

A TRANSECT APPROACH TO LAND USE MANAGEMENT IN SOUTH AFRICA

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» (...) it is evident that a transect, based on criteria such land use and registration, density/intensity and agricultural suitability can be formulated for South Africa to define the predominant preferred use in that area. Further, each transect can serve as a basis for developing both spatial planning and land use management on a regional and local scale. Within each zone of the transect, locality specific development options can be developed and regulated. «



INTRODUCTION

Transects or sections through a landscape are not unique to regional planning. They have been used in environmental sciences to identify the changes in biological populations in changing habitats (Grant et al, 2004) and assessing the role of humans in a socio-ecological system (McDonnell and Pickett, 1990). The application of a transect as an analytical tool through a region can be traced back to early planning theorists such as Ebenezer Howard and Patrick Geddes (Hall, 2002; Talen, 2002). Howard's garden cities were intended to have a strong density gradient, with densities resembling those of inner London at its centre and an agricultural fringe that included institutional uses (Hall 2002). The concept of a 'valley section' promoted by Geddes—inspired by Reclus and Le Play—encompassed both natural habitats as well as human (urban) habitations (Hall, 2002). More recently a rural-to-urban transect has been adopted as the basis for development regulation by New Urbanists to generate an urban form that is sustainable and liveable (Duany and Talen, 2002; Garnett, 2013).

While the rural-to-urban transect and accompanying form-based codes originated in the USA, they have been touted as a remedy for the troubles of the modern city (Singh, 2010). Transect planning is viewed as an alternative to urban sprawl that, combined with form-based codes, can create compact pedestrian and cycle-friendly places. However, to date, the planning transect has not been used in South Africa, where land development has been controlled by land-use zoning rather than urban design codes.

With the recent enactment of the Spatial Planning and Land Use Management Act (SPLUMA) (South Africa, 2013), this could change. SPLUMA requires all local municipalities to adopt a land-use scheme that covers their entire municipal area. Most municipalities are large enough to constitute a region and include vast rural areas, some under commercial farming and others under the authority of Traditional Leaders. Often urban areas within these municipalities include informal settlements with varying degrees of access to basic services. While SPLUMA stipulates the essential objectives of a land-use scheme, neither it nor the regulations

(South Africa, 2015) provide much detail on the nature of the regulations that must be adopted. This is an opportunity for innovation in land-use management in South Africa.

This paper explores the possible adaptation of a rural-to-urban transect for land-use and development management in the South African context. The following section provides a brief background to development regulation in South Africa and the current issues facing planners in South Africa followed by a short description of Mangaung Metropolitan Municipality which is used as a case study area (MMM). Thereafter the concepts around transect planning are discussed leading to the development of a theoretical transect along with the considerations behind its conceptualisation with particular focus on the criteria defining each sector. The proposed transect is then tested in a short transect across the MMM where many of the sectors exist. Some preliminary inferences on the applicability of the transect as a basis for land development regulation conclude the paper.

LAND-USE AND DEVELOPMENT REGULATION IN SOUTH AFRICA

BACKGROUND

Initially most urban areas in colonial South Africa adopted British land use planning and development theories, approaches and tools. The prevailing paradigm was modernism, with its emphasis on separation of land-uses and activities by means of zoning through town planning schemes (Charlton, 2008; Watson 2009) that was also extended to include the separation of people on the basis of race (Christopher 1997, Mabin and Smit, 1997). Town planning schemes usually only applied to those parts of the urban area inhabited by whites. Little land-use control was applied to the remainder of the country, whether commercial agriculture or the Bantustans where land allocation and management was delegated to traditional leaders (Khunou, 2013). Later, some of the Bantustans enacted legislation to regulate the use and development of land, while each of the original four provinces had their own town planning ordinances. Thus by the end of the twentieth century South Africa was characterised by a highly fragmented legal

landscape relating to land-use regulation (Van Wyk, 2012).

New national legislation that applied to all places was imperative to address this situation, and to this end the Spatial Planning and Land Use Management Act (SPLUMA) (South Africa, 2013) was enacted. It provides a framework for spatial planning and land-use management throughout the country and a uniform set of principles and processes for land development. The Act also requires municipalities to adopt a “single land-use scheme for its entire area” (South Africa, 2013: section 24(1)). This scheme comprises the regulations, maps and a register of all amendments to it. Its content must “include appropriate categories of land-use zoning” (Section 24(2)(a)). Schedule B to SPLUMA contains a list of land-use zones that apply where no land-use scheme is in place.

CHALLENGES OF DEVELOPMENT REGULATION IN SOUTH AFRICA

While the national framework provided by SPLUMA is welcomed, there are still challenges in developing land-use and development regulations for the diverse landscapes within many municipalities. A number of municipalities have prepared town planning or land-use schemes that include the former ‘townships’ reserved for Africans and that may include rural areas under traditional authority and commercial agricultural areas. Thus there is a gradual move to municipality-wide land-use schemes. However, in some cases—such as the Free State contestations between government departments over the authority to authorise land-uses on agricultural land has prevented the finalisation of land-use schemes (Nel 2011). Even where there are schemes, there may not be consistent enforcement for various reasons, including lack of personnel and capacity or fear of intimidation (Watson, 2013; Parnell and Pieterse, 2010). Municipalities with large informal settlements or areas under traditional authority have found it difficult to prepare conventional zoning schemes in areas where there are no formally registered individual sites to which land-use rights can be attached (Du Plessis, 2011).

