in the East Kalimantan province, on a site partly sitting in the North Penajam Paser Regency and partly in the Kutai Kertanegara Regency. Within this 200,000 hectare area the construction of a world-class sustainable city was planned to start within five years following the August 2019 announcement.

With such a high level political, economic and environmental agenda, the government decided to consider both existing internally prepared design concepts for the future capital and to consult overseas planners, engineers, architects and other qualifying professional and academics. An international competition was announced in October 2019, with the brief calling for a smart, green, modern 'forest city', with a strong formal expression of national identity.

The significance of Indonesia's NCC project thus radiates beyond the national boundaries. This project could demonstrate that in many other instances on this rapidly urbanising planet, not only in Indonesia, booming cities could be harnessed to bring substantial benefits to the global ecosystem. They just need to go one step beyond the conventional 'sustainable city' formula based on 'minimising the ecological costs and instead aim at 'maximising the ecological benefits' (Thomson & Newman, 2016).

Figure 1: The location for the new capital city (NCC) of Indonesia
Source: (Maulia, 2019)

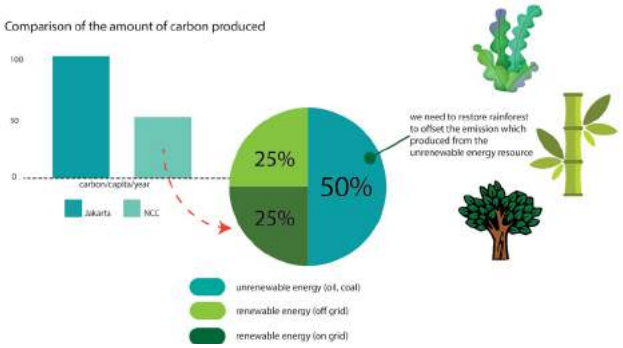


Figure 2: The principle of carbon off-set
Source: Authors' diagram

The winning entry, named *Ngara Rimba Nusa ("Forest and Island Hilltop")*, was announced in late December, 2019 [1] [2].

While our proposal was not selected, in this article we aim to show that our approach offers a formula for ecological restoration – using growing cities as its principal driver – worldwide**.** With the global climate crisis simmering in the background, it should be imperative to restore the world's forests as carbon sinks.

THE MASTER PLAN CONCEPT

We took up the Indonesian NCC challenge and after a rather short period of time (four weeks) given by the competition organiser, and along with 755 other competitors, submitted our entry in time. In our proposal we took the position that the future city should *maximise the environmental benefits* rather than just *minimise the environmental costs*. This lead to our design concept being based on the concept of 'regenerative city' – the idea that a city can produce positive, regenerative impacts on the natural environment, not just minimize its negative impacts.

Our approach translated to our central proposition that *NCC's construction and operation are conditional upon restoring a significant portion of the forest ecosystems of Kalimantan* which have been destroyed over the past 30 years, mainly by farming and mining, and fires. In other words, we responded to the competition brief with a suggestion that this nationally important project should be about restoring the legendary Borneo tropical forest – a severely endangered national and international treasure (Fig.3) – as well as about building the new national capital.

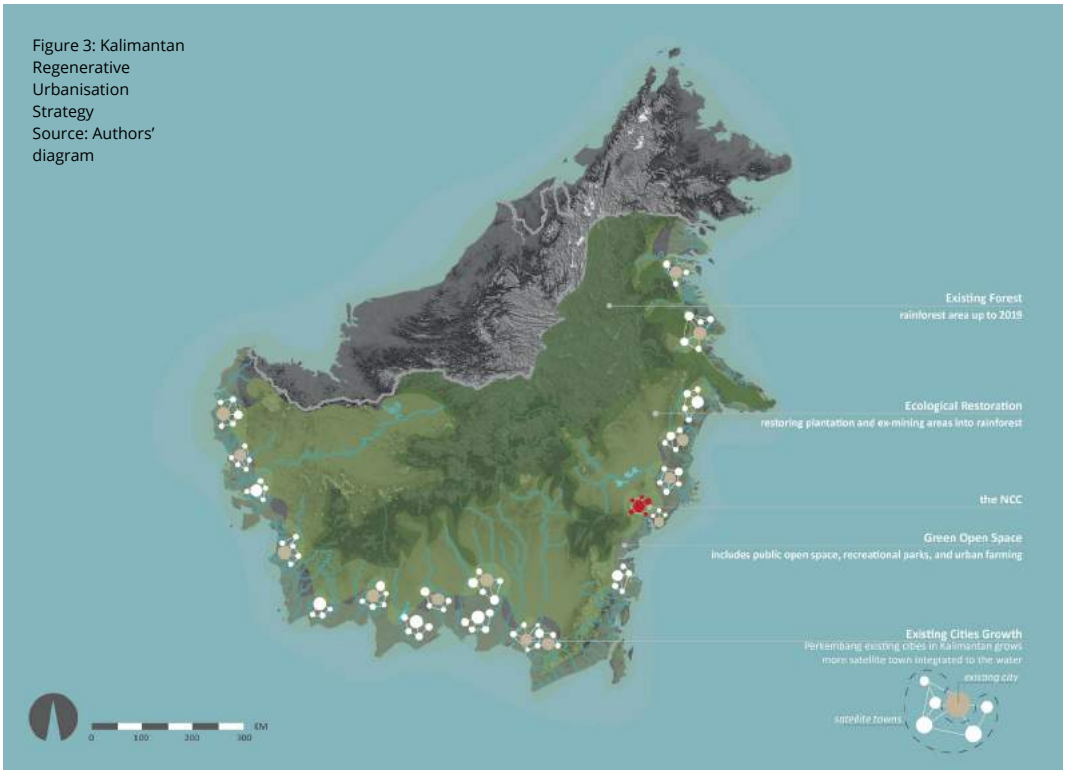
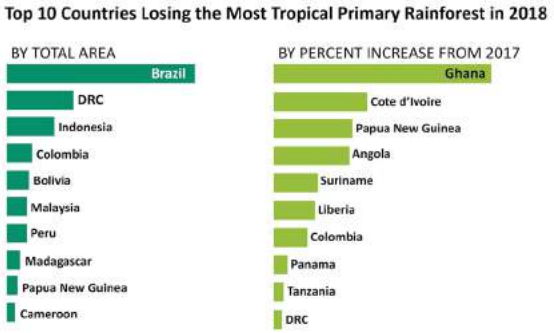


