



Valuing green infrastructure in an urban environment under pressure – The Johannesburg case

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ABSTRACT

This article considers the importance of robust planning for green infrastructure in fast changing Southern African cities. A key theme is the extent to which ecosystem services are valued publicly, and the opportunity costs of not investing in the green infrastructure. We explore green infrastructure through pairing insights of social–ecological resilience with perspectives on urban infrastructure transitions. By converging these views, we show how green infrastructure can be viewed as an innovative response to challenged urban environments.

Through a Johannesburg case study, a number of ecosystem services constitute sources of resilience for an otherwise constrained city. While this is positive and to be valorised, many South African cities are in the midst of service delivery protests, so that resilient ecosystems, and the citizen networks that sustain these, are largely overlooked in planning processes.

This article offers three key conclusions. First, a proper understanding of green infrastructure requires blending insights from social–ecological system thinking and infrastructure transition scholarship. Second, there is a paucity of knowledge around ecosystem services in Johannesburg, and that the planning to facilitate ecosystem service valuation is largely inadequate. Third, addressing this requires ecosystem valuations relevant to the unique conditions in developing world cities such as Johannesburg.

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1. Introduction

With 61% of its population living in urban areas, Southern Africa is the most urbanised subregion in Africa (UNHabitat, 2010). Sub-Saharan Africa also has the fastest growing urban population among developing regions, followed by South and Central Asia (Angel et al., 2011). Although the momentum of demographic growth is slowing in Africa, as is the case globally, massive rural to urban migration continues as a defining trend, shaping ever-larger cities that are often poorly equipped to accommodate new arrivals (Sanyal, 2011).

62% of all Sub-Saharan urban dwellers live in largely non-serviced slums, reflecting the ongoing urbanisation of poverty and social insecurity (UNHabitat, 2010). This is perhaps the most striking representation of a global infrastructure crisis that has beset an increasingly resource-constrained world. The stark contradiction, that large parts of the urban world lack the infrastructure required for a quality of life equivalent to that found in developed world cities, but where provision

of the requisite infrastructure will dramatically exacerbate global resource-pressures, has prompted a growing body of scholarship on urban transitions towards sustainability (Hodson and Marvin, 2009; Krausmann et al., 2008; Smith et al., 2005). Although the work on urban infrastructure transitions is a welcome response to the infrastructure crises facing fast-growing cities, it has been oriented largely towards the question of how to reduce resource consumption and improve resource efficiency through the redesign of infrastructure (Brunner, 2007; Hodson and Marvin, 2010; Weisz and Steinberger, 2010), and tends to focus on the so-called ‘grey infrastructure’ networks of energy and material supply systems (Weisz and Steinberger, 2010). The literature has largely overlooked the importance of urban biophysical networks – what could be termed ‘green assets’ or ‘green infrastructures’ – that provide ecosystem services critical to enhancing cities’ resilience.

Our view is that the failure to consider green assets as equally important to cities’ networked grey infrastructures is an omission from two perspectives. First, it neglects the role of urban ecological assets in generating a range of ecosystem services (Jansson, 2013–this issue). While there has been significant progress in ecosystem valuation studies, insights from this work have not translated into studies on whether and/or how ecological assets are being taken into account by authorities responsible for planning a city. More research is needed on the way in which ecosystem services are being, or ought to be valued in cities,

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with a specific focus on how they might conceivably be incorporated into spatial planning and urban design, as well as financial accounting and public-asset management frameworks.

Second, there has been little if any attention paid to how urban green assets function as an economic driver by means of the community social networks, business value chains and household property investment decisions that are constituted wherever these assets are developed and maintained (Ernstson et al., 2010a). The extent to which cities are giving due recognition to the positive economic impacts from green infrastructure projects warrants deeper investigation.

Writing from a developing country, we are sensitive to the particular dynamics that characterise Southern African cities, where research into, and planning around, environmental issues in general are both in their infancy (Simon, 2010). In these cities, environmental concerns are largely absent from academic, policy and even civil-society activist discourse, being dwarfed by the seemingly more pressing matters of service delivery deficits, economic exclusion and poverty. Certainly, there is work that takes its impetus from the concern that much urban development in Sub-Saharan Africa is proceeding through the rapid and widespread conversion of natural areas into urbanised land, where vegetation is being replaced with built forms – often continuous, low-density sprawl – without greenways, natural urban drainage systems, or riparian zones (de Lange et al., 2009; OECD, 2011; Palmer et al., 2004). But this work falls short of assessing how green infrastructure is or is not being counted as an asset worth building and maintaining in the fabric of fast-growing cities, both from an ecosystem service and economic development perspective.