Conventional land-use zoning as implied in SPLUMA, has been criticised on several grounds.

These include segregation of land-uses, leading to urban sprawl that necessitates unsustainable commuting and expensive infrastructure (Duany and Talen, 2002; Wheeler, 2009; Swilling, 2010), as well as the placelessness of modern cities (Ben-Joseph, 2005; Coyle, 2011). According to Duany and Talen (2002:246) “conventional zoning schemes and the way they encourage development to separate and disperse are counter-intuitive to the way in which we ought to be planning and regulating urban development” and is contrary to urban planning goals. Separation and the formation of homogeneous areas tend to create exclusivity and exclusion, particularly of the poor (Watson, 1993; Silver, 1997; Knaap et al., 2007; Talen, 2012) that is a grave concern, particularly in the South African context where inclusion and equity are national imperatives to counteract the legacy of apartheid.

Consequently, alternatives to conventional zoning with all its problems that are more suitable for the South African landscape should be sought. Although there are a variety of regulatory systems for land and development (Hirt, 2014) only one, that of transect planning, will be investigated in later sections of this paper.

MANGAUNG METROPOLITAN MUNICIPALITY

The Mangaung Metropolitan Municipality (MMM), the judicial capital of the country, is located roughly in the centre of the Free State Province and contains a number of settlements² within a vast rural area. Bloemfontein is the only city; Dewetsdorp, Van Stadensrus, Wepener are small towns while Botshabelo and Thaba Nchu are remnants of Apartheid planning (Figure 1). It comprises an area of 9708 km² (Local Government handbook: online) and a population of 774,634 persons (StatsSA, 2011). It is the provincial capital and the main economic and service centre of the region, hosting two universities, numerous private and public schools, state and private hospitals as well as financial and retail services.

As indicated in Table 1 Blacks comprise nearly 83,6% of the population. Historically wealth was concentrated within the white minority; this legacy is reflected in household incomes where 65% of households earn under R5000 (roughly \$320) per month. The official unemployment



Figure 1: MMM location in South Africa (OSM, 2016)

COMPOSITION OF POPULATION (1996-2011)

	1996	2001	2011	1996	2001	2011
	NUMBER			PERCENTAGE		
Black	491 717	561 663	648 022	77,9%	83,2%	83,6%
White	102 974	79 765	83 590	16,3%	11,8%	10,8%
Coloured	32 190	32 911	37 838	5,1%	4,9%	4,9%
Indian	1 122	1 117	3 259	0,2%	0,2%	0,4%
Other	3 113	NA	2 227	0,5%	NA	0%
TOTAL	631 116	675 457	774 935	100%	100%	100%

Table 1: composition of population (1996-2011)
Source: StatsSA 1996, 2001, 2012

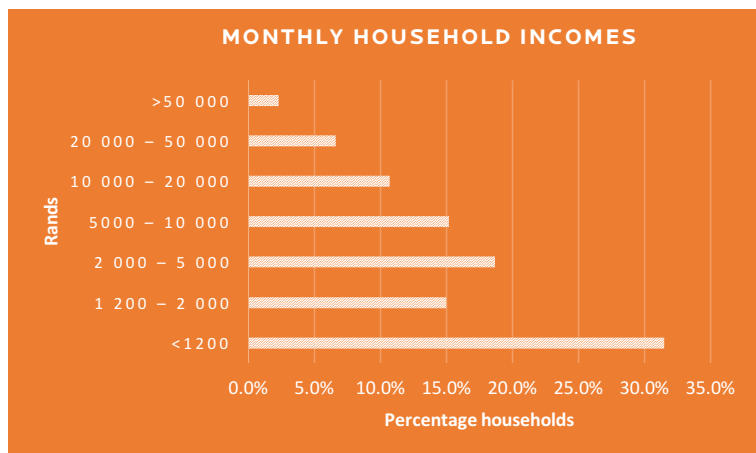


Figure 2: Household income in Rands per month (2011 values)
Source: StatsSA, 2012