Figure 3: Kalimantan Regenerative Urbanisation Strategy
Source: Authors' diagram



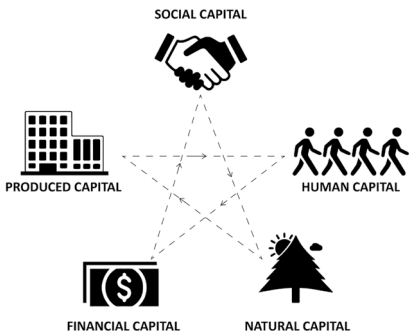


Figure 4 (left): Top 10 Countries Losing the Most Tropical Primary Rainforest in 2018
Source: World Resources Institute, 2018

Figure 5 (right): Five capitals of regenerative development
Source (Mang, et al., 2016)

This fundamental principle was then developed into a master plan concept with the help of five design-generating propositions, themselves derived from five types of capital in regenerative development (Fig.4). These multiple forms of capital are the actualisation of stakeholder systems that creates a co-evolving mutualism needed for maintaining the regenerative effects of urban development (Mang, et al., 2016).

The first capital of regenerative development is the *social capital*. It is the capacity to foster cooperation, trust and mutual benefit among interdependence communities to achieve collective goals.

The second capital of regenerative development is *human capital*. It is the health and capacity of communities which can be developed through education, training, and experience (Mang, et al., 2016).

The third capital of regenerative development is the *financial capital* which means the money invested to provide goods and services to produce other forms of capital return.

The fourth capital of regenerative development is the *production capital* which includes assets such as buildings, city infrastructures, and natural resources that enable development.

The last capital of the regenerative development is the *natural capital* composing the web of living systems that generate, provide sustenance for, and enable the evolution of life.

In the NCC regenerative urbanisation project, this capital is translated into the process of *city metabolism*. The NCC became the prototype of city devel-

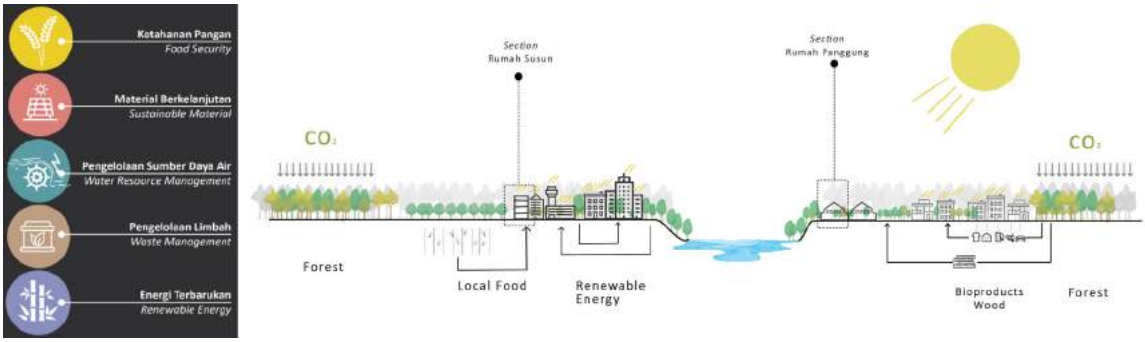


Figure 6: City Metabolism System of NCC
Source: Authors' diagram

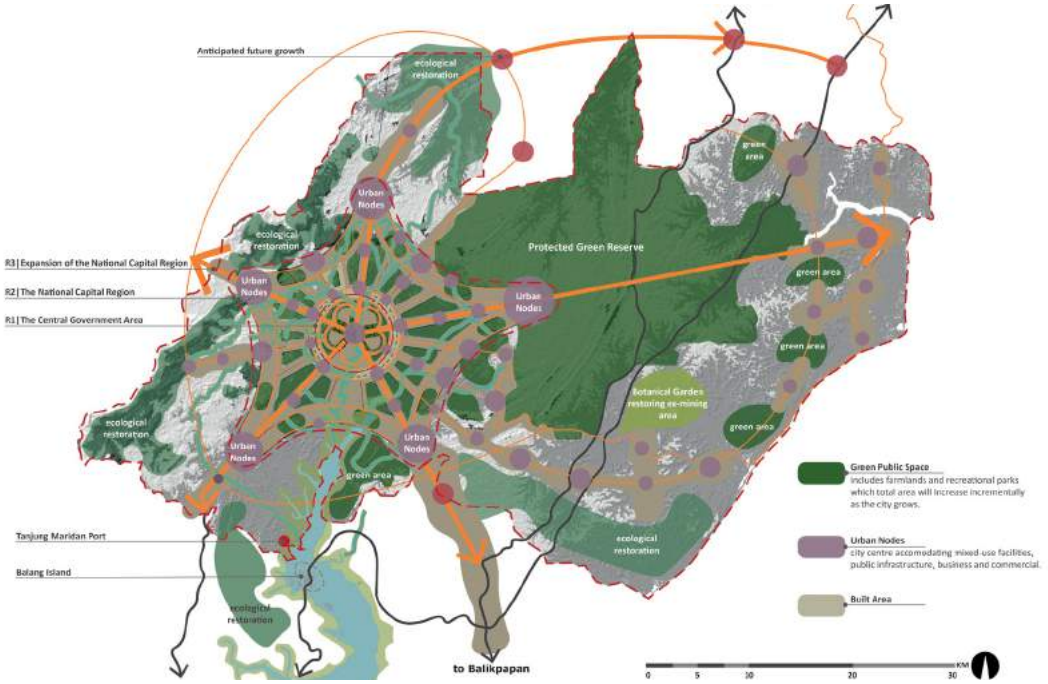
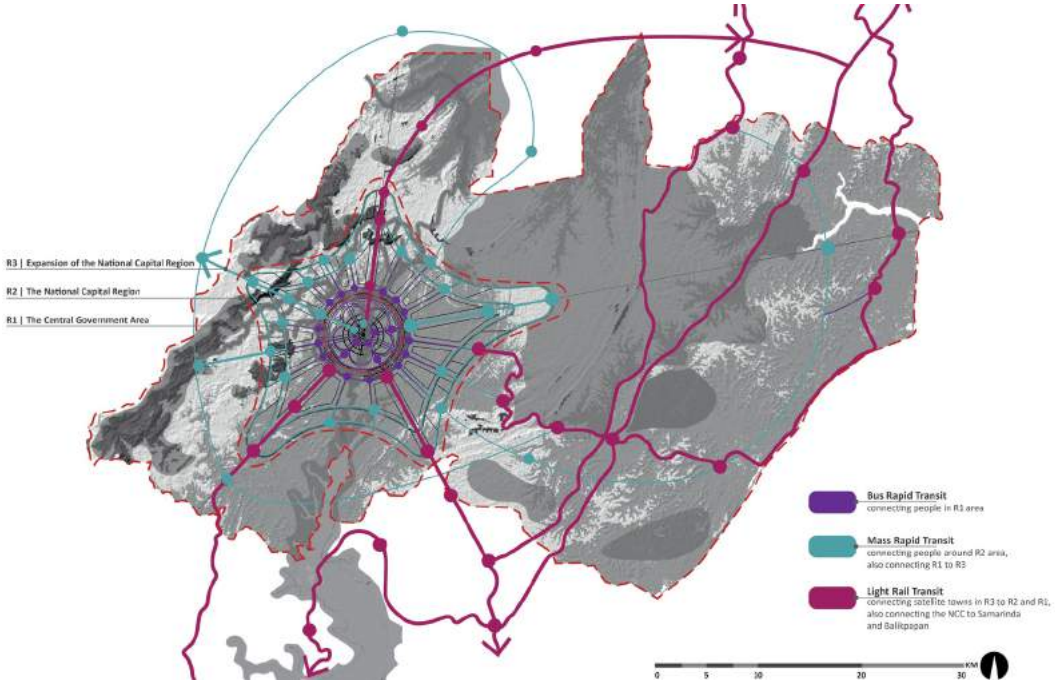


