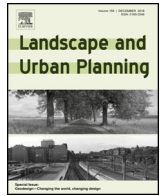




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# How important is green infrastructure in small and medium-sized towns? Lessons from South Africa

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### HIGHLIGHTS

- Most greens spaces and GI are under private tenure.
- There are spatial inequities in the distribution of GI within towns.
- There are multiple consumptive and non-consumptive uses of GI.
- Urban residents are willing to participate or contribute to the maintenance of GI.

### ARTICLE INFO

#### Article history:

Received 17 August 2015  
Received in revised form  
29 November 2016  
Accepted 14 December 2016  
Available online xxx

#### Keywords:

Cultural ecosystem services  
Gardens  
Green space  
Parks  
Private green infrastructure  
Provisioning ecosystem services  
Willingness-to-pay

### ABSTRACT

The current nature and challenges of urbanisation in sub-Saharan Africa display several unique features only weakly evident on other continents. Key ones include the current high rates of population growth, inadequate planning and governance systems, concentration in small and medium-sized towns, and increasing urban poverty. These shape the extent, nature and use of ecosystem services provided by urban green infrastructure. This paper first examines the location of green infrastructure across nine towns, showing that it is unequal between suburbs and that the bulk is located under private tenure (74%) rather than in public spaces. We then consider the extent and patterns of use of selected provisioning and cultural ecosystem services from green infrastructure in different locations within towns, including private gardens, public parks and street trees. The results show significant use of green infrastructure for a range of provisioning and cultural services as well as its contribution to spiritual and mental wellbeing. Provisioning contributions are both in regular support of livelihood needs as well as increased use after a covariate shock (a flood), both of which help reduce household vulnerability. Lastly, our results show the expressed level of support and willingness-to-pay or work amongst urban residents for green infrastructure and the services it provides. Whilst the composite results indicate marked variation between and within towns, they show that there is widespread use of green infrastructure for both basic needs as well as for more aesthetic and psycho-spiritual appreciation and recreation, in small and medium-sized towns in a developing country such as South Africa.

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## 1. Introduction

Urbanisation is a multidimensional process that manifests as increasing human population densities accompanied by changing land cover from one dominated by vegetation or waterways to one dominated by built structures (Elmqvist, Alfsen, & Colding, 2008). As such, it is a profound driver of ecological and socioeconomic change. Sub-Saharan Africa is currently experiencing the highest rates of urbanisation anywhere on the globe, with urban popula-

tions having increased from 14% of the sub-continental population in 1950 to 40% in 2010 and will surpass 50% within the next two decades (United Nations, 2014). Despite the institutionalised suppression of urbanisation in South Africa for almost four decades in the second half of the 20th century, it is already well ahead of this ratio, with an urban population of approximately 64% (World Bank, 2015).

The rapidly increasing urban populations and areas in sub-Saharan Africa demand that urgent attention is given to the environmental and socioeconomic consequences of this demographic and spatial transition. The locus of poverty and vulnerability in sub-Saharan Africa is inexorably adopting an urban visage as many urban centres struggle to accommodate, absorb and

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provide for their rapidly burgeoning populations (Angel, Parent, Civco, Blei, & Potere, 2011). Discourses on the transformations required to address the challenges posed by rapid urbanisation are dominated by analyses of large cities which inevitably are national economic hubs. However, this belies the reality that most urban growth in sub-Saharan Africa is occurring in medium- and small-sized cities and towns of less than half a million inhabitants (Cohen, 2006; United Nations, 2014), and that collectively they are already home to more people than those living in cities of one million people or more (Schlesinger, Shackleton, & Drescher, 2015). The models and prescripts of urban development and sustainability derived and examined in large cities may well be found wanting in these smaller ones because of their lower revenue and skills bases (Gwedla & Shackleton, 2015; Pickett et al., 2013; Wisner et al., 2015) as well as their potentially smaller ecological footprint.