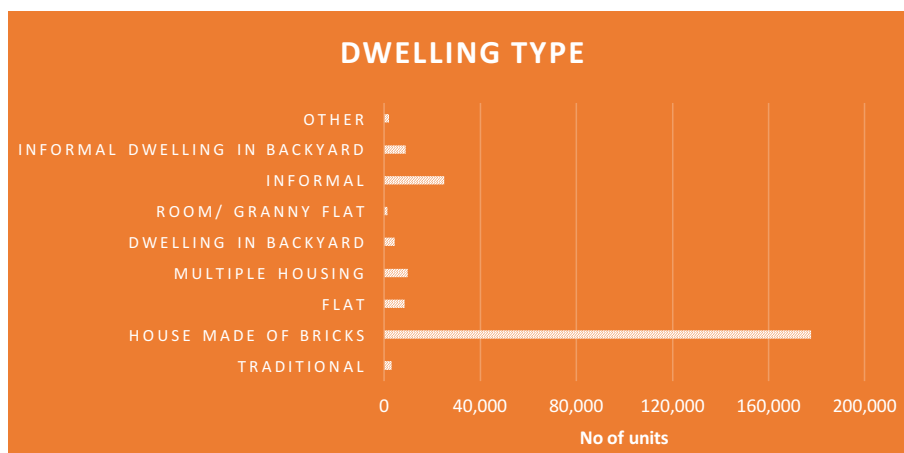


Figure 3: Dwelling type
Source: StatsSA, 2012

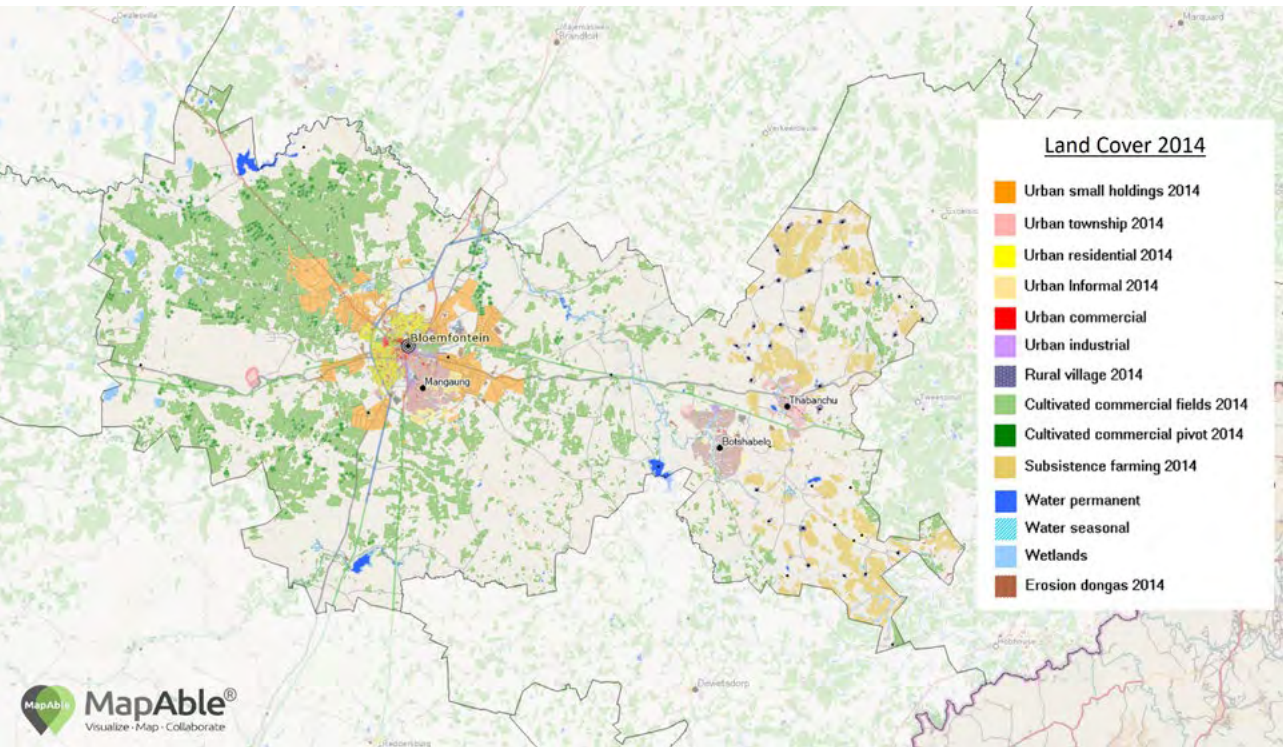


Figure 4: Land cover in MMM. (GeoTerralimage, 2014)

rate of 27% (excluding discouraged work-seekers) confirms high levels of poverty in the municipality (Local Government Handbook: online). Bloemfontein is the destination of many migrants, including those from Lesotho. Acute shortages of affordable housing have resulted in informal settlements, mainly on the periphery of the city.

The urban structure of Bloemfontein clearly reflects apartheid planning: the wealthier suburbs are to the north-west while the ‘townships’ and burgeoning informal settlements lie to the south and east separated by industrial areas from the remainder of the city. However, the majority of social facilities and employment opportunities are in the CBD and north-west part of the city. This pattern is typical of most South African towns and the small towns of MMM are no exception. Thaba Nchu is part of the former Bophuthatswana Bantustan and falls under traditional authority. Although subject to the same legislation as the rest of MMM, land uses and land-use management are largely controlled by the traditional council (Sekonyela, 2014). Botshabelo was established by the apartheid government

for people who were neither Sotho nor Tswana. Neither Botshabelo nor Thaba Nchu have a significant economic base and hundreds of people commute daily to Bloemfontein to work.