Figure 7 (top): Curitiba as the world's leading model of ecological urbanism
Source: (Mang, et al., 2016)

Figure 8 (bottom): NCC Land Use Map
Source: Authors' diagram



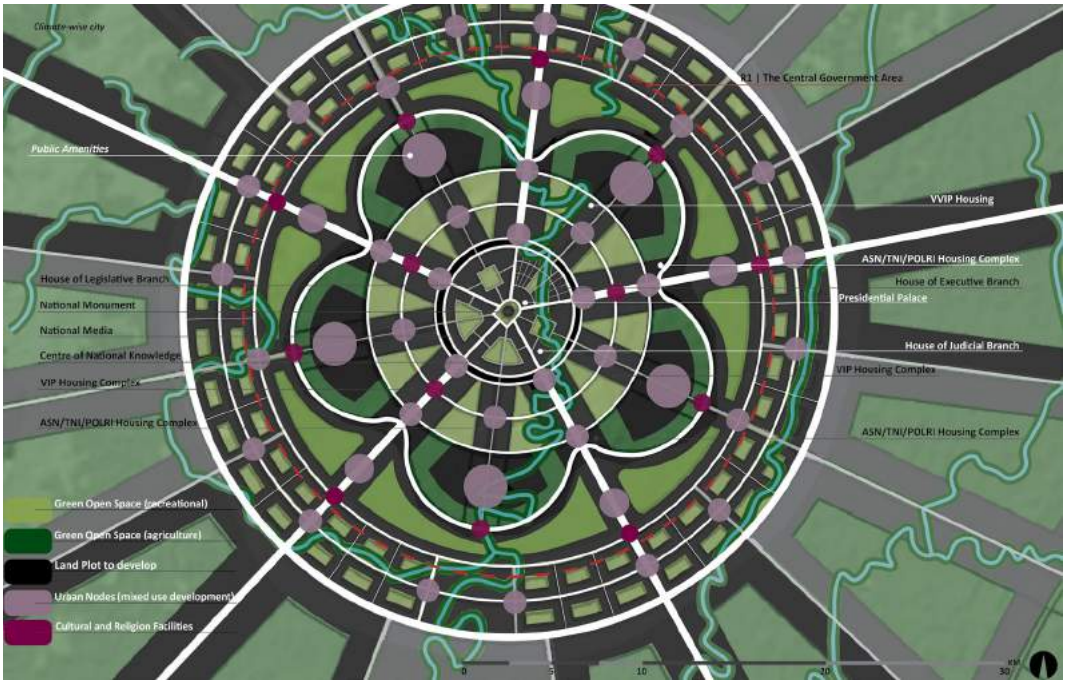


Figure 9 (top): NCC Public Transport System
Source: Authors' diagram

Figure 10 (bottom): Government Precinct (R1) Master Plan
Source: Authors' diagram

opment which is driven by five key components of the city's metabolic system: renewable energy, food security, water resource management, sustainable materials and waste management. These five streams, working independently as well as in an integrated manner (e.g. solar energy powering the wastewater system, at the end of which the solids are converted into construction material), should operate at a necessary minimum to achieve a harmonious coupling of the 'smart city' and 'green city' models (Thomson, 2018).

The *Smart City* concept is about deploying 'green-telligence' to reduce demand and optimize the use of all resources, then minimise and absorb all waste. A city with a reduced aggregate metabolism is a city which offers a better quality of life and has a more realistic prospect of off-setting its carbon and water footprints. The *Green City* concept is about using the 'ecological services' of the 'green infrastructure'. This means actively using natural systems – weather, waterways, soils and vegetation – in and near the city to lighten the load of conventional 'grey infrastructure'. The NCC will be a global model of a 'Smart Green City-Region'. As the net carbon sink, it will have a proven record of positive carbon balance and will contribute to stabilising the world's climate and reversing the global biodiversity loss.

Our design for the NCC was influenced by that of Curitiba, Brazil as one of the leading cities for ecological urban development. Its master plan envisages a generous amount of green open space, functioning as green infrastructure. In Curitiba, the amount of green space in the city has increased incrementally during the last 30 years, resulting in nearly 1/5 of the city being the green area. The city's government also acquired lands along the city's river to create linear parks to maintain the riparian ecosystem as well as provide connection between the urban nodes as an alternative transportation corridor (Mang, et al., 2016).

