

Land quality, urban development and urban agriculture within the Cape Town urban edge

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Abstract

The article analyses the consumption of agricultural land within the Cape Town urban edge between 2002 and 2007. The agricultural potential of the developed land and the distribution of land uses are analysed to determine the impact of urban growth on urban agriculture. The research indicates that low-density residential development is still the major consumer of high-potential agricultural land within the Cape Town urban edge. Commercial, industrial and informal residential development has little impact on the loss of agricultural land. High-potential agricultural land is not sufficiently protected. Urban agriculture is limited by open competition with more profitable land uses such as residential development. Consequently, the paper argues for a flexible urban containment policy whereby high-potential agricultural land within the urban edge is reserved solely for agricultural production, while land with little agricultural potential outside the urban edge should be made available for future urban development.

GRONDKWALITEIT, STEDELIKE ONTWIKKELING EN STEDELIKE GRONDGEBRUIK BINNE DIE KAAPSTADSE STEDELIKE GRENS

Hierdie artikel ondersoek die mate waarin goeie kwaliteit landbougrond binne die stedelike grens van Kaapstad vanaf 2002 tot 2007 verbruik word. Die landboupotensiaal van grond waarop verstedeliking plaasgevind het, is ontleed om die invloed van stedelike ontwikkeling op stedelike landbou te bepaal. Die navorsing dui daarop dat lae-digtheidsontwikkeling die belangrikste verbruiker van hoë potensiaal landbougrond is. Kommersiële, industriële, en informele behuisingsontwikkeling dra minimal by tot die verlies van hoë potensiaal landbougrond. Daar is aanduidings dat landbougrond nie genoegsaam beskerm word nie. Die groei van stedelike landbou word ook beperk deur onbeperkte mededinging met meer winsgewende grondgebruike, veral residensiële ontwikkeling. Die artikel redeneer dat 'n buigsamer benadering tot ontwikkeling binne die stedelike grens toegepas moet word. Op gebiede waar hoë potensiaal landbougrond binne die stedelike grens voorkom, is dit wenslik dat stedelike ontwikkeling daarop verbied word terwyl stedelike ontwikkeling op lae kwaliteit landbougrond buite die stedelike grens oorweeg behoort te word.

BOLENG BA LEFATSHE, NTSHETSOPELE YA METSEMEHOLO YA DITOROPO LE TEMO YA DIBAKENG TSA METSEMEHOLO YA DITOROPO KA HARA DIBAKA TSA METSEMEHOLO YA DITOROPO YA MOTSEKAPA

Ditaba tsena di lekola loe ho lekanyetsa tshbediso ya lefatshe la temo le sebediswang ka yona ka hara Motsekapa ho tloha ka selemo sa 2002 ho fihella selemong sa 2007. Bohlokwa ba tsa temo ba lefatshe le sebeditsweng (hlabolotsweng) le ditshebediso tsa lefatshe tse hlabolotsweng e lekenyetswa ho fumana matla a kgolo ya tsa temo dibakeng tsa metse ya ditrope. Dipatlisiso tsena di bontsha hore ntshepele ya dibaka tsa bodulo tse se nang batho ba bangata kapa matlo a mangata e sa boetse e le yona mosebedisi tsa temo ya bohlokwa e phahameng ka hara dibaka tsa Motsekapa. Ntshepele ya tsa kgwebo, tsa indasteri le ntshepele ya dibaka tsa bodulo ha e ba matla a makalo tahlehelong ya lefatshe la temo. Tshireletso e sa lekanang e beilwe

lefaltsheng la temo la boemo bo phahameng. Temo ya dibaka tsa metsemeholo ya ditrope e lekanyeditswe hore e be e ka hlodisana le ditshebediso tsa lefatshe le nonneng le kang la ntshepele ya tsa bodulo. Ka bomadimabe pampiri e lwanela leano le bulehileng la metsemeholo ya ditrope la poloko leo ka lona lefatshe la temo la boemo bo phahameng ka hara metsemeholo ya ditrope le tla bolokelwang temo feela, ha lefatshe le se nang bohlokwa bo bokaalo ka ntle ho dibaka tsa metsemeholo ya ditrope le flamehile hore ho fanwe ka lona bakeng sa ntshepele le ya dibaka tsa metsemeholo ya ditrope e tla hahwa.

1. INTRODUCTION

High levels of rural-urban migration over the past two decades have resulted in the rapid growth of South African cities. High-density core economic regions around cities have accommodated large population shifts from the densely populated periphery around tribal authority regions. The reason for this migration is that urban areas contain 88% of the total national economic activity, twenty-two times that of the 4% of the national economic activity contained in tribal authority regions (National Urban Development Framework Steering Committee, 2009).

The city of Cape Town has also experienced its share of this in-migration and has doubled its population since 1994. The majority of the immigration to Cape Town originates from tribal authority regions in the Eastern Cape and farming areas in the Northern Cape where subsistence farming is the primary economic activity and formal unemployment is high (Kok & Collinson, 2006: 14). Consequently, the city is experiencing an enormous demand for developable rural land to accommodate the high population growth rate. Much of the potential agricultural land within the Cape Town urban edge has already been converted to urban land uses, and the remaining agricultural land within the perimeter of the urban edge is under increasing pressure for conversion to urban land uses (City of Cape Town Metropolitan Municipality, 2010a: 49).

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The city is also experiencing an increasing demand for undeveloped land for agricultural purposes. South Africa has a very high rate of formal unemployment and a low labour absorption rate (Nattrass & Walker, 2005: 500). Government authorities in Cape Town are thus actively promoting urban agriculture as a mechanism to ensure greater food security and employment among the urban poor. The Western Cape region's unique climatic conditions make it an ideal location for intensive cropping. The Western Cape Province produces 20.9% of the national agricultural output and is the leading agricultural region in the country (Statistics South Africa, 2002: 13). Government authorities have therefore prioritised the preservation of agricultural land use in highly fertile areas. However, with competing demands for developable urban land within the urban edge, it is debatable whether both agricultural and urban land uses can be accommodated equally.

This article analyses the competition between urban development and urban agriculture priorities. The consumption of agricultural land within the Cape Town urban edge is analysed to determine whether urban development causes a significant decline in agricultural potential. This is contextualised within the planning systems of the city of Cape Town. The qualitative loss of agricultural land to urban development between 2002 and 2007 is analysed to determine the potential agricultural cost of urban edge relaxation in the future. This is particularly relevant as current urban density growth rates could necessitate the extension of the Cape Town urban edge by 2021, resulting in further consumption of agricultural land (City of Cape Town Metropolitan Municipality, 2010b: 9). Government authorities in the Philippi Horticultural Area have supported the recent urban edge relaxations, and it is reasonable to assume that this trend will continue as densities increase.

2. URBAN AGRICULTURE AS AN INFORMAL ECONOMIC ACTIVITY

Urban agriculture has historically been an essential land-use function of African settlements. Traditional settlements practised horticulture on family plots in close proximity to the settlements while practising pastoral activities further afield (Bundy, 1972: 379). Until the 1950s

most urban settlements were, to a large extent, self-sustaining, with urban agriculture practised as the rule rather than the exception (Swanepoel, 1958: 43). Older settlements were built as close to the road boundary as possible to accommodate the maximum area of land at the rear for agricultural use. This is evident in the lack of adequate road reserves in older suburbs.

During the 1950s the historic tradition of urban farming declined as commercial agriculture and rising urban incomes made urban agriculture, to a large extent, redundant. Decreasing marginal agricultural revenues and the decline of the unit value of agricultural produce also lowered the profitability of small-scale agriculture. The low economic rents achieved in urban agriculture combined with the high opportunity costs of alternative land uses have resulted in the wholesale conversion of agricultural land into other land uses. The implementation of municipal bylaws and property taxation has also de-incentivised agriculture in urban areas (Eberhard, 1989: 67). Subsequently, agriculture has declined to only 1% of the urban food supply in Cape Town (Frayne, Battersby-Lennard, Fincham & Haysom, 2009: 25). The only areas where significant formal agriculture is still being practised within the urban edge are the Constantia farms where alternative land uses are restricted by zoning policies, as indicated in the Cape Town zoning scheme (City of Cape Town Metropolitan Municipality, 2007a).