Dewetsdorp, and Wepener are small towns established to serve an administrative function to the local farming community, while Van Stadensrus is a village in the foothills of the Maloti Mountains. Urban settlements constitute under 3% of the municipal area and the remaining area is rural, largely rangelands interspersed with field crops (Figure 4) (GeoTerralimage, 2014).

THE TRANSECT

A transect can be defined as a cut or a path (Garnett, 2013), a gradient (McDonnell and Pickett, 1990) and a “geographical cross section of a region used to reveal a sequence of environments” (Duany and Talen, 2002: 246). Transects are generally used as an analytical tool to assess variation within the region. However, the concept has been adapted as a planning and urban design framework to organise and regulate the built environment (Talen, 2002:295). Thus, instead of describing what is, it describes how development

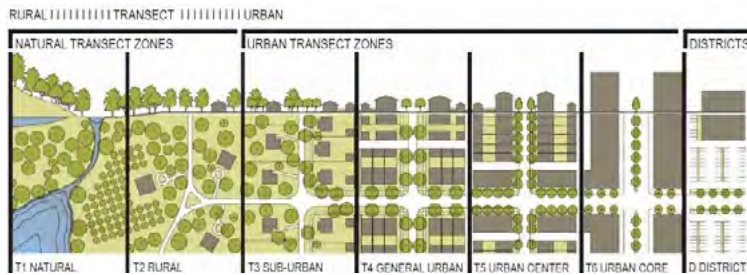


Figure 5: Transect zones
(Centre for Applied Transect Studies., n.d.)

ought to occur (Brower, 2002). The best known version of a planning transect is the Smart Code developed by Duany Plater-Zyberk and Company with six zones (Figure 5); rural preserve, rural reserve, sub-urban, general urban, urban centre and urban core (Duany and Talen, 2002).

This planning transect is conceived as a rural-to-urban gradient with increasing densities and intensity of development forming a logical progression from rural to urban, that is divided into sectors each with its own set of densities, building forms and streetscapes (Brower, 2002; Talen, 2002). The changing ratio of natural to man-made elements reflects the changing density and complexity of the urban environment; natural materials are most evident in rural areas but man-made elements dominate high density urban areas. Although posed as a continuum, the transect contains discreet sectors, each with their own set of rules, or form-based code appropriate to the density of the sector (Talen, 2002:295). Such codes focus on the 'building disposition' (site size and building envelope), building elevation /façade, function (land-use) and development standards for parking, landscaping and signage (Duany and Talen, 2002:254; Brower, 2002:314).

Proponents of New Urbanist transect planning state that it is a simple, flexible and holistic system, that generates and supports diversity and greater sustainability (Talen, 2002; Duany and Talen, 2002, Talen, 2006). However, according to critics, while the theory is attractive, the practice is perhaps not as rosy (Garnett, 2013, Garvin and Jourdan, 2008; Brower, 2002; Correa, 2006; Kriken, 2006).

Garnett (2013) and Correa (2002) point out that the idealised transect does not exist in the USA, nor is it applicable to all cultures, e.g. Arabic cities or Mediterranean hilltop cities

(Orr, 2006). On the contrary, the emphasis on a given set of urban sectors may deprive areas of their uniqueness derived from culture, history and topography, producing the very placelessness that the planning transect seeks to avoid (Kriken, 2006). Despite claims about flexibility and simplicity, critics point out that the detailed architectural form-based codes are complicated and rigid, difficult to interpret and increase the cost of development (Garnett, 2013, Garvin and Jourdan, 2008). By attempting to impose a planned 'organic' order, they ignore the natural complexity of the city (Garnett, 2013; Correa, 2006).

While the aesthetics of a place may be important, research by Brower indicates that it is the people, and the relationships between them that determine how attractive a place is "[p]hysical elements are valued less for their intrinsic qualities than for their social implications" (2002:314). Consequently, the focus on urban design may be less relevant in the search for more sustainable and liveable areas than proponents believe, as "the regional problem is not how a settlements looks, but where it locates. The planning tools are needed are ones that help protect valuable, irreplaceable land, promote air and water quality and conserve energy" (Kriken, 2006:78).

The question then arises: is it possible to apply the concept of a transect to determine where development should locate and to preserve natural resources while avoiding the problems of rigid form-based codes and zoning? The following section explores the use of a transect as a land development and use management tool in the South African context. In the first part a theoretical framework is developed while in the second part the concept is tested along a transect in the MMM.

APPLYING A TRANSECT FOR SOUTH AFRICAN LAND USE MANAGEMENT

In South Africa's municipalities that cover large areas with diverse activities, a single form of regulation may not meet the land use management needs of the municipality. Development controls formulated for urban areas may not be suitable or necessary for rural areas, and rules for suburbs may not be applicable in areas under traditional authority where land is generally held under communal tenure. Transect planning can generate appropriate land use and development controls for each unique sector, based on environmental, social, physical, economic and aesthetic criteria tailored to the needs of the area. A transect approach is compatible with SPLUMA, as it can still generate broad land-use zones that can be nuanced as required.