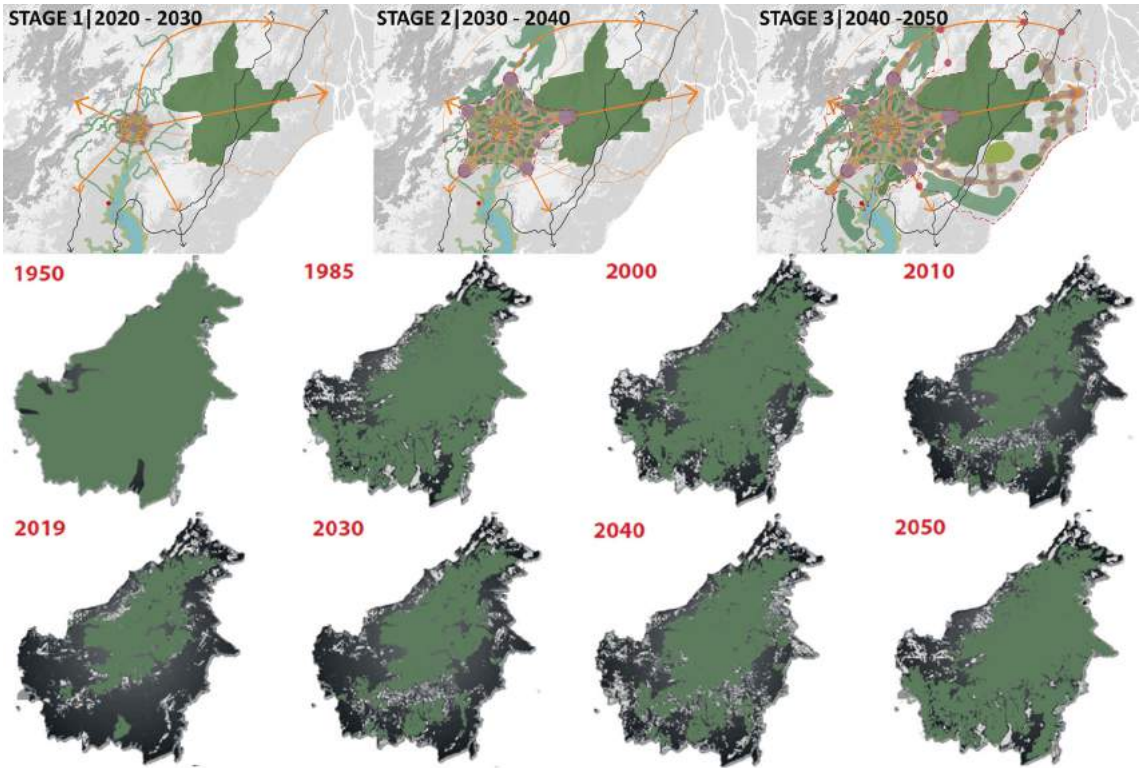


Figure 11: Staging Plan and Kalimantan Rainforest Regeneration
Source: Authors' diagram

The exact layout of the green network would be determined using an accurate GIS data base, while following the *land suitability analysis* method made famous 50 years ago in the book *Design with Nature* (McHarg, 1959).

We proposed a star-shaped NCC master plan, with the centre accommodating the 'five powers' of the national government, and five axes of high-density development radiating out from that centre. Between the five axes are green wedges of open space, with occasional satellite town/village development in them at some distance from the city centre.

Looking at the whole region, the master plan will have a total sum of 60:40 ratio of green and built areas (Fig.15). The green areas are also divided into three different types in a befitting manner towards the local culture including (1) urban farm land, supporting the NCC's permaculture system, (2) recreational parks acquired by restoring the ex-mining area into botanical gardens and linear parks within the dense built area, and (3) protected reserve which are part of the regional ecological restoration effort.

Again looking at Curitiba city's fabric, we adopted its linear city principle manifested in structural arteries servicing densely populated built areas as public transport corridors. In Curitiba this design resulted in around 30% decline in auto traffic since 1974 despite the city's population doubled growth. Curitiba's public transportation is effective, fast and able to carry more passengers per weekday than New York City's public transport systems (Mang, et al., 2016).

The inclusion of a public transportation system is a fundamental part of regenerative urban development in order to make cities 'carbon-positive'. We proposed a NCC public transport system with three layers of connection: (1) local connection using bus rapid transit (BRT); (2) regional connection using mass rapid transit (MRT); and (3) macro-regional connections using light-rail transit (LRT). Supporting the main purpose of a 'carbon-positive' city, the master plan encourages a strict rule of no-cars in the governmental precinct area by optimising the use of BRT, walking and cycling.

The regenerative development of NCC and its 'followers' – the other cities and towns of Kalimantan – is divided into three construction stages during a 30 year timeline, with its ultimate goal to build cities in the manner which grows the forest back. The first ten years are focused on the construction of the core government precinct and the infrastructure of bus rapid transit. The second stage is about the construction of the metropolitan district, building more mixed-uses and public facilities integrated with the mass rapid transit. In the last stage, more satellite towns start to emerge along five growth corridors accompanied by the light rail transit infrastructure and ecological restoration. We envision that, by 2050, the Kalimantan rainforest would be restored approximately close to its extent in 1985. This process will happen incrementally, as the NCC and other regional urban clusters on the island emerge and grow.

