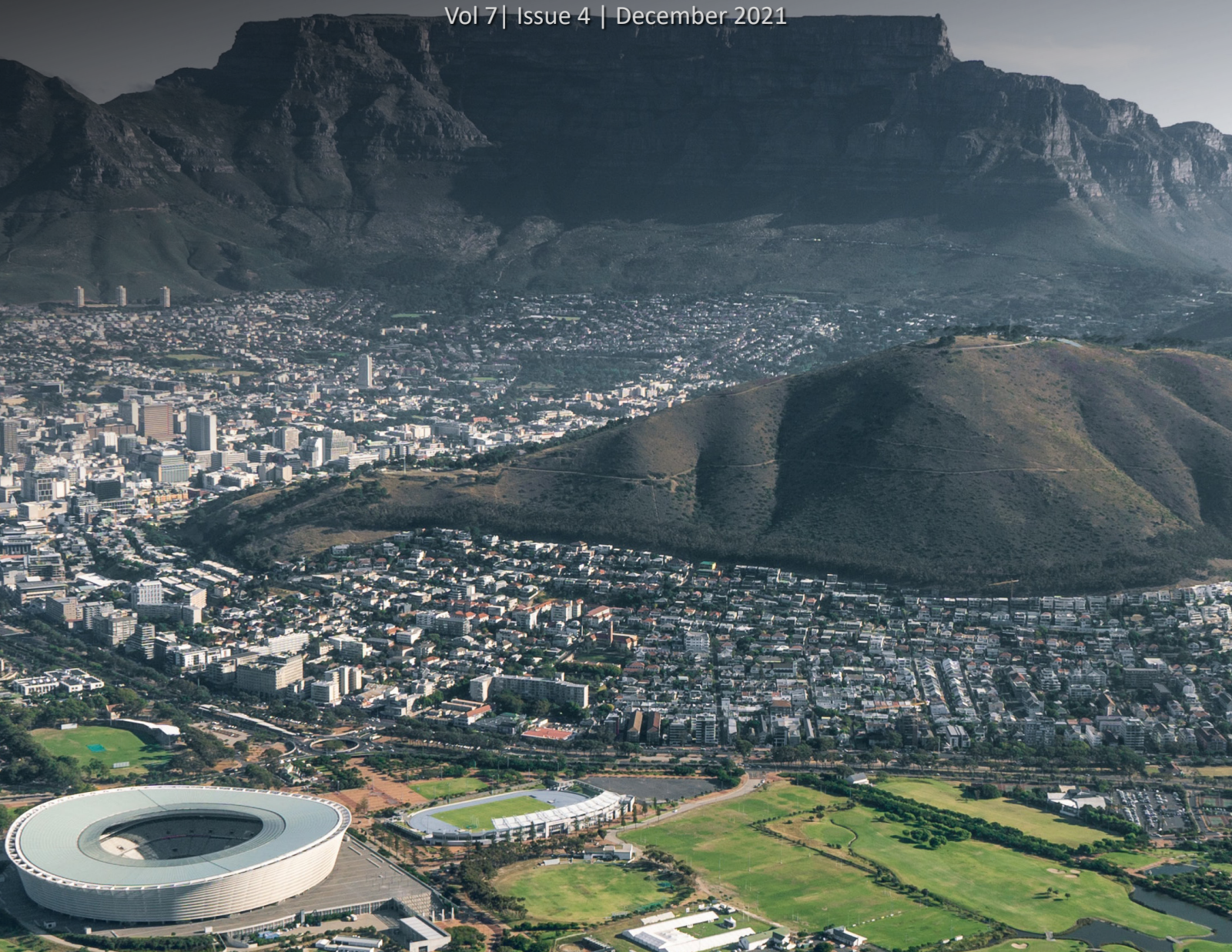
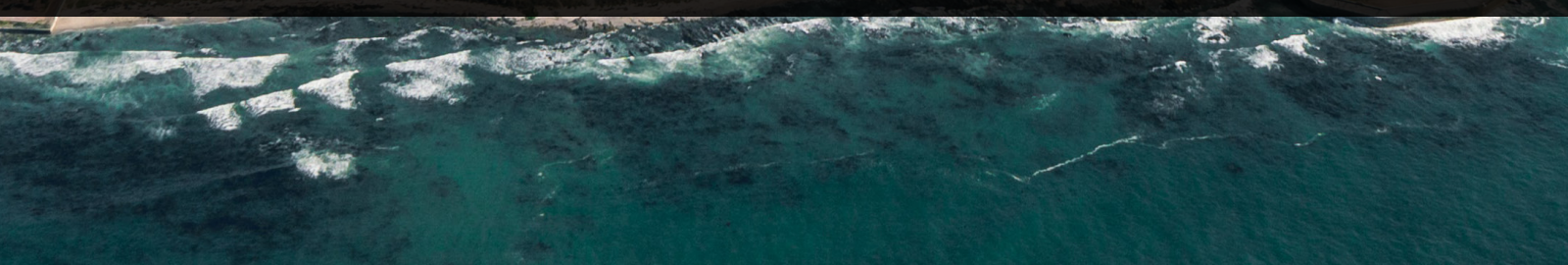
iglusQUARTERLY