Contemporary urban agriculture programmes originated in the late-1970s and early-1980s anti-apartheid movements. A number of politically active non-governmental organisations (NGOs) such as the Food Garden Foundation in Gauteng and Abalimi Bezekhaya in Cape Town, focused on recreating self-sustaining communities in the townships by forming grassroots organisations involved in urban agriculture. Unlike historic urban agriculture, contemporary urban agriculture comprises almost exclusively small-scale, informal activities aimed at providing subsistence and supplementary incomes for individuals and families in deprived local communities (Kirkland, 2008: 34).

Informal urban agriculture generally consists of small-scale gardening or animal husbandry, supplementing the subsistence needs of private households (Van Veenhuizen, 2006: 6). Vegetables

are grown on tiny tracts of land ($\pm 50\text{m}^2$) within the boundaries of the residential property or illegally in larger vacant public plots and in nature conservation areas. Chickens, goats and even sheep are kept within the gardens and graze 'illegally' on open land in road reserves or on public land. Illegal farming is a risky endeavour because no property rights can be established and thus no fencing can be erected to prevent theft or scavenging. The majority of impoverished urban farmers are not able to access public land other than by squatting (City of Cape Town Metropolitan Municipality, 2011a: 6). All surplus produce is sold locally but the local marketing potential is limited due to commercial market saturation and low disposable incomes (Kirkland, 2008: 85).

Although economically insignificant due to the low unit value of agricultural produce, informal urban agriculture nonetheless provides substantial income savings to households that spend the largest portion of their income on food (Maxwell, Levin & Csete, 1998: 419). Informal agriculture is relatively inexpensive, requiring few resources (other than land) and requiring little skill. Informal urban agriculture thus forms a food security measure that supplements incomes in periods of instability (Nugent, 2001: 77; Moustier & Danso, 2006: 189). During periods of economic instability, urban agriculture increases spontaneously until the economic and political balance has been restored, whereupon it declines again as a residual activity. The decline is a direct consequence of the high opportunity cost of alternative incomes to urban agriculture.

Recently, increasing food insecurity and the decline of real incomes have led to the popularisation of informal urban agriculture. Urban agriculture was a relatively minor urban planning priority immediately after the apartheid years as the urban agenda focused on redistribution and spatial restructuring. However, recent spikes in food prices in 2002 and 2008 and the high national formal unemployment rate of 47% have led to food insecurity. Currently 80% of Cape Town's population is considered food insecure (Frayne *et al.*, 2009: 13). Because of these declining economic conditions, urban agriculture is currently being promoted as a solution to social problems. Accordingly, both the National Government and the City of Cape Town Municipality have prioritised

urban agriculture as a core thrust in their urban planning interventions.

3. ACCOMMODATING URBAN AGRICULTURE IN PLANNING SYSTEMS IN CAPE TOWN

The main policy document of the Cape Town municipal area is the Urban Agriculture Policy of the City of Cape Town (2007). It formally recognises urban agriculture as an urban land use and creates a legal framework in which land-use rights can be protected and government assistance and intervention can be legitimated. The Cape Town Spatial Development Framework (CTSDF) also plays a crucial role in integrating and aligning the planning priorities and principles of the various spheres of government spatially, thus ensuring the protection of agricultural land uses in specific areas.

The Cape Town Urban Agriculture Policy is an important document because it formalises urban agriculture as a legitimate urban land-use function, and assigns rights to urban producers which otherwise would have prohibited urban agriculture (City of Cape Town Metropolitan Municipality, 2007b: 2). It also prescribes the responsibilities of government in protecting, facilitating and assisting urban agriculture initiatives. The policy aims to promote household food security and economic development among the poorest communities in the city. It prescribes the release of land through market sales, contractual leasing and the development of commonages. The policy also specifies the types of agriculture permitted within urban areas. Livestock is specifically prohibited but the policy specifies the creation of agricultural commonages outside urban areas for grazing purposes, which would eventually be integrated into the land reform programme. The Urban Agriculture Policy details the types of assistance available to urban farmers and the criteria for qualification of assistance, with collectives receiving the most assistance and subsistence farmers and small commercial farmers receiving decreasing amounts of aid, respectively.

The limitation of this document is that the Urban Agriculture Policy focuses on implementing costly initiatives such as surveys, research, environmental guidelines, agricultural consultative forums, land release procedures, and impact assessment mechanisms which compete for limited resources with

agricultural assistance programmes. Furthermore, the policy prescribes that the legal interaction between parties should occur according to contracts, business plans and formal legal entities. This interaction contradicts the extra-legal nature of informal urban agriculture, which is only economically feasible due to its extra-legal nature.

The CTSDF provides the spatial framework in which agriculture is practised as an integral function of municipal land-use systems (City of Cape Town Metropolitan Municipality, 2010a: 9). The CTSDF reserves high potential and unique agricultural land beyond the urban edge exclusively for agricultural purposes to ensure food security. The CTSDF uses the urban edge to concentrate formal urban development within a fixed urban boundary by severely restricting development beyond the urban edge. The urban edge limits the value of peripheral agricultural land, thereby preventing investors from speculating in developable agricultural land. The urban edge is also used as a policy instrument to promote urban densification and to direct development to appropriate locations. However, the urban edge is not an indefinite barrier to urban growth as the densification policy is limited to average densities of 25 units per

hectare. The viability and practicality of the proposed metropolitan urban edge has only been estimated to be sufficient to accommodate development needs up to the year 2021. At historic urban growth rates, it was estimated that an additional 650 ha of land per annum would be needed to accommodate the demand for urban land after 2021 (City of Cape Town Metropolitan Municipality, 2010b: 8).

The CTSDF protects high-potential agricultural land along the periphery of the urban edge (Figure 1). High-potential and unique agricultural areas have been designated outside the urban edge. These include Tygerberg Hills/Philadelphia, Joostenbergvlakte, Bottelary and Blackheath, Boffontein, Helderberg, Macassar and Faure, Philippi, and Constantia. All these areas are designated as 'Intensive Agriculture' on the CTSDF and are therefore statutorily protected according to higher level policies, including the National Policy on the Protection of High Potential and Unique Agricultural Land and the Western Cape Provincial Spatial Development Framework (City of Cape Town Metropolitan Municipality, 2010a: 49).

The CTSDF provides a theoretical framework in which various types of agricultural land uses are permitted

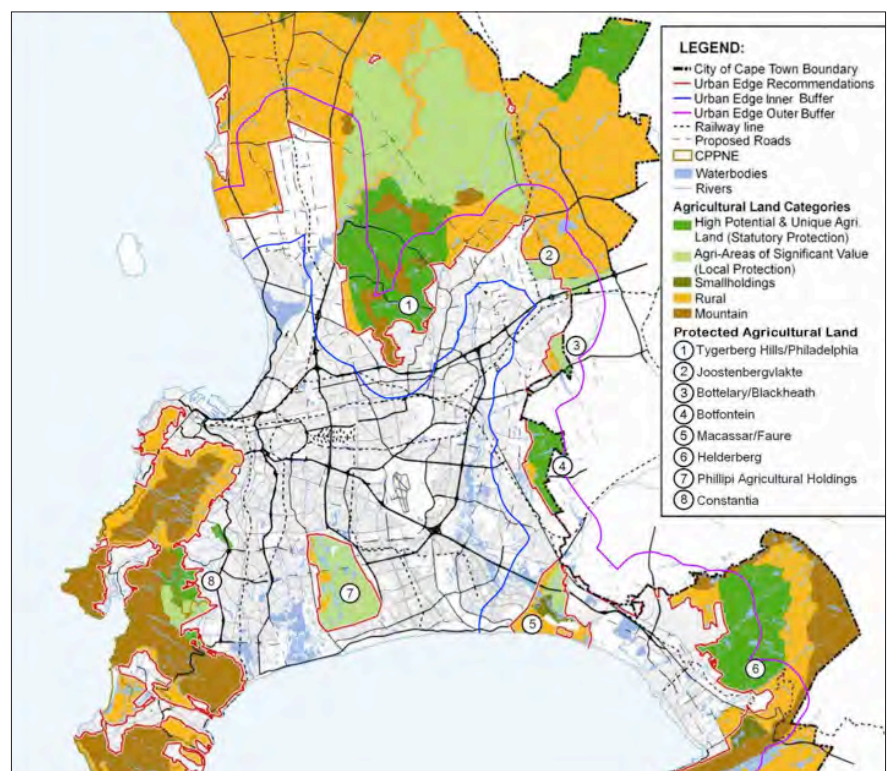


Figure 1: Agricultural areas protected by the Cape Town Spatial Development Framework (Adapted from City of Cape Town Metropolitan Municipality, 2010a: 48)

within urban areas. In principle, it promotes urban agriculture, particularly in areas where it can provide employment and additional income in deprived communities (City of Cape Town Metropolitan Municipality, 2010a: 47). All agricultural activities within urban areas are permitted, except for animal husbandry activities. However, the CTSDF has limited applicability to urban agriculture because it does not specifically designate spatial areas exclusively for urban agriculture within the urban edge. Therefore, although legitimated, urban agriculture has to compete with other more profitable land uses such as residential and commercial development. Furthermore, because the CTSDF is only concerned with the management of land-use rights regionally, it is not applicable to most urban agricultural activities which are extra-legal in nature.