THE METABOLISM OF THE NCC

Urban metabolism (UM) is a concept with a long history in urban ecology and urban planning. (Grimm et al. 2008). This theoretical model perceives cities as quasi-organic systems which have input (resources) and output (waste) as a constant flow of quantities. Ideally, the volumes and rates of these flows can be monitored, measured and managed. According to Kennedy et al. (2007), urban metabolism has four fundamental flows to be explored and monitored – water, materials, energy and nutrients. Cities use these flows to transform and support their population and activities every day. The scale of the city de-

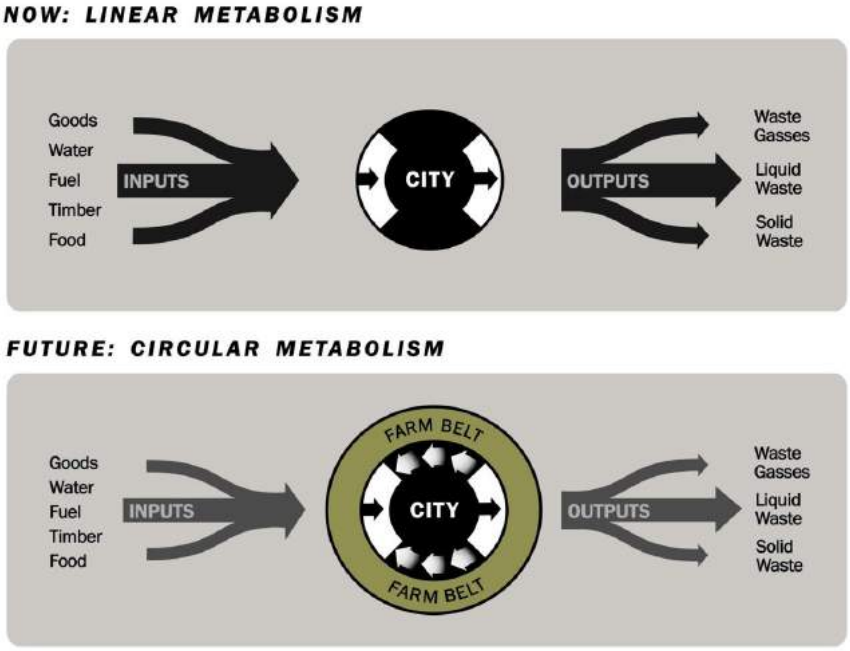


Figure 12 (top): Circular Metabolism System
Source: (Lehmann, 2010)