DEVELOPING CRITERIA

In developing the criteria for a transect-based land development management system, the following aspects are relevant:

- Environmental management. Sustainable development demands that attention is given to ecological integrity (Haughton, 1999), maintenance of biodiversity and the quality of essential ecosystem services such as the soil, air and water. This is particularly crucial in protected areas and agriculture, while the management of wastes and pollution are essential for urban areas (Swilling, 2006).
- Social. In most settlements, the ability to sustain livelihoods is critical. This requires access to opportunities —education, health, employment (Rihani, 2002) —and the capacity to use social and physical capital, e.g. a home, to generate an income (Watson, 1993; Pelling, 2003). Addressing social exclusion, poverty and inequality are also vital.
- Economic. Access to resources and opportunities are essential along with agglomeration economies.
- Physical. In addition to factors such as topography and climate, infrastructure – roads, water and sanitation services, energy and telecommunications—is essential. Aesthetics can contribute or detract from a place and may be important in historical districts for social and

economic goals. Land use control is related to the potential impact of the use on the environment community and infrastructure.

- Level of control required. The nature and degree of control over environmental impact, aesthetics or land uses is not the same for all areas. In protected areas environmental management will take precedence over economic considerations, while in informal settlements, access to opportunities and livelihoods may be paramount. Thus the planning transect must reflect the primary needs of the sector. Three levels of control are suggested for environmental aspects, land use and urban form:
 - Maximum control: primary consideration around regulation of development
 - Partial control: management of impacts
 - Minimum control: only serious impacts controlled

DEVELOPMENT OF THE REGIONAL TRANSECT ZONES

Each transect zone, be it on a local or in this case a regional zone needs to have discrete or unique features. These features help differentiate different natural and human dominated spaces. It should, however, be noted that the criteria used to define each zone can be present in multiple zones, but the intensity or form can change (such as in the case of housing and population density etc.). The focus of this classification is on a functional description of place rather than an arbitrary administrative classification.

The regional transect presented below contains seven broad zones that is representative of a typical South African municipality or planning region (with a specific focus on the MMM). The zones move from natural and protected areas to more urban and densely populated centres. The zones can also be seen as a settlement typology broadly describing the settlement patterns and characteristics within a municipality.

The transect zones were constructed utilising existing classification systems (such as the CSIR Settlement Typology and Rural Typology) with real world analysis of MMM (CSIR, 2013). The methodology utilised to construct the regional transect is a multi-criteria analysis or suitability analysis. A set of criteria was constructed per

Zone/Sector	Characteristics	Examples
CONSERVATION	Protected areas requiring protection	Proclaimed reserves and landscapes, Conservancies Wetlands, forests, aquifer recharge areas Battlefields and heritage sites
AGRICULTURE	Intensive agriculture, extensive agriculture	Viticulture, Orchards, Horticulture etc., Poultry farms and feedlots, Rangelands; Field crops (e.g. maize & wheat)
RURAL SETTLEMENTS	Traditional rural	Areas under traditional authority including homesteads and subsistence agriculture
	Small towns and service centres;	Small service towns, mining towns; urban fringes
URBAN	Informal settlements	Settlements with un-surveyed sites
	General urban	Secondary cities and metropolitan areas
	Urban cores	High intensity urban areas with mixed uses, Central business districts
SPECIAL	Areas requiring unique controls	Historic districts/ streets Astronomy reserves