The current IDP does not specifically promote urban agriculture as a key policy directive, although the 2011/2012 IDP review briefly refers to urban agriculture as a secondary objective in its economic development directive (City of Cape Town Metropolitan Municipality, 2011b: 48). Municipal policies support urban agriculture in general by providing a legal framework for the protection and assistance of urban agriculture as a legitimate urban land use. However, municipal policies create a restrictive legal framework in which informal urban agriculture must operate. This is not conducive to the promotion of informal and extra-legal agricultural activities. Furthermore, the municipal policy framework does not spatially plan for urban agriculture in its plans and frameworks, but only promotes formal urban agriculture in principle. Thus urban agriculture is not protected as a land use, and has to compete with more profitable land uses.

4. THE CONFLICT BETWEEN URBAN PLANNING AND INFORMAL URBAN AGRICULTURE IN CAPE TOWN

The agricultural function of food systems has historically been marginalised by planning theory as a separate rural feature. Orthodox planning ideology traditionally regarded food systems as an exogenous function unrelated to planning processes (Drescher, 2000: 23). However, recent food crises in the developing world necessitate that food systems be integrated into the planning

systems of cities. This also requires that agricultural functions be integrated into urban morphology with certain areas reserved for intensive agricultural production (Mubvami & Mushamba, 2006: 56).

Urban agriculture and urban planning have long been at odds. Just as the division between urban and rural has been institutionalised, so has the separation between agriculture and urban land uses (Binns & Lynch, 1998: 777). This tradition has its roots in the Victorian-era municipal reforms in which agriculture was prohibited in cities for health reasons (Mougeot, 1994: 5). This dichotomous tradition has been entrenched in planning mechanisms and has been adopted extensively in the developing world (Smit & Bailkey, 2006: 147). The result is that urban agriculture has often been supported in theory and suppressed in practice (Kirkland, 2008: 34).

Unless practised according to highly specialised techniques, agriculture is a polluting industry, resulting in environmental pollution and negative health effects (Mwaniki, 2006: 4; Kirkland, 2008: 32). The inherent health risks of practising urban agriculture still remain a strong motivation against the practice (Lewcock, 1995: 229). Crops can easily be affected by harmful pathogens, heavy metals and synthetic chemicals in untreated waste water, air and soil (De Bon, Parrot & Moustier, 2010: 25). It is very difficult to regulate the use of chemical pesticides and fertilisers in production as most of the production is not bound for regulated markets. Livestock can also transmit diseases and attract pests such as rats and fleas in addition to creating unpleasant smells and noises (Van Veenhuizen, 2006: 5). Livestock are often grazed on open stands and road reserves, creating safety risks for passing motorists.

It is doubtful whether urban agriculture can contribute to the local economy and whether commercial agriculture is the model on which urban agriculture programmes should be based (Mudhara, 2010: 6). A study by the City of Cape Town in 1989 determined that the potential economic value of household garden production was less than 1% of a household budget at subsistence level (Eberhard, 1989: 3). Among the approximately 3,000 urban farmers supported by Cape Town NGOs such as Abalimi Bezekhaya and the 300 urban farmers supported by the

City of Cape Town's Urban Agricultural Assistance Programme have not yet emerged as independent commercial farmers and only a few farmers are able to subsist without external support (Small, 2009). In addition, the financial feasibility of urban agriculture is not very strong. The general cost of subsidising urban farmers averages approximately R1,000 per annum, yet the revenues of commercial urban agriculture are very low. Urban farmers of the Harvest of Hope project, the most successful commercial urban agriculture programme in Cape Town, only acquired a net profit of approximately R90 per capita per month (De Satgé & William, 2008: 14).

There are often disagreements between the local authorities who strictly apply local municipal by-laws, restrictions and bureaucratic procedures to regulate urban agriculture and urban farmers who farm illegally in order to survive (Kilbey, 2008: online). There are also disagreements between urban farmers and urban planners over the allocation of public resources. Urban agriculture commands an unequal share of scarce public resources such as land, labour, water and physical infrastructure, and therefore directly competes with public resource demands for other urban land uses (Von Braun, McComb, Fred-Mensah & Pandya-Lorch, 1993: 23). A good example of the recent conflicts between urban farmers and municipal officials is one particular disagreement regarding the type of urban agriculture that should be practised on a particularly large open site. Urban farmers are currently cultivating vegetables illegally on the site, but the city planners want to develop the site for collective husbandry activities (City of Cape Town Metropolitan Municipality, 2011a: 20). The municipality has identified the site as the only site suitable for urban animal husbandry in close proximity to low-income residential areas, because Cape Town municipal systems do not permit animal husbandry and grazing within residential areas for health and safety reasons (City of Cape Town Metropolitan Municipality, 2010a: 49). City officials do not want to confiscate the urban farmers' animals and have identified the site as a suitable location for the construction of a large stock enclosure. Unfortunately, the site has insufficient grazing capacity and is separated from residential areas. The animal owners therefore are unwilling to bear the risk of theft and the cost of feeding animals at a remote site.

All three parties are unsatisfied about the arrangement and see no mutually acceptable solution in the future.

The barriers between urban land use and agriculture have recently started to dissolve since the adoption of the Cape Town Urban Agriculture Policy. Planning authorities are starting to prioritise public interest in better public nutrition, additional household income and food security by integrating agriculture with other urban land uses (Purushothaman, Brook & Purohit, 2004: 59). Officially, governments have also started to integrate urban agriculture into urban planning systems as a legitimate urban land use. Planning policy instruments are also being modified to accommodate agricultural functions on land with high alternative opportunity costs using facilitative planning instruments such as zoning (Mubvami & Mushamba, 2006: 60). However, the extra-legal nature of informal urban agriculture, the inequitable share of scarce public resources commanded by urban farmers, and the low economic value of urban agriculture still present significant challenges that cannot be overcome by reforming planning systems.

5. THE AGRICULTURAL POTENTIAL OF UNDEVELOPED LAND WITHIN THE CAPE TOWN URBAN EDGE

Determining the agricultural potential of land is based on the relationship between land qualities and agricultural inputs. The terroir qualities of the land include its climate, soil type, sloping, vegetation type and cover, proximity to markets and the size of the farm. However, agricultural potential is also secondarily determined by the scale of external inputs such as management skills, labour, machinery, fertiliser and irrigation. Superior agricultural management processes could lead to improved output on any given agricultural unit if the correct spatial location between agricultural units and urban markets is present (Peet, 1969: 287). Agricultural potential is an expression of the internal attributes combined with the necessary external inputs required for agricultural production (MacVicar, 1974: 1).

Agricultural potential is usually determined using proxy historical values such as production, volume or the net turnover per area measured over a period of time. In the absence of quality historical data, and given that land with low-quality attributes requires a high level of external inputs, the agricultural

potential of a region can be expressed in anecdotal terms (e.g. high, medium, or low) relative to other agricultural properties with similar attributes. External inputs are highly variable over time whereas land attributes rarely change significantly over time. Given that higher levels of external inputs are needed to produce a given level of agricultural productivity on marginal land, and that these external inputs are costly and thus lower the profitability of agriculture, agricultural potential is primarily determined by land attributes, *ceteris paribus* (Soil Classification Working Group, 1991).