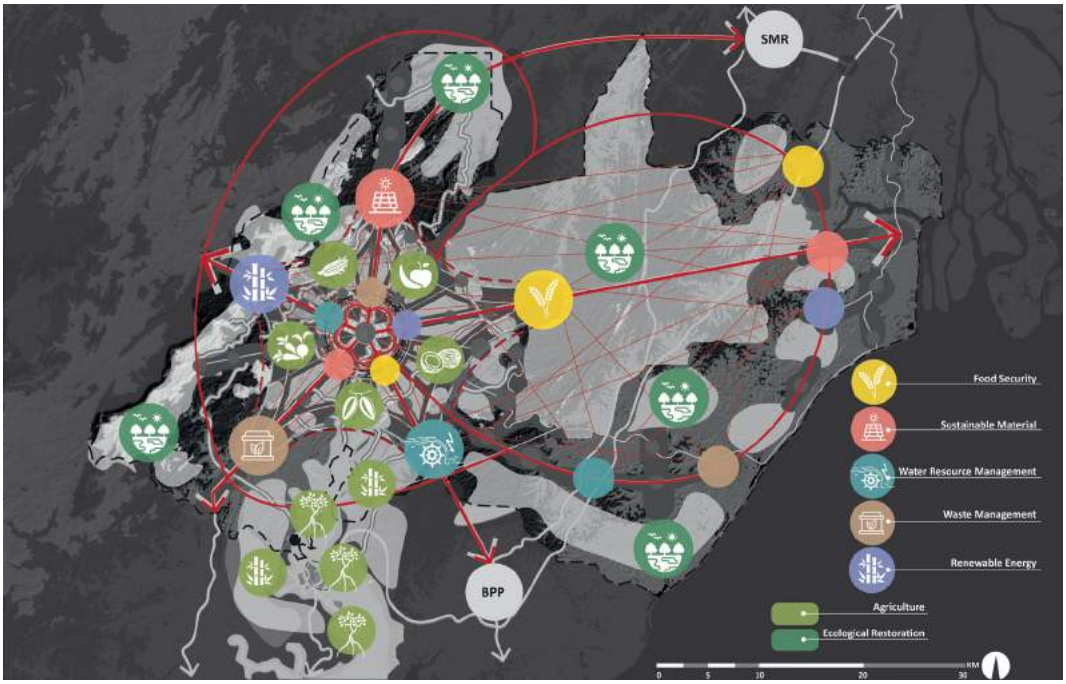


Figure 13 (bottom): NCC Urban Metabolism System
Source: Authors' diagram

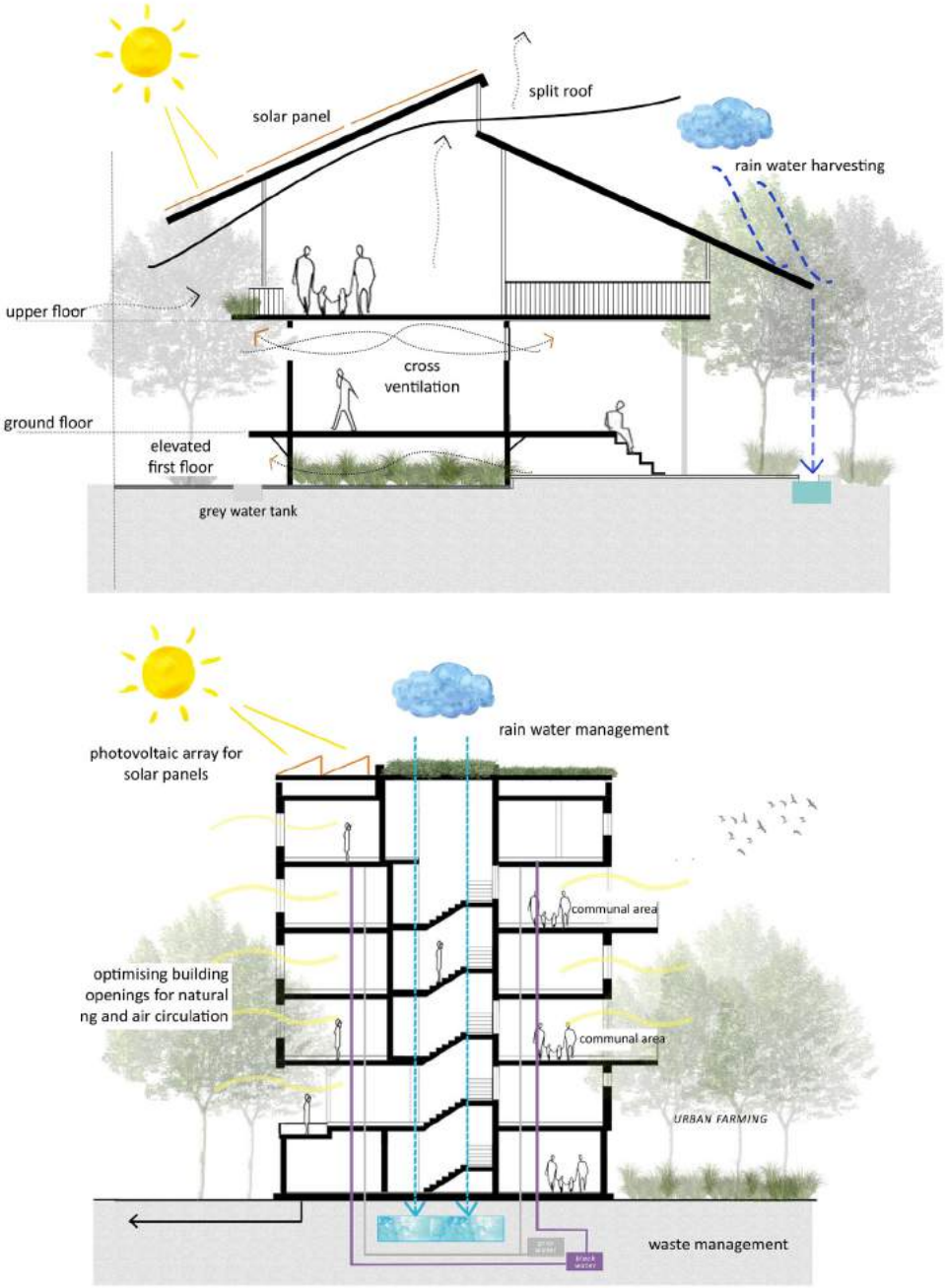


Figure 14: Passive Design Principles for housing
Source: Authors' diagram

termines the requirement for the input of resources which ultimately affects the environmental loading. To ensure the loading is within the carrying capacity of the surrounding ecosystem, we must measure and regulate the volume and rate of UM.

We must also distinguish the linear and circular flows of inputs and outputs (Fig.21). Circular flows – usually referred to as 'loops' – are preferred over the linear flows because they indicate self-sufficiency. The ability of the city to treat the 'waste' of some of its processes as a (recyclable) 'resource' for some other processes increases its security and reduces its loading on the environment.

In an ideal planning and management situation, we would strive to calculate the total circulation of resources (input) and wastes (output) in the city, and then use the data to minimise and re-loop the flows as much as possible, aiming at a balance between the city as a 'parasite' and the supporting ecosystem as the 'host'. Information on this interaction is thus important. When comprehensive, reliable and accurate information is available and used, it enables 'intelligent' functioning of the city. In other words, its metabolism qualifies as 'smart' (Bogunovich, 2002) and only then the popular idea of 'smart city' becomes meaningful.

The NCC development agenda in Kalimantan also is of global interest since it is located in the second largest island in Indonesia and one of the largest in the world. The future UM of the NCC will affect the natural ecological metabolism of Borneo/Kalimantan, and that cannot but have consequences for the entire planet. The island is one of the "three lungs of the Earth" places where the abundant tropical rainforest supports and regulates oxygen on a global scale. This 'lung' is now badly damaged (just like the other two 'lungs', the Amazon and the Congo basins), so NCC planning offers a rare opportunity to consider an approach beyond the 'good' urban planning which only minimises the carbon footprint of a city.

The UM of the future city must indeed be reduced in volume, and circular in principle, as much as possible. With modern technology, especially information and communication technology (ICT), the desired super-efficiencies in the resource consumption and resource generation are possible. But beyond that, the city must rely on off-setting remaining, unavoidable impacts if it is to be 'carbon-negative' or at least 'carbon-neutral'.[3] Eventually, the master plan of the super-efficient, resource-conserving city must be accompanied with an ecological protection and restoration plan for a wider area, to retain and, over time, to enlarge the natural carbon sinks and biodiversity in its surroundings.[4]

In our regenerative development scheme, the UM of the NCC consists of five pillars of productivity and security: (1) renewable energy, (2) food security, (3) water resource management, (4) sustainable materials procurement, and (5) waste management. These are the five elements of UM which have to be subject to control, regulation and optimisation. The aim of this 'green-telligent' intervention is to *reduce the demand* via eco-efficiency, and *secure the supply* via eco-sufficiency.

Our master plan has five Urban Metabolism Hubs. Each hub becomes the centre facility co-ordinating the servicing of the whole city via suburban and neighbourhood scale facilities. To ensure the success of the circular city metabolism, the five activities must be carried out into the smallest scale at household level. For example, every household in the NCC should be:

- Optimising green space in their housing area for planting edible plants.
- Separating waste before it is circulated to the district level and acquiring a compost bin to process their own kitchen waste.

- Installing rainwater harvesting system, recycling grey water, and preparing large portion of water catchment area in their green space.
- Installing solar panels (heat and power) in their roof to support the minimum needs of electricity.
- Using as much as possible renewable and sustainable materials – timber primarily – for construction which is also be included in the building permit.

When all the key aspects are already put in place at the lowest spatial level of the city – the household, or a workplace – the combined benefits accumulate through the whole urban metabolic system. Maintaining a moderate volume, and mainly circular flow, of inputs and outputs in all five strategic consumption areas, makes the task of off-setting the unavoidable ecological footprint (by regenerating the native forests and wetlands) more realistic. It also enables the speed of the eco-restoration to be in step with the speed of the NCC's growth.

However, this is not possible without considering a much wider geographical area than the territory designated by the government for the physical development of the NCC. A region-wide approach is imperative if the NCC is to be a carbon-negative city.

We estimate that the NCC – along with similar re-alignment of all future growth in the neighbouring cities of Samarinda and Balikpapan – would require a series of forest regeneration projects over the entire province of East Kalimantan.