Table 2: A South African transect

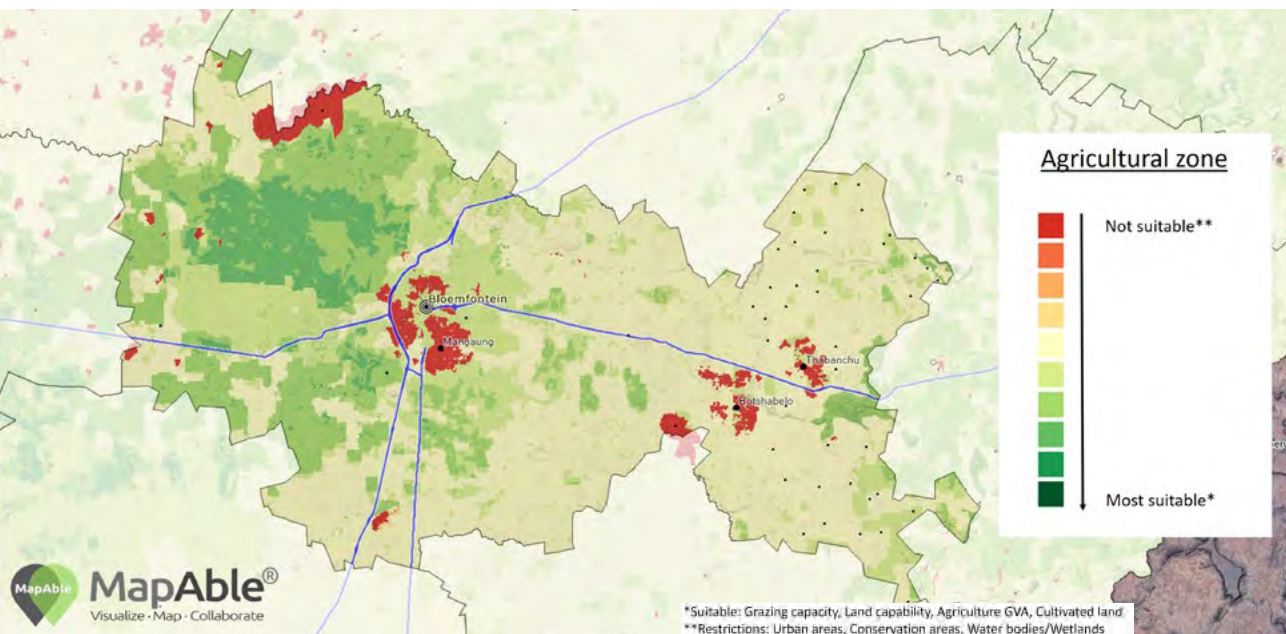


Figure 6: Agricultural Zone Suitability analysis

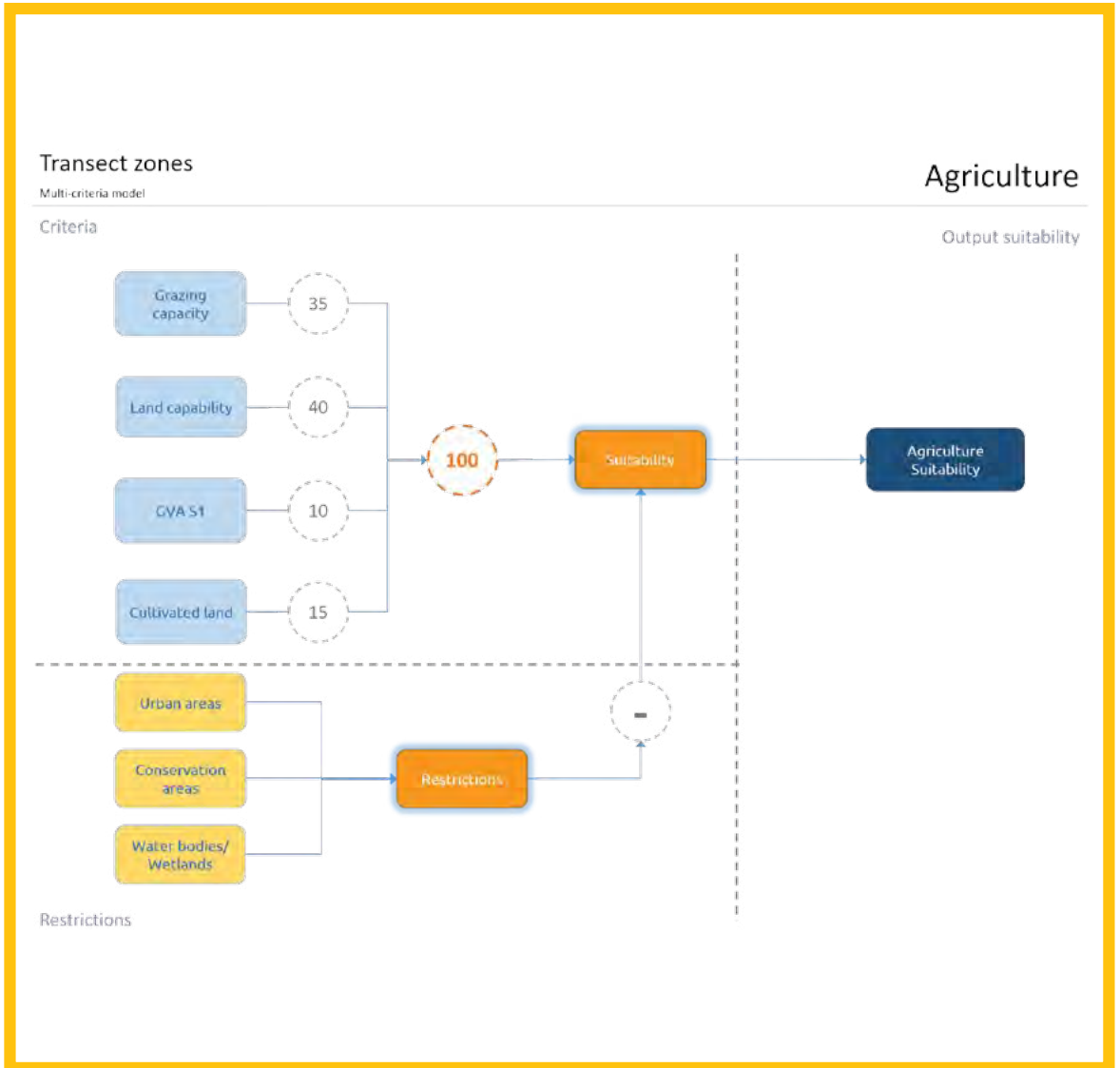


Figure 7: Example of application of multi criteria model

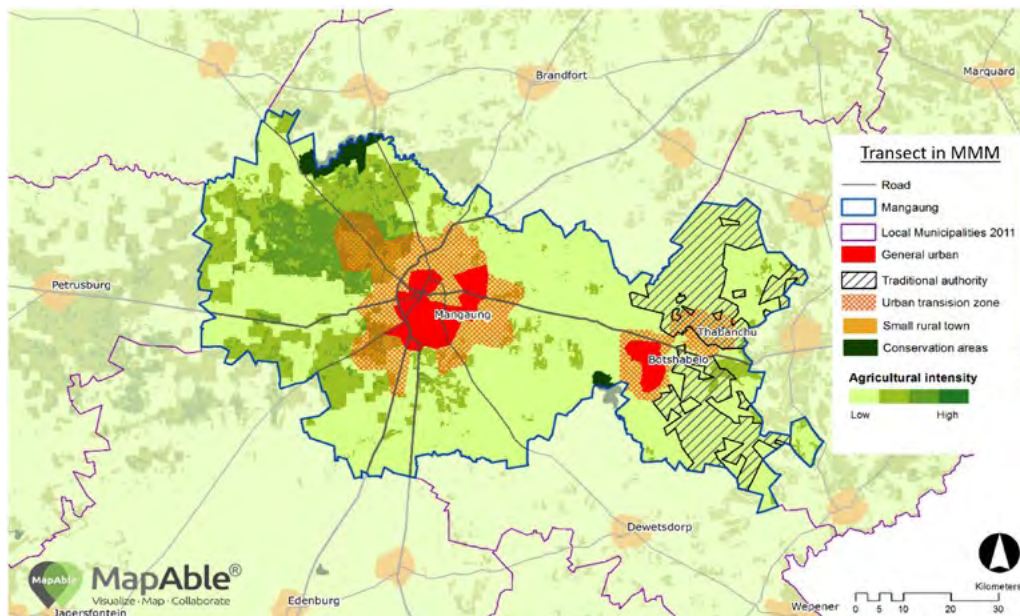


Figure 8: MMM Transect

transect zone which identifies areas that are suitable according to the criteria. The criteria can be positive (includes various areas that are suitable) or negative (excluding areas that are not suitable) (See figures 2 and 3 below). The criteria and subsequent analysis utilises appropriate spatial data sources in a GIS system to create a weighted overlay that describes the various zones (Bridney, 2014).

Figure 8 illustrates the transect applied in MMM along the N8 between Bloemfontein and Lesotho. All the transect zones are illustrated with an additional transitional zone around urbanising or peri-urban areas.

THE REGIONAL TRANSECT ZONES

The following sections describe the transect zones in more detail along with key considerations.

CONSERVATION

The conservation transect is characterised by protected and vulnerable areas that are important for ecosystem and tourism functions. The zone contains officially protected areas such as national parks, areas that are designated as

vulnerable to ecosystem change and vulnerable river and wetland areas. The areas should exclude all high intensity urban development with noxious industries and mining strictly prohibited. The focus of development should be on eco-tourism and low impact human settlements that support the natural environment.