To this end, the soil suitability map of the greater Cape Town Metropolitan area (Figure 2) was compiled from various soil surveys undertaken. A new soil legend based on the 1991 Soil Classification System was used to integrate all previous soil information into a new database (Soil Classification Working Group, 1991). All the different map units occurring on the soil map represent soils with more or less the same characteristics. The soil map in Figure 2 also shows the urban edge of Cape Town in red and the extent of urban development in 1988 as grey. For purposes of analysis a buffer zone of 2.5 km on either side of the edge was delineated. This area received special attention in the soil analysis in the study. The outside buffer is used to measure areas for potential future expansion, while the inside buffer is used to measure the effect of urban development on the periphery between 2001 and 2007.

The properties used to determine the attributes of the land include the

texture of the soil, its structure, chemical composition, mineralogical composition, parent material, depth, slope, and drainage. These were rated by local expert soil scientists on a scale of 1 to 10 to indicate their suitability for perennial crops (vines and fruit trees). To simplify the grouping of soil map units, five main suitability classes with their ratings were created, namely low (0,1-3,5), medium-low (3,51-3,9), medium (4-4,9), medium-high (5-5,9) and high (>6). The five main suitability classes were compiled into an ordinal scale from 1 to 5, with 1 indicating highly unsuitable land, 2 to 4 indicating potentially suitable land, and 5 indicating prime agricultural land. Soil with a low suitability class of between 0.1 and 3.5 is regarded as unsuitable for commercial agriculture. Soil with a medium suitability class of between 3.5 and 6 is regarded as potentially suitable for commercial agriculture and requires appropriate feasibility studies. Soil with the high suitability class greater than six is regarded as land that should be exclusively reserved for agricultural purposes.

The soil potential of undeveloped land located within a distance of 2.5 km inside the urban edge is reflected in Figure 3. Figure 3 indicates that 34.1% of the land is unsuitable for commercial agriculture, whereas 60.7% of the land consists of soils which have potential agricultural value and should not be developed without appropriate feasibility studies. Only 5.2% of the land is classified as high-potential agricultural land that should not be developed under any circumstances.

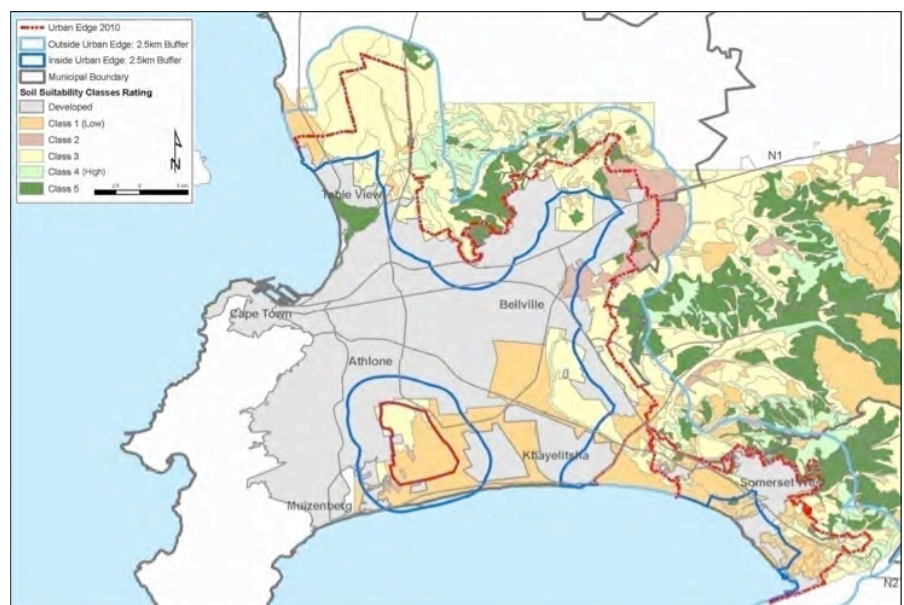


Figure 2: The agricultural potential of land within the city of Cape Town Metropolitan area

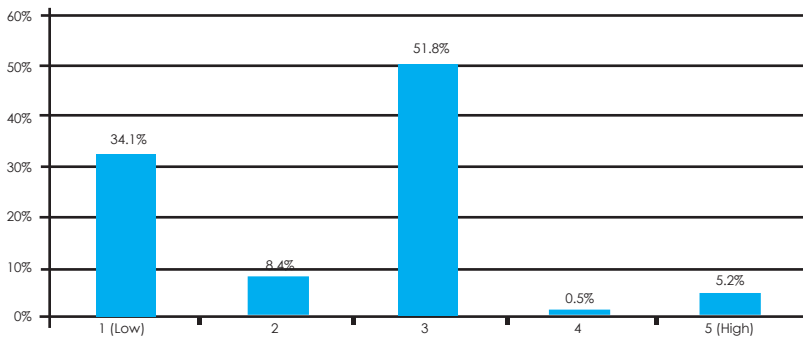


Figure 3: Soil potential within 2.5km of the urban edge of Cape Town

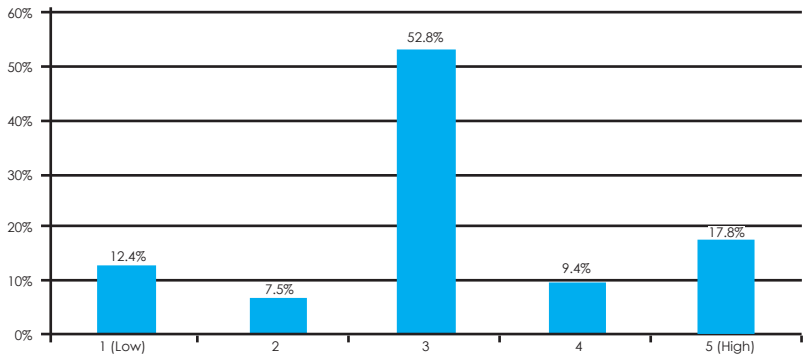


Figure 4: Soil potential within 2.5km outside of the urban edge in Cape Town

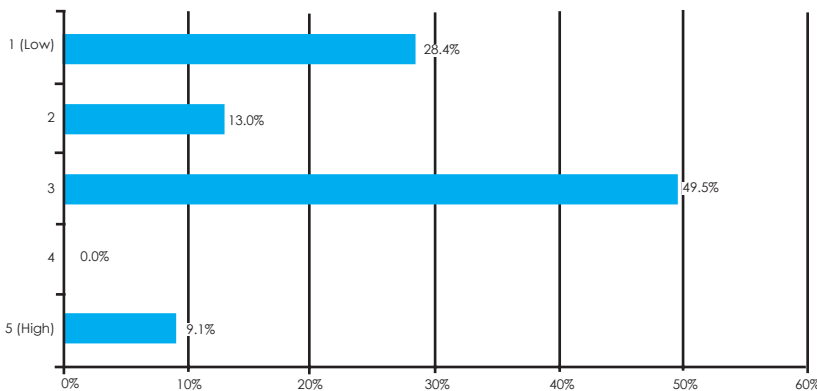


Figure 5: The qualitative consumption of agricultural land within 2.5km of the urban edge in Cape Town between 2002 and 2007

The analysis of Figure 4 indicates that of the 32,949 ha of land is located within the 2.5 km buffer outside the urban edge, only 12.4% of the land outside the urban edge is unsuitable for agriculture. Most of the land (69.7%) outside the urban edge has potential agricultural value and should not be developed without appropriate feasibility studies. A large percentage of the land (17.8%) is high-potential agricultural land and should not be developed under any circumstances.

Figure 5 shows the total consumption of undeveloped land for urban land uses between 2002 and 2007. The analysis indicates that 3,533 ha of the total consumption of undeveloped land was developed between 2002 and 2007, and 47.9% or 1,693 ha of that amount

was developed within the 2.5 km buffer around the urban edge. Of the total urban development, 28.4% or 1,003 ha took place on land unsuitable for agriculture. Much of the development took place on land which potentially had agricultural value (62.5% or 2,208 ha) and 9.1% or 322 ha of urban development took place on high-quality agricultural land that could have been preserved for agricultural use.