This paper builds an argument that rapidly expanding cities such as those in Sub-Saharan Africa urgently need to consider the importance of green assets as part of their broader infrastructure development programmes; that this will only happen if the value of the ecosystems services provided by these assets are formally recognised in city budgeting and accounting systems; and if the ecological economy of citizen greening networks is integrated into city-planning processes. The argument proceeds through three steps. First, insights from two theoretical traditions – social-ecological system thinking and infrastructure transition scholarship – are combined to construct an intellectual model for green infrastructure. Second, we use a case study of Johannesburg, one of the largest and fastest growing cities in Africa, but one with a unique ecological asset in the form of an urban forest, interspersed with green spaces and gardens, to explore how green assets could be, and then whether they are being, adequately valued by city authorities in charge of seriously challenged urban contexts. Third, we use insights from the case study to suggest innovative ways for how green infrastructure can be factored into public asset management and economic planning frameworks.

2. Theoretical Framework: Green Infrastructure

According to Kambites and Owen (2006), green infrastructure is the “connected network of multifunctional, predominately unbuilt, space that supports both ecological and social activities and processes”. Green infrastructure includes street trees, private and public gardens, parks, riparian zones along urban drainage lines, undeveloped ridges, and a variety of urban agricultural spaces such as food- and community-based gardens.

While green features and spaces can be found in all cities, to a greater or lesser extent, it is not a given that these will be regarded as green infrastructure. The defining contribution of a green infrastructure approach is that it sees ecological and natural assets as infrastructure, equivalent to water or power networks, for example, that provides multiple social, environmental and economic functions (Landscape Institute, 2009).

Green space systems need to be conceived as green infrastructure in the same way as other built infrastructures, so that they can be

designed and developed to function as a whole, rather than as a set of separate unrelated parts (Barthel et al., 2005; Benedict and McMahon, 2002). They need to be ‘formalised’ as a coherent object of planning. As Wolf (2004) states: “A city would never build a road, water or electrical system piece by piece, with no advanced planning or coordination. Green infrastructure is the idea that nature in cities should be administered in an integrated way, just as grey infrastructure systems have been.”

To achieve this, two schools of thinking are combined. These are discussed below as: (1) unlocking the ecosystem services potential of urban green spaces, and (2) infrastructure transitions for increased urban resilience. When brought together these two streams of thinking offer a new perspective on how rapidly urbanising regions can better adapt to confluence of urban challenges.

2.1. Unlocking the Potential for Urban Green Spaces

Amidst unprecedented urbanisation, the role of cities in influencing the capacity of ecosystems to sustain societal development and to generate ecosystem services is increasingly being recognised (Alberti et al., 2003). This recognition is rooted in a social-ecological system approach to cities, which depicts cities as closely coupled human-nature systems whose institutional adaptability to environmental feedbacks is a critical determinant for enhancing urban resilience (Barthel and Isendahl, 2013-this issue; du Plessis, 2008). As defined by Folke et al. (2010), a social-ecological system is an “integrated system of ecosystems and human society with reciprocal feedbacks and interdependence. The concept that emphasises the humans-in-nature perspective”.

Social-ecological system analysis has stimulated new thinking about the relationships that exist between people and biophysical processes in cities (Bai et al., 2010). This is based on the metaphor of resilience, defined by Folke et al. (2005) as the potential of a system to absorb disturbance re-organise, i.e. the capacity for self-organisation. Socio-ecological resilience thus relates to the mutual adaptability of both social and ecological systems, which determines the ability of a complex system to absorb disturbance and re-organise in the face of pressures (Barthel, 2008; Ernstson, 2008; Folke et al., 2005). Applying this metaphor, Ernstson et al. (2010b) explain that reducing resilience exposes systems to greater risks, uncertainties and surprises, whereby it takes progressively smaller shocks for that system to lose its capacity to sustain a certain regime.

A major focus of urban resilience thinking is the role of urban green spaces in producing local ecosystem services, such as air purification, rainwater drainage, sewage treatment and food provision, alongside recreational and social benefits (Barthel et al., 2010; Ernstson et al., 2010b).

However, green space planning in many cities has been negatively affected by institutional failures to acknowledge the mutual benefits that ecosystem services supply to both ecological and social systems (James et al., 2009; Jansson and Polasky, 2010; Sandström et al., 2006). As a result, the concept of urban green space is often treated one-dimensionally – that it is something *nice* to have instead of providing critical ecological and social functions (Sandström et al., 2006; Van der Ryn & Cowan in Walmsley, 2006). Although there are few exceptions, such as the Brazilian government's success with en-mass green infrastructure investments in reforesting the Tijuca Massif National, the treatment of green assets as an integral part of the infrastructure networks that maintain city functioning remains rare (Da Cunha et al., 2001).

In African contexts, this misperception is particularly perverse since what are seen as purely socio-economic issues – such as poverty and job creation – receive primary attention in social or activist dialogues and planning agendas, which overlook the broader socio-economic opportunities of resilient ecosystems. Similarly, in South Africa, ecological issues receive low priority in relation to social issues, which are often perceived as more pressing on political agendas while

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