AGRICULTURE

The agriculture transect zone includes all areas that predominantly rely on the agricultural sector or areas that contain high potential agricultural land. The sector is relatively broad with different types of agriculture having different requirements or carrying capacity with associated support industries. The focus of development is supporting the overall industry through protection of both land and water resources, prohibiting mining and high density urban development or urban sprawl.

**RURAL SETTLEMENTS
TRADITIONAL RURAL**

Traditional rural settlements were formally part of the ‘Bantustans’ but now fall within municipi-



Figure 9: Soetdoring Nature Reserve in MMM (NGI, 2014)



Figure 10: Commercial Agriculture north of Bloemfontein in MMM (NGI, 2014)



Figure 11: Traditional settlement (Thaba Nchu) (NGI, 2014)



Figure 12 : Small town south east of Bloemfontein (Dewetsdorp) (NGI, 2014)



Figure 13: Informal settlement in the Grootvlei area (NGI, 2014)



Figure 14: Suburb in Bloemfontein (Fleurdal) (NGI, 2014)



Figure 15: Bloemfontein CBD (NGI, 2014)

palities and are governed by traditional authorities. These settlements often have little or no economic development resulting in chronic under-development (Harrison, 2014). A number of factors, including over-population and over-grazing have resulted in degraded land (Meadows and Hoffman, 2002) with low economic potential. Land is generally held under communal ownership, with households allocated land for homesteads, *kraals* and small fields and shared communal grazing rights.