The loss of agricultural land to development cannot be underestimated. High-potential agricultural land was developed at a faster rate than lower potential agricultural land. 9.1% of the developed land consisted of high-potential agricultural land (Class 5), even though high-potential agricultural land only consisted of 5.2% of the total

land available within the 2.5 km buffer within the urban edge. Comparatively 49.5% of the land developed consisted of medium-potential agricultural land (Class 3), which consisted of 51.2% of the total developable land within the 2.5 km buffer within the urban edge. Agricultural land of little or no potential (Class 1) only consisted of 28.4% of the total land developed even though it consisted of 34.1% of the total developable land within 2.5 km buffer within the urban edge. Therefore, high-potential agricultural land (Class 5) was developed at a rate of 83.1% higher than medium-potential agricultural land (Class 3) and at the rate of 110.1% higher than low-potential agricultural land.

6. THE IMPACT OF URBAN DEVELOPMENT ON UNDEVELOPED AGRICULTURAL LAND

The new urban development distribution is based on the GeoTerraImage spatial dataset which measures the distribution of land uses in Cape Town in 2002 and 2007. The basic dataset consists of spatial data captured using ortho-rectified aerial photography and high-resolution satellite images. These images were converted into vector-based polygons and linked into multiple land-use categories. The associated attribute information was sourced from municipal land-use data and supplemented with fieldwork to verify certain classes.

The results portrayed in this section were aggregated into a more generalised set of thematic maps indicating specific land-use categories. Land-use categories were determined using neighbourhood statistical techniques to establish the focal mean of different land uses. Uniform non-overlapping neighbourhoods were bounded into singular land-use classes according to the spatial characteristics. The analysis specifically targeted residential, commercial and industrial components which represent the main space-consuming elements of the urban structure. The housing classifications do not necessarily reflect the legal status of the various housing categories in terms of planning and other statutory processes, but rather the spatial characteristics of settlement patterns as captured by remote sensing. This is especially true in the case of informal housing and formalised informal townships. The barriers between

low-density housing and high-density housing are similarly spatially defined. The general classifications of land uses include the following categories:

- Low-density formal housing: formal single-unit structures on individual stands.
- High-density formal housing: formal housing on shared stands including cluster housing, hostels and multi-storey flats.
- Informal housing: housing structures which do not conform to formal housing regulations or settlements which are in the process of formalisation after residential occupation.
- Industrial development: secondary sector economic activities.
- Commercial development: tertiary sector economic activities.

The analysis of the spatial distribution of the various housing types between 2002 and 2007 reveals a number of very distinctive spatial trends between different land-use categories. Low-density formal housing (Figure 6) has historically predominated in the southern suburbs of Cape Town, particularly Athlone, Rondebosch, Houtbay, Cape Town and Kommetjie/Fishhoek, and in the older northern suburbs of Parow, Bellville, and Brackenfell and Tableview (2002 inset map in Figure 6). Other historic concentrations include Mitchells Plain and Somerset West. New low-density housing developments since 2002 (primary map in Figure 6) are sparse in established areas. The majority of new formal housing developments are concentrated along the periphery of the urban edge. The peripheral areas under development include Melkbosstrand, Tableview, Durbanville, Brackenfell South and Strand. A significant portion of low-density formal housing has developed in central locations through government-sponsored public housing programmes, including Delft, Mitchells Plain and Khayelitsha. However, government-sponsored public housing has also been developed in peripheral locations such as Brackenfell South, Strand and Maccassar.

High-density formal housing has historically been developed in peripheral locations with strong concentrations in Tableview, Durbanville, Somerset West and Strand (2002 inset map in Figure 7). Smaller historic concentrations are also found in more centrally located areas such as Rondebosch, Cape Town, Hout Bay, and Fishhoek. Note that these

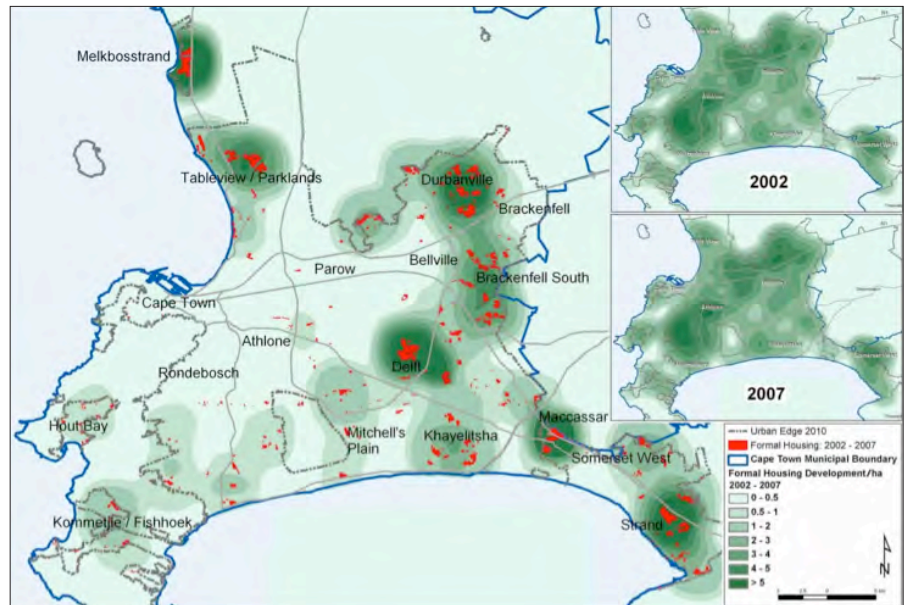


Figure 6: The spatial distribution of new low-density housing development in Cape Town between 2002 and 2007

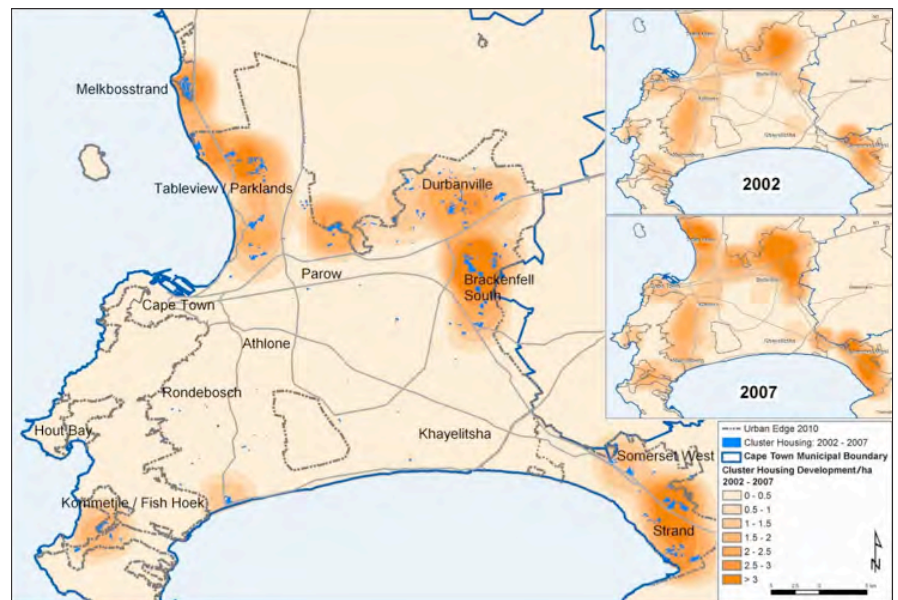


Figure 7: The spatial distribution of new high-density housing development in Cape Town between 2002 and 2007

maps indicate coverage and not population density. New high-density housing developments, (primary map in Figure 7), are concentrated almost exclusively along the periphery of the urban edge in areas such as Melkbosstrand, Tableview, Parow, Durbanville, Brackenfell South and Strand.