Looking at an even larger scale, we have proposed that all other cities and towns in Kalimantan be involved in this grand, island-wide regenerative project. All existing and future urban development in all five Kalimantan provinces need to mimic the UM of the NCC, which serves as a beacon of the 'right practice'. All urban settlements in Kalimantan should form clusters modelled on the 'East Kalimantan trio' – Samarinda, Balikpapan and the Capital City – and draw plans to restore natural habitat in their local and regional areas. In this manner, over some 30 years, they will grow back their own carbon sinks and thus create their own off-setting capacity.

Thus the core principle is the rigorous control of the UM of the NCC, and then balancing the remaining, inevitable 'entropic surplus' of the new city with the help of the regenerated forests in the wider region. This is the only way to achieve the first 'neg-entropic' city in history, and with it establish Indonesia as the global leader in Regenerative Urbanisation.

DISCUSSION: THE PROMISE OF REGENERATIVE URBANISM

Our proposal shows how it might be possible for a new or growing city to make the surrounding nature better off, rather than worse off. Regenerative urbanism is also a case for *Ecologically Positive Urbanisation (EPU)*[5] – building cities which grow forests. The case for a 'good urbanisation' is extremely important in a world where more than 50% of all people live in cities, which consume 75% of all resources and generate 75% of all waste.

'Regenerative urbanism' means that the growth of the NCC must be 'off-set' (Fig.2) by restoring some of the once-enormous tropical and subtropical forest of Kalimantan. The carbon emissions generated by the NCC must be neutralised – and eventually 'over-compensated' – by the carbon sinks of the re-instated forests in the East Kalimantan province.

This principle that the ecological impact of urban growth from now on must be off-set by reforestation applies to the rest of the island. All new cities and towns, and all future expansion of the existing cities and towns in

Kalimantan, must be conditional upon restoring the forest carbon sinks and boosting biodiversity in their local regions. Our master concept envisages a dozen or more of clusters of cities with their satellite towns (Fig. 10) which are in sum 'carbon-negative' or at least 'carbon-neutral'. Together, they should be able to restore about 100,000 square kilometres of forest over the next 30 years (2020-2050).

This model must be physically demonstrated, not just theorised. Regardless of the current focus on the physical plan for the new city, the Republic of Indonesia's decision to build a new national capital is a rare opportunity to demonstrate the principles of EPU at a major urban and regional scale, and amidst one of the most ecologically degraded areas on Earth. The scale and pace of the ecological devastation of Borneo has been a matter of international concern for many years. However, it must be acknowledged that reversing the damage would be a very costly exercise. The global significance of the tropical forests of Borneo offers Indonesia a chance to seek international assistance. Presenting to the potential donors a clear idea of how this can be done, strengthens the case.

The Government would indeed have a strong case at the world stage, since the idea of the Regenerative City now has considerable international recognition[6] and following[7]. It is well established in theory (Girardet, 2010 & 2015; Zari, 2018; Axinte, 2019), and to some degree in practice (Hand, 2017; Fayed & Rashid, 2019), that this approach to the global climate action is imperative, effective and feasible.

Our competition entry shows that the truly 'sustainable city' conundrum has been solved. At its core lies the concept of 'regeneration'. Regeneration is about mimicking what living nature does all the time in its cosmic battle against entropy: it uses the information to achieve ever higher levels of the organisation. While this makes sense to a scientist, this may feel like a foreign language to a city planner, or an urban designer.

Arguably, a different jargon is needed and possible. To use the language of urban design and city planning, 'regeneration' is essentially about a harmony between Form and Function.

In our case, the Form is embodied in the proposed Master Plan for the capital city; the Function is manifested in the prescribed Urban Metabolism. On another site, with a different climate and topography, and different political and popular culture, both the master plan concept and the urban metabolism synopsis would have looked different. But that is of marginal importance, since what really matters is the essential message: you do not get a 'forest city' by mimicking real forest in the urban design of that city, or even cultivating real forest groves in the city, but by (re)establishing real forest in the surrounding region. This has to be done at a regional scale which keeps ahead of the city's volume of UM and stays above the size of its ecological footprint.

Only at the regional scale can true urban sustainability and resilience be achieved.

CONCLUSION: NCC IS ABOUT KALIMANTAN

The NCC project has global significance. Along with the forests of the Amazon and Congo basins, the Indonesian forests of Kalimantan, Sumatra and Irian-Jaya are one of world's three most important forested regions. For a good reason, they have been called the "three lungs of the planet"[8] – a powerful reference to their function as carbon sinks and sources of oxygen, without which the abundance of life on Earth would not be possible.