RURAL SETTLEMENTS – SMALL TOWNS/CENTRES AND URBAN FRINGES

Small towns and centres typically function as service centres for the surrounding agricultural area. The main functions include general retail and trade activities and value-adding industries including distribution of agricultural products. Small towns often contain community and social facilities including regional government offices. The housing is generally in the form of

detached houses while the settlements typically have regular grid street patterns. Most towns still have an apartheid structure with distinct residential areas. Key considerations are livelihoods and quality of life.

URBAN - INFORMAL SETTLEMENTS

Informal settlements consist of housing and other structures that are generally unplanned and may be illegally occupying the land. The individual sites are not surveyed or registered. Shanties and shacks constitute most of the housing. Informal settlements are often located on the periphery of cities with limited basic service infrastructure and facilities. Economic and social opportunities as well as improving the quality of life are crucial considerations.

URBAN - CITIES AND THEIR SUBURBS

Suburbs of differing densities constitute this zone. The major housing typologies range from single residential to medium density housing. These areas are usually well served with social

Transect zone/sector	Primary activities	Example of Secondary activities	Rules applicable to secondary activity
Conservation	Nature reserve	Rest camp	Small town
	Conservancy	Rangeland/ communal grazing	Agriculture
Agriculture	Agriculture, residences, farm stay guest house, home-based businesses	Resort	Small town
Rural Settlement: Traditional area	Homesteads, communal grazing and subsistence agriculture, small scale economic activities (eg spaza shops and workshops)	Urban node with retail exceeding 1000m ² floor area, community facilities and transport (bus stops/ taxi ranks)	Urban node or small town depending on scale
	Small town	Golf or eco-estate	General urban
General urban	Suburban area: residences, home-based businesses, community and religious facilities	Local node exceeding 20 000m ² non-residential floor space	Urban node
	Informal settlement	Local node comprising community facilities, retail and transport (bus stops/ taxi ranks)	Urban node
Urban core	High intensity mixed use	Park/ public open space	Conservation

Table 3: Land use management based on transect zones

and community services and contain various business and trade functions. Liveability and diversity are important social issues along with accessibility for low income employees.

URBAN - CORE

The urban core contains multiple uses in high density, often high-rise, buildings. These spaces are the most connected area in the city featuring with uses such as residential, business and government offices, retailing and service industries. Liveability and accessibility are key issues in these zones. Urban cores serve the larger urban area and are often the primary employment nodes with users and residents from all economic sectors.

SPECIAL AREAS

Special areas require specific or unique controls. These areas typically serve a unique function or service including economic, historical, cultural or social. Examples of special areas in the MMM could include the historical town centre, the new Airport node, the sports precinct around the Free State stadium, the universities and military bases.

CONCLUSIONS

From the analysis above, it is evident that a transect, based on criteria such land use and registration, density/intensity and agricultural suitability can be formulated for South Africa to serve as a basis for both spatial planning and land use management on a regional and local scale. For each zone of the transect, locality specific development options can be developed and regulated.

Among the benefits of this approach are flexibility and focus. The latter enables each zone to have appropriate planning and controls emphasising that most critical aspects to be regulated, controlling only what is essential to control (Oranje, 1995). Change can be accommodated by amending the transect zone as an area becomes urbanised or formalised (e.g. informal settlements).

Unlike conventional zoning schemes with a myriad of different land use zones, these few transect zones have the potential to generate diversity, resilience and sustainability³. The pro-

posed transect or typology is fractal:⁴ thus while an area may be part of one zone on a regional scale, the detailed planning and regulation of a small precinct may follow the guidelines of a different zone (Table 3). This will also enable a few rules to be applied flexibly in different transect zones to accommodate diverse environments and needs.

The proposed transect is legally possible within the confines of SPLUMA, and pertinently includes all areas previously excluded from planning and regulation. It is flexible and can promote diversity, inclusion and resilience. Furthermore, the simplicity of the system allows for its use in areas of limited skills and personnel.

However, more work is required to develop the regulatory details pertaining to each zone. Such refinement will require input from a number of stakeholders, including government agencies, to ensure that critical aspects of environmental sustainability, economic development and social justice can be supported. ♦

ENDNOTES

1 Apartheid era public housing estates on the urban periphery built for Black Africans (Mabin and Smit, 1997:206)

2 Note that the boundaries of the MMM have grown substantially over the past 16 years, with the inclusion of the Motheo district in 2011 (from 6284km²) and the Naledi municipality in 2016 (to 9700,1 km²). The statistics in this paper reflect the data from the 2011 Census for Mangaung and Naledi municipalities.

3 Complex adaptive systems are typically built using a few rules, however rich feedback loops generate the complexity, diversity and emergence.

4 The fractal nature of the transect means that the various transect zones are self-replicating on various scales (Mandelbrot, 1982). This means one can find the various zones on a regional scale but on a local scale within a regional zone, multiple local transect zones can be identified. A practical example of this can be an urban core (on a local scale) found within a traditional area (regional scale).

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