Informal housing was historically concentrated close to existing low-income suburbs of the city such as Khayelitsha, the Gugulethu/Nyanga/Crossroads area, Lwandle and Wallacedene (2002 inset map in Figure 8). Some newer informal housing settlements are developing close to centrally located government-sponsored public housing developments such as Khayelitsha, and

Mfuleni (primary map in Figure 8). Many newer informal settlements are developing in peripheral locations close to new industrial and commercial developments. Note the proximity between informal settlements in Figure 8 and their respective industrial locations in Figure 9, including Dunoon and Milnerton, Wallacedene and Brackenfell, Mfuleni and Kuilsrivier, Gugulethu and Parow, Lwandle and Strand, Vrygrond and Muizenberg. This indicates that informal housing development follows formal urban development trends because informal housing populations are economically dependent on urban economic growth. It is also noticeable that informal settlements tend to be located closer to the periphery while

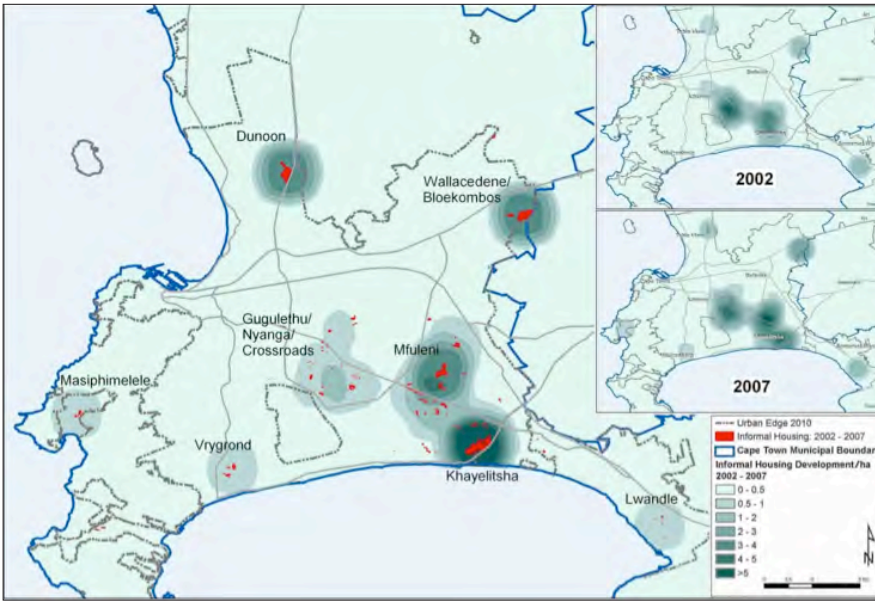


Figure 8: The spatial distribution of new informal settlements in Cape Town between 2002 and 2007

industrial developments are located closer to the centre.

Industrial development has historically concentrated in the northern suburbs of Milneron, Parow and Bellville, with other significant concentrations in Cape Town and Somerset West (2002 inset map in Figure 9). Early industrial development patterns of Cape Town were strongly influenced by road and railway networks. Newer industrial development has not altered these concentrations significantly (2007 inset map in Figure 9). New industrial developments (primary map in Figure 9) have been established

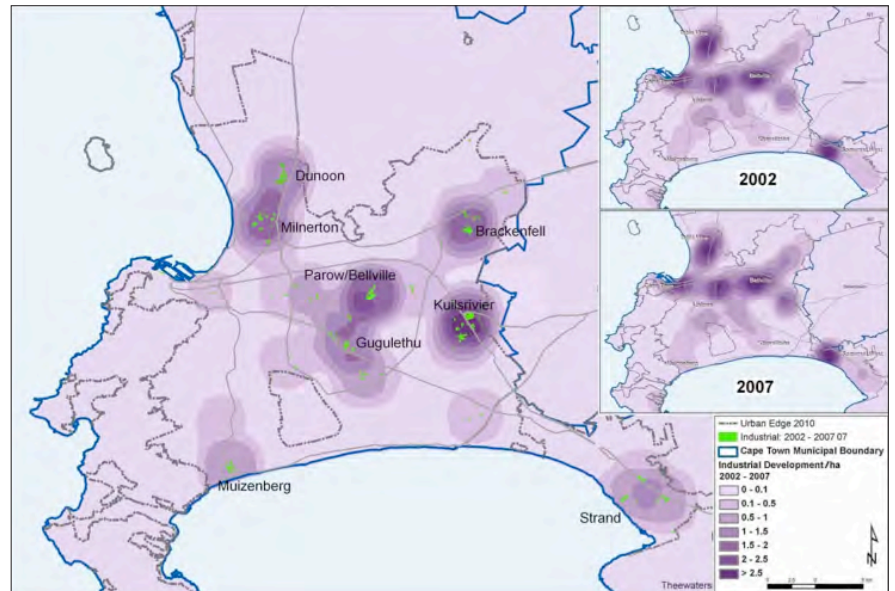


Figure 9: The spatial distribution of new industrial development in Cape Town between 2002 and 2007

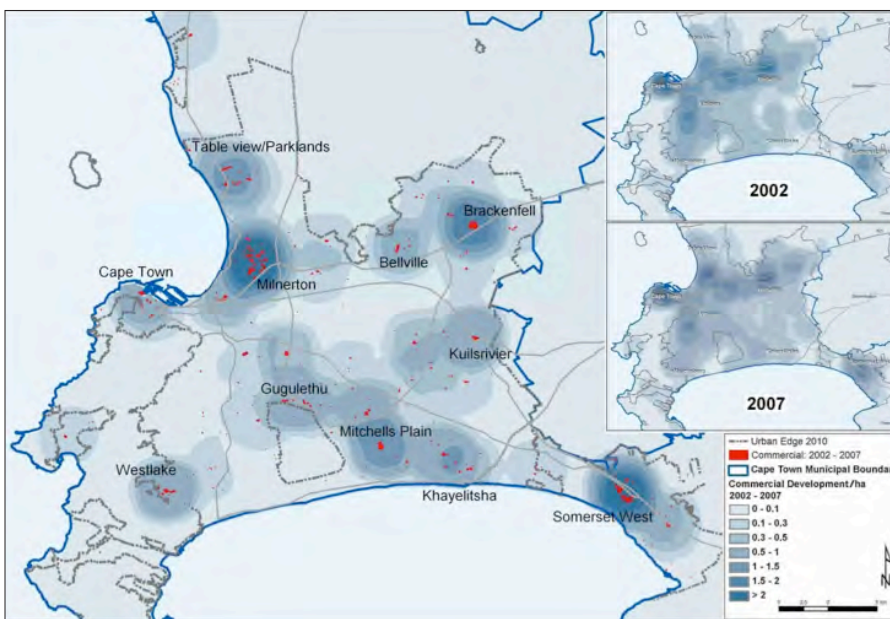


Figure 10: The spatial distribution of new commercial development in Cape Town between 2002 and 2007

in peripheral areas such as Brackenfell, Rustdal and Strand, but these represent a minority of recent industrial development. Industrial concentrations are also generally located along regional road networks, as the proximity to road and rail networks is the primary determinant of location. Industrial development along the periphery is, therefore, limited by its dependence on transportation infrastructure and does not threaten the large-scale consumption of agricultural land.

Similarly, commercial development has historically concentrated in central locations such as Cape Town, Milneron, Parow, Bellville, Brackenfell, and Somerset West (2002 inset map in Figure 10). The spatial distribution of commercial activities was historically

developed along main transportation networks. New commercial developments between 2002 and 2007 generally maintain the status quo, as indicated in the inset maps in Figure 10. Newer commercial developments (primary map in Figure 10) show some patterns of decentralisation giving rise to a polycentric city structure. Although much smaller in extent, new nodes are also emerging in peripheral locations such as Brackenfell and Kulsrivier. However, the location and extent of these new commercial development nodes appear to be strongly influenced by accessibility to major transportation networks and, therefore, the future impact of commercial development

on agricultural activities appears to be relatively limited.

able land remains (City of Cape Town Metropolitan Municipality, 2010b: 8).