Until recently, discourses and design and policy proposals to reduce urban ecological footprints and promote sustainability focused on reducing consumption and waste generation, within the paradigm of the so-called sanitary city (Pickett et al., 2013). Within the last decade or two, the potential role of green infrastructure (GI) in contributing cost-effectively to urban sustainability has gained acceptance. This has paralleled the paradigm shift embodied in ecosystem services thinking, which together have revolutionised the foundational discipline of urban ecology. In this context GI is taken to be “the connected network of multifunctional, predominantly unbuilt, space that supports both ecological and social activities and processes” (Kambites & Owen, 2006). Core considerations of the GI concept is that it relates to (1) urban green areas, (2) that are networked and (3) multifunctional (Albert & von Haaren, 2014; Hansen & Pauleit, 2014; Sandström, 2002; Wright, 2011), and as such provide a range of ecosystem goods and services to urban dwellers. Whilst some authors emphasise GI as a planning approach (Pauleit, Liu, Ahern, & Kazmierczak, 2011; Sandström, 2002) many deem it as the physical green spaces and trees on the ground and the corridors between them that provide multiple ecosystem goods and services at various scales (Tzoulas et al., 2007). This view might be more pronounced in developing countries where integrated planning approaches are challenged by the rapid urbanisation rates and high poverty levels. A fourth dimension not explicitly covered in the above definition is the importance of GI in building both social and ecological resilience. Most commonly urban design passively retains some vegetated surfaces to provide some ecosystem services, typically regulating ones such as storm-water attenuation and air purification, or for recreational purposes. Alternatively, designers and planners can proactively incorporate and mould GI into urban designs to simultaneously optimise resilience and sustainability through the ecosystem services provided and reduce the need for and costs of built infrastructure (Ahren, 2007). However, according to Schäffler and Swilling (2013), examples of this are not commonplace. This is perhaps not surprising due to the lack of suitable tools and that the concept, principles and benefits of GI are still relatively poorly disseminated and understood within the planning profession (Albert & von Haaren, 2014; Wright, 2011). The transition to mainstreaming GI into urban design requires both an evolution in urban design principles as well as in urban governance and budgeting processes and structures (Andersson et al., 2014). This is likely to be more challenging in small and medium-sized towns and cities in sub-Saharan Africa because of their generally weaker planning and regulatory institutions and the higher levels of poverty (Wisner et al., 2015). Yet paradoxically, mainstreaming GI could well save infrastructure development and maintenance costs thereby allowing greater funding for social services in such towns. Indeed, smaller urban centres are less path-dependent (i.e. can be more flexible in development trajectories) and therefore, with appropriate vision, have the potential to be more resilient than their larger counterparts (Pickett et al., 2013).

Given the paucity of understanding of GI provision and use in (i) sub-Saharan Africa and (ii) small and medium-sized towns, the objective of this paper was to examine the extent and use of GI in small South African towns using a social-ecological systems lens. Whilst the findings are specific to South Africa, the study has relevance to other sub-Saharan countries because of the focus on poorer and less well-developed towns and cities rather than the large and modern cities. Although the primary quantification of the potential of GI to provide services useful to human wellbeing is via green space abundance and distribution, we also include trees in private and public spaces and streets. To achieve this objective we considered the following key questions: (1) How much green space is there and where is it located? (2) What is the nature and magnitude of GI use by residents for provisioning services? (3) What is the nature and magnitude of GI use by residents for cultural services? and (4) How supportive are urban residents of public green space? Answers to these questions will provide some understanding of GI provision and use for multiple functions in these poorly studied settings and thereby contribute to GI planning and policy in such contexts. Because of the multidisciplinary, mixed-methods approach, the above questions are addressed sequentially by synthesis of results across a number of different studies in a range of small and medium-sized towns in South Africa. Specific methods are presented under each question. Because of the historical legacy of racially segregated planning and development in South Africa, we first briefly describe the spatial segregation that is apparent in most South African urban areas against which any analysis of GI and its benefits must be examined.

### 1.1. Historical segregation; contemporary separation

The racially discriminatory patterns of urban development during the colonial and apartheid periods in South Africa have been well documented (Christopher, 2001). In brief, a plethora of racially biased legislation and ruthless enforcement dictated where black South Africans (which during apartheid included black Africans, Asians and those of mixed race parentage) must live and work and the social and infrastructural services that were provided in different areas. At a macro-scale, millions of black South Africans were required to live in ethnically defined and geographically disparate ‘bantustans’. These areas had little or no economic base and the apartheid government provided relatively little investment in infrastructure and services. Today many towns in the former bantustans are thriving hubs, yet massive backlogs in the provision of housing and services remain and the economic base is limited and so poverty and underdevelopment are a lot higher than in urban areas that were not located in the former bantustans. The racial profile also remains almost exclusively black South African, unlike the more cosmopolitan urban centres elsewhere in the country.

The apartheid system also regulated where black South Africans outside of the bantustans could reside. In urban areas they were required to live in discrete areas zoned as ‘townships’, often on the periphery of the city, or even some distance from it. Like the bantustans, there was no formal economic base in the townships and central government and urban authorities provided only the barest of infrastructure. After the demise of apartheid in the mid-1990s, much national government investment has been targeted at improving the living conditions in the townships, but disparities remain in many spheres when compared to other urban residential areas (Donaldson, du Plessis, Spocter & Massey, 2013; Mirafab, 2007). The racial profile of residents in the townships remains almost exclusively black South African. Additionally, as part of the investment in improving living conditions, the post-apartheid government built millions of low-cost housing units in and around towns throughout the country (in and out of former bantustans) of uniform size and appearance, which colloquially are referred to

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