INNOVATIVE GOVERNANCE OF LARGE URBAN SYSTEMS

Vol 7| Issue 4 | December 2021



Planning for Sustainability: A View from the Global South



CONTENT

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ISSN | 2571-628X

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Image Credit for the Cover Page | Tobias Reich on Unsplash

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The ideal of sustainable development has become increasingly prominent in global development discourse over the last half-century and is now firmly being embedded within global agreements such as the 2030 Agenda for Sustainable Development and the New Urban Agenda. This prominence is also reflected in the recent UN-Habitat World Cities Report 2020 aptly titled 'The value of sustainable urbanization' and reaffirmed that sustainable urbanization remains central to the goal of overall sustainable development by creating social, economic, and environmental value in pursuance of the 2030 Agenda for Sustainable Development goals. However, despite considerable progress in many dimensions, continued and rapid urbanization poses a particular challenge for urban planning in pursuit of sustainable development, especially in urban contexts in the Global South. The series of articles in this edition reflect on some of the challenges in planning for sustainability and provide some case studies of how cities in the South have responded to these challenges.

Mariske van Aswegen's article sets the scene for this theme and compares the overall performance of the five countries forming part of BRICS against the 17 SDGs, with a specific focus on SDG 11 which pertains directly to the urban space. It explores sustainability within the urban context, with a pertinent focus on three Global South countries, i.e. Brazil, South Africa and India. These countries are highlighted against the backdrop of the Sustainable Development Goals, in order to highlight the disparities between the Global North and the Global South regarding sustainable urban development. It concludes that the development of cities in most parts of the Global South are decades behind that of their counterparts in the Global North, and therefore, will require context specific responses truly focusing on the most pertinent urban development needs.

In the second article Juanee Cilliers draws our attention to the importance of urban planning approaches progressively turning towards green planning solutions, incorporating the multiple benefits that green spaces can provide to cities and societies, and the need to understand how human and ecological processes could coexist in human-dominated environments for reaching future sustainability goals. The article calls for green(er) thinking to be embedded as part of mainstream urban planning with the understanding of the value of green space and nature for cities and citizens would need to be reinforced. It points out that green space value are context-based, and could differ between communities, geographical locations and cultures, and argues that ecological considerations (in particular ecosystem services) need to be better articulated in urban planning policy and legislative frameworks, especially to reclaim nature in cities and prioritise urban green spaces and Green Infrastructure networks.

In the third article Danie du Plessis illustrates that, although the concept of green infrastructure is increasingly considered as an appropriate approach to incorporate ecological service solutions within planning processes, its integration with mainstream urban planning is still a developing field of research and practice impacted by a number of challenges. It identifies a number of critical challenges that impact on the effectiveness of fully integrating green infrastructure (and its associated ecosystem services) into mainstream urban planning practices. It then uses the City of Cape Town as case study to describe the integrated approach adopted by Cape Town to effectively integrate green infrastructure across the city's strategic urban plans and policies. These initiatives to overcome the identified challenges provide potentially useful lessons for other cities facing similar challenges and could support outcomes towards urban sustainability.

In the fourth article Herman Geyer picks up on the point made by Cilliers that green space value are context-based and could differ between communities and geographical locations. It draws attention to the subtle differences in the use of green spaces in the global North and in the South. One of the specific challenges is the extent of population in cities of the global South living in slums and informal settlements, and the article identifies specific challenges for urban planning processes in these regions regarding the effective incorporation of green spaces as part of planning for sustainable urban environments. It then uses a case study of low-income and informal settlements in Cape Town to illustrate the different perceptions and use of green space prevalent in informal settlements compared to traditional approaches and assumptions. It clearly articulates the importance of extensive community consultation in the planning of green spaces in these

communities, to ensure successful development within the local context of informal settlements.

The final article highlights the impact of climate change on urban