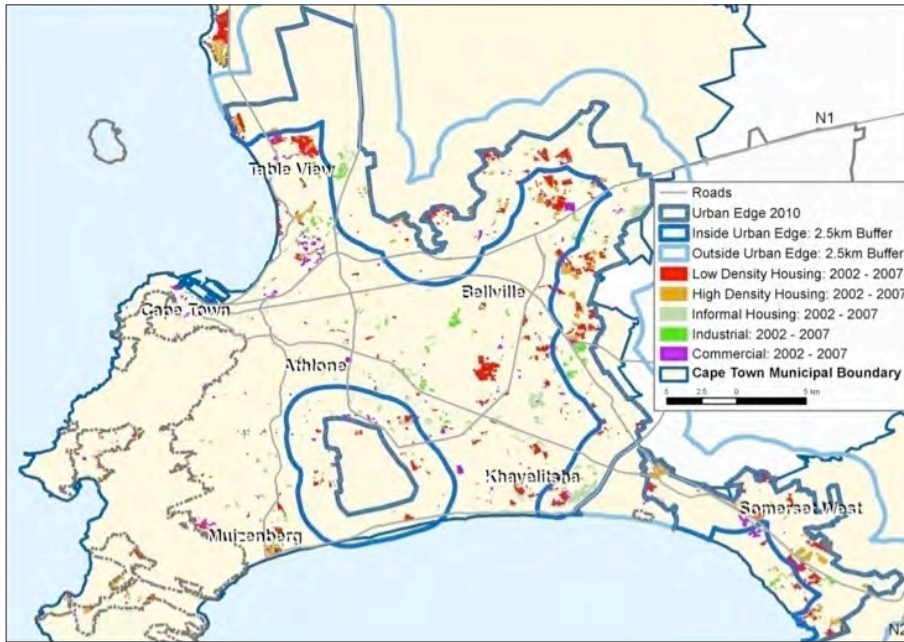


Figure 11: The spatial distribution of urban development in Cape Town between 2002 and 2007

Figure 11 gives a spatial representation of the extent and distribution of various types of urban development in Cape Town between 2002 and 2007. The 2.5km buffers within and outside the urban edge are clearly indicated with solid blue lines. The map indicates a significant degree of new residential development towards the urban edge and the marked centralisation of new commercial and industrial development. Research indicates that the total extent of new residential, commercial and industrial development on undeveloped agricultural land within the Cape Town urban edge between 2002 and 2007 was approximately 3,533 ha. This amount is somewhat higher than the 2,947 ha urban growth figure indicated in the City of Cape Town land assessment data (City of Cape Town Metropolitan Municipality, 2010b: 8). Research indicates an average growth of 707 ha per annum between 2002 and 2007, which is somewhat higher than the 650 ha per annum growth rate estimated between 1996 and 2007 in the CTSDf (City of Cape Town Metropolitan Municipality, 2007b: 14). According to recent land assessments performed by the City of Cape Town, as of 2007 approximately 38,123 ha of land has been developed within the urban edge and only between 9,827 ha and 11,432 ha potentially develop-

residential development, accounting for 63.4% of the total urban growth in the city, with low-density housing accounting for 40.1% and high-density housing accounting for 23.3% of this total. New informal housing settlements consisted of a further 13.8% of the total urban growth. Commercial and industrial growth together comprised only 22.8% of the total amount of urban development within the urban edge. Commercial and industrial development comprised 11.9% and 10.9% of the total urban growth between 2002 and 2007, respectively.

Figure 13 indicates the distribution of new development between different land uses within 2.5km of the urban edge in Cape Town between 2002 and 2007. Of the total urban growth within the 2.5km buffer, 68.4% was formal residential development with low-density housing development consisting of 38.6% and high-density housing development consisting of 29.8% of the total land use. New informal settlements consisted of a further 16.6% of the total urban growth in the periphery. Commercial and industrial development together consisted of only 15.1% of the urban growth along the urban edge.

Figure 12 indicates the distribution of new urban development between land-use categories within the urban edge between 2002 and 2007. The bulk of the urban growth consisted of formal

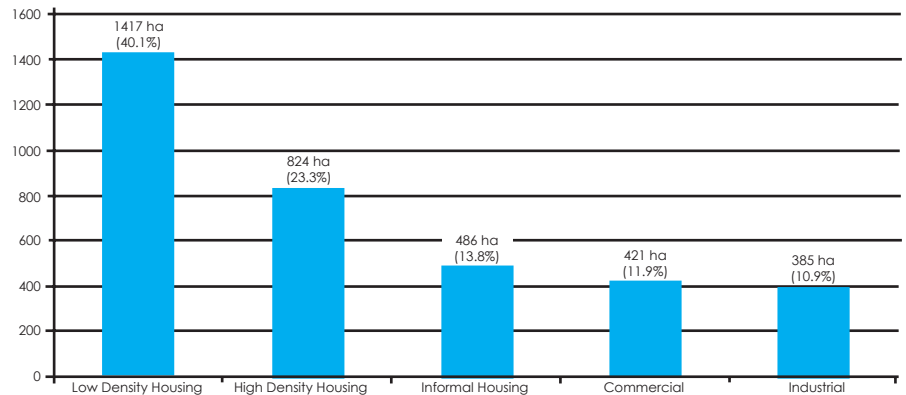


Figure 12: The distribution of new development between different land uses in Cape Town between 2002 and 2007

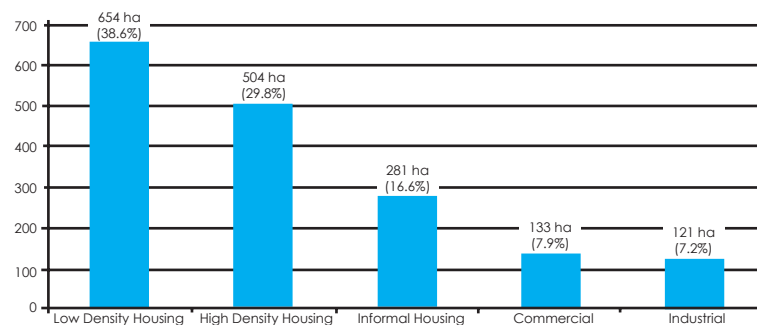


Figure 13: The distribution of new development between different land uses within 2.5km of the urban edge in Cape Town between 2002 and 2007

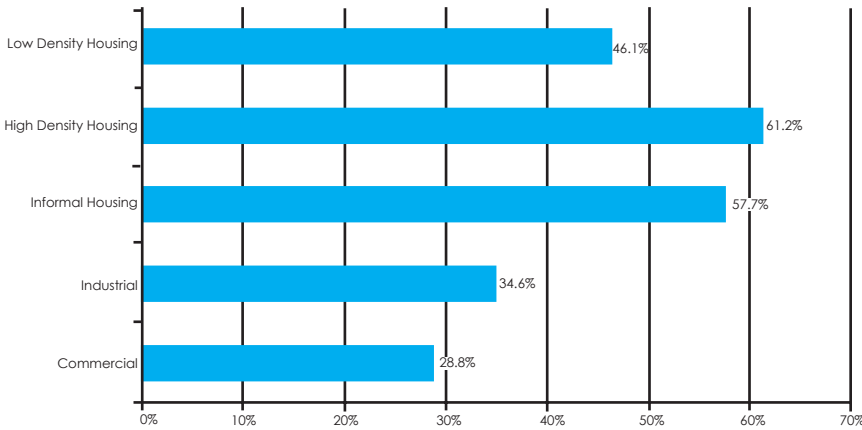


Figure 14: The probability of urban development within 2.5km of the urban edge in Cape Town per land use category between 2002 and 2007

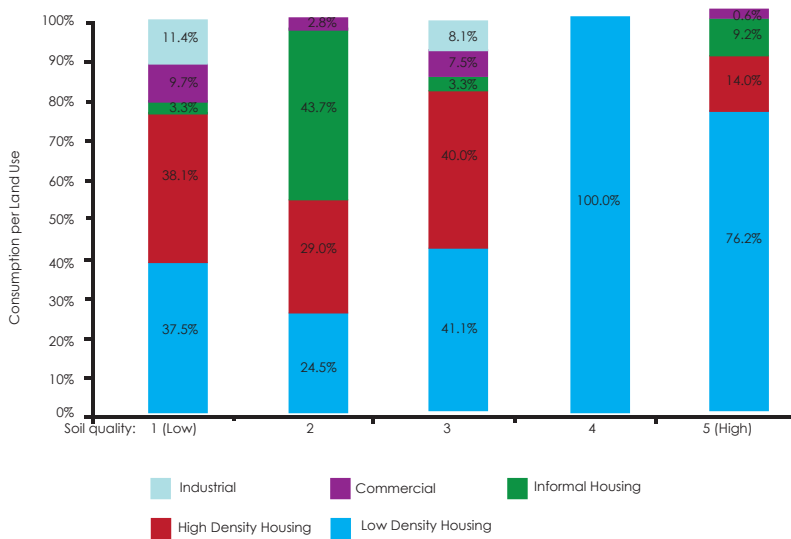


Figure 15: The impact of urban development on the loss of agricultural potential within 2.5km of the urban edge in Cape Town between 2002 and 2007

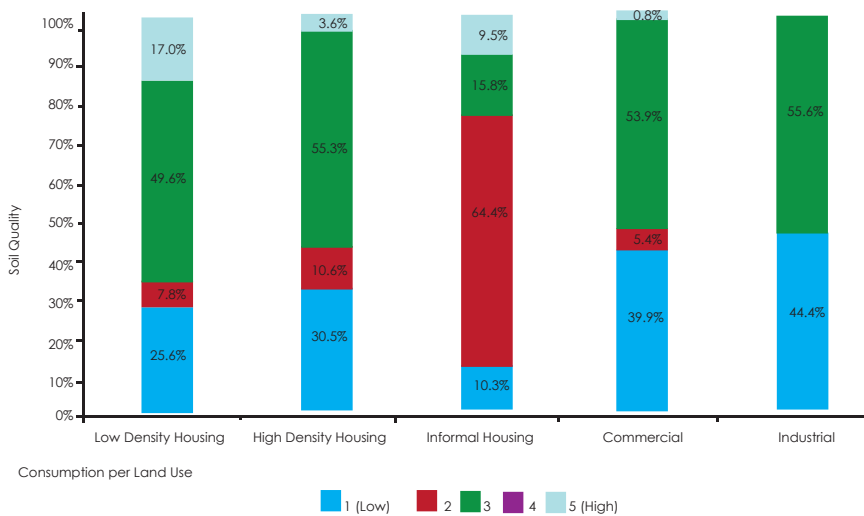


Figure 16: The consumption of agricultural land potential classes within different land-use categories between 2002 and 2007 within 2.5km of the urban edge in Cape Town

Figure 14 depicts the probability of urban development per land use within 2.5km of the urban edge. This indicates the probability that a certain land use will be developed within 2.5km of the urban edge. At 61.2%, high-density housing development is most likely to be developed along the periphery, with new informal settlements and low-density housing development at 46.1% and 57.7%, respectively, very likely to be developed close to the urban edge. The comparative figures for industrial and commercial development are 34.6% and 28.8%, respectively, indicating that commercial and industrial development is least likely to be developed in the urban edge. At an aggregated level, it is probable that 47.9% of total development, 52.8% of residential development and 31.6% of commercial and industrial development is likely to be developed within 2.5 km from the urban edge.

Figure 15 reflects the impact of urban development on the loss of agricultural potential within 2.5km of the Cape Town urban edge between 2002 and 2007. The X axis indicates soil of different agricultural potential classes as mapped in Figure 2. The Y axis indicates the percentage of land consumed by the various land uses within each agricultural potential class. Note that Figure 15 does not indicate how much agricultural land was consumed (as indicated in Figure 5) but which land-use categories consumed the developed land. Figure 15 indicates that the major consumer of high-potential agricultural land was low-density housing development. A total of 76% of the high-potential (Class 5) agricultural land and all medium- to high-potential (Class 4) agricultural land was consumed by low-density housing. Of the high-potential agricultural land (Class 5) consumed by urban development within this period, 99.4% of this class was consumed by residential development, and 90.2% of this land was lost to formal residential development. Medium-potential agricultural land (Class 3), the most common agricultural potential class, is also predominantly consumed by formal residential development (81.1%). With soils of low agricultural potential (Class 1), the consumption of agricultural land for new land-use developments within 2.5km of the urban edge correlates closely to the status quo in Figure 13.

Figure 15 is transposed in Figure 16 to reflect the consumption of land within agricultural potential classes by different land-use categories between 2002 and

2007 within 2.5km of the urban edge in Cape Town. The X axis indicates different land-use categories. The Y axis indicates the percentage of agricultural potential classes consumed by the various land-use categories. A large portion of low-density housing is developed on high-potential agricultural land (17%) and a further 49.6% was developed on medium-potential soils. Very little low-density housing is developed on low-quality (Classes 1 and 2) agricultural land (35.4%) relative to other land uses. The majority of high-density housing development was developed on medium-potential soils (55.2 per cent) and low- or low to medium-potential soils (30.5% and 10.6%, respectively). Only 3.6 per cent of high-density housing development took place on high-potential soils. Informal housing mostly occurred on low- and medium to low- (Classes 1 and 2) potential land (74.7%), although a notable proportion (9.5%) of informal housing has also developed on high-potential soils. Commercial and industrial development within the buffer area had virtually no impact on high-potential soils, although the majority of the development took place on medium-potential soils (53.9% and 55.6%, respectively).

7. CONCLUSIONS

The research analysed the consumption of undeveloped land within the urban edge between 2002 and 2007 to determine whether urban development causes the significant decline of the agricultural potential of the city of Cape Town. The significance of this research is relevant because the success of urban agricultural programmes is dependent on the availability of high-potential agricultural land. The preservation of agricultural land is essential for food security and economic development through urban agriculture. Urban agriculture is being promoted through policies to supplement diets and income and to provide employment for the urban poor. Most urban agriculture is practised informally and in the absence of a legal framework of land-use rights. Although urban agriculture has been legitimised through the implementation of policies and planning systems, the extra-legal nature of informal urban agriculture prohibits its establishment. Furthermore, the planning systems do not spatially plan for urban agriculture or reserve high-potential agricultural land for urban agriculture. Therefore, urban agriculture has to compete with

other more profitable urban land uses for land. While agricultural land outside the urban edge is exclusively reserved for agricultural purposes and thus protected from speculation, agricultural land use within the urban edge is not protected. The limited economic incentive, the restrictive legal environment and the limited spatial reservation of urban agriculture is evident in the loss of high-potential agricultural land to urban development.

The potential loss of high-potential agricultural land within the urban edge is relatively low, with only 5% of the land classified as high-potential agricultural land, 51% of the land classified as medium-potential agricultural land, and over 34% of the land classified as unsuitable for agriculture. However, beyond the urban edge the agricultural potential of the land drastically increases, with 18% of the land classified as high-potential agricultural land and only 12% of the land classified as unsuitable for urban agriculture. It is imperative that high-potential agricultural land be statutorily protected within and outside the urban edge, but that an intelligent relaxing of the urban edge is necessary to allow the consumption of low-potential agricultural land outside the urban edge. It is imperative that medium-potential agricultural land should not be developed without appropriate feasibility studies. This will become increasingly important as the amount of developable land within the urban edge is expected to be exhausted by 2021. Strict urban edge policy will no longer suffice but should be replaced with a flexible qualitative zoning.

The loss of agricultural land to development cannot be underestimated. Of the total land developed along the urban edge high-potential agricultural land (Class 5) was consumed at a rate of 83% faster than medium-potential agricultural land (Class 3) and 110% faster than low-potential soil (Class 1). The greatest amount of high-potential agricultural land is lost to low-density residential development. Housing consumed almost 85% of the developed land between 2002 and 2007, with almost 40% consumed by low-density housing. Low-density housing is also the dominant consumer of high-potential agricultural land, with over 76% of high-potential agricultural land within the urban edge lost to low-density residential developments. Therefore, urban agriculture policies should focus on identifying high-potential agricultural

land and restricting residential development on agricultural land, to enable the preservation of high-potential agricultural land.

The research indicated that commercial and industrial development poses little threat to the loss of agricultural potential due to its dependence on the location of essential infrastructure. The losses of potential agricultural land to commercial and industrial development are insignificant compared to residential development figures. The research indicated that informal settlement development, which is extra-legal and cannot be planned, is spatially incidental to commercial, industrial, and public housing development. Informal settlements consume a significant percentage of high-potential agricultural land, but the impact of informal settlements on the loss of potential agricultural land can be contained by locating commercial, industrial and public housing development far from high-potential agricultural land, and reserving open land surrounding these developments for informal settlements.

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