In these times of dire and urgent global climate and biodiversity crises, it

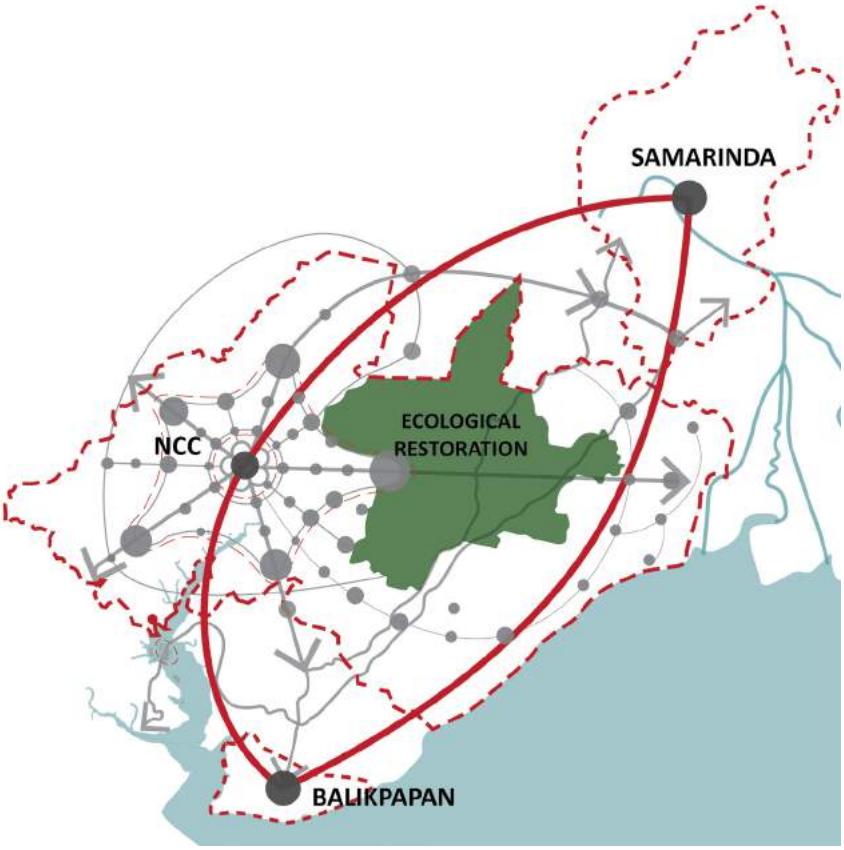


Figure 15: The NCC as the prototype of regenerative urbanism
Source: Authors' diagram

is no exaggeration to state that human survival depends on the three 'green lungs' of the planet like never before.

In summary then, if the NCC project is conceived, promoted and implemented as a demonstration of Regenerative Urbanism – or, an experiment in *Ecologically Positive Urbanisation* – it would enable the Government of Indonesia to do three things:

1. Respond to the scepticism in the international community that moving the capital from Jakarta to Kalimantan will not cause even more damage to Kalimantan, after decades of well-publicised forest devastation;
2. Seek substantial international technical and financial assistance for the NCC project, since Borneo/Kalimantan is widely recognised as a vital global carbon sink;
3. Face the global community as a modern, progressive, ecologically-conscious nation, which understands its international responsibilities and will act accordingly – but also demands fairness in sharing the burden of healing the planet.

To ensure the success of this demonstration, the global community should respond and offer collaboration, technical and financial assistance. One could think of a long list of nations and organisations [9] which should take part in this opportunity to demonstrate global solidarity in the common battle against the looming climate catastrophe.

ENDNOTES

1 https://www.thejakartapost.com/news/2019/12/26/nagara-rimba-nusa-announced-winner-new-capital-city-design-contest.html

2 https://www.straitstimes.com/asia/se-asia/indonesian-govt-picks-winner-of-design-for-new-capital-city-in-east-kalimantan

3 There is some confusion in the literature around the use of the terms 'carbon-neutral', 'carbon-positive' and 'carbon-negative'. The word 'positive' usually means something good, so some authors use the expression 'carbon-positive' to denote an entity which stores CO2, i.e. functions as a sink. But since CO2 ('carbon') is a 'bad' substance in this context, we side with those authors who choose to call carbon removing systems – 'carbon-negative'.

4 To avoid any misunderstanding, in no way are we advocating that 'carbon offsetting' is a panacea, and that if we 'plant enough trees', we can go on with polluting as before. At the global scale, humanity's carbon-addiction can only be resolved with a parallel action on reducing combustion and GHG emissions, and sequestering the past, and any future, carbon emissions by restoring the natural carbon sinks in oceans, soil and vegetation. See discussion here: https://www.maxfordham.com/mf-net-zero/carbon-offsetting---friend-or-foe

5 References to the expression Ecologically Positive Urbanisation appear impossible to find in the academic literature. However, the discussion of is lively in various corners of the world, in most cases in the business and professional communities rather than academia. For example: https://www.eco-business.com/opinion/urbanisation-can-be-good-for-the-environment/

6 Wikipedia: Regenerative City. https://en.wikipedia.org/wiki/Regenerative_city

7 Medium: S. Surig. https://medium.com/thebeammagazine/regenerative-cities-an-urban-concept-whose-time-has-come-e08b5271ccf8

8 Arief Rabik, of the Bamboo Foundation, describes (p.12) "Indonesia as one of the three lungs of the world" in: https://www.churchilltrust.com.au/media/fellows/Long_J_2016_Treatment_methods_to_develop_Australias_bamboo_industry.pdf

9 Some of the international institutions and other entities which could, or might, or should support this project, whether in finance, kind or expertise, are listed here:
UNDP, UNEP, UNESCO and UN-Habitat
The World Bank
Asian Development Bank
Asian Infrastructure Investment Bank
Belt and Road Initiative (China)
Partnership for Quality Infrastructure (Japan)
ASEAN and APEC
The European Union
The Commonwealth of Australia
Governments of China and India
The governments of Malaysia and Singapore
The Government of Netherlands

REFERENCES

Bogunovich, D., 2002. Eco-Tech Cities: Smart Metabolism For A Green Urbanism. *The Sustainable City II: Urban Regeneration and Sustainability.* Ashurst, UK: WIT Press.

Grimm, N. B. et al., 2008. Global Change and the Ecology of Cities. *Science,* Volume 319, pp. 756-760.

Kennedy, C. E. J., Cuddihy, J. & Engel-Yan, J., 2007. The Changing Metabolism of Cities. *Journal of Industrial Ecology,* 11(2), pp. 43 – 59.

Lehmann, S., 2010. *The principles of green urbanism : regenerating the post-industrial city.* Washington, DC: Earthscan.

Mang, P., Haggard, B. & Regenesis, 2016. *Regenerative development and design : a framework for evolving sustainability.* Hoboken: Wiley.

Maulia, E., 2019. *Jokowi announces Indonesia's new capital in East Kalimantan,* Jakarta: Nikkei Asian Review.

McHarg, I. L.,1959. *Design with Nature.* Garden City, N.Y.: Natural History Press.

Ministry of Public Works and Housing, 2019. *Terms of Reference: Design Ideas Competition for The National Capital Region.* Jakarta: Ministry of Public Works and Housing.

Palazzo, D. & Steiner, F. R., 2011. *Urban ecological design : a process for regenerative places.* Washington, DC: Island Press.

Thomson, G., 2018. Urban fabrics and urban metabolism – from sustainable to regenerative cities. *Resources, Conservation and Recycling,* pp. 218-229.

Thomson, G. & Newman, P., 2016. Geoengineering in the Anthropocene through Regenerative Urbanism. *Geosciences.*

Zari, M. P., 2018. *Regenerative urban design and ecosystem biomimicry.* New York: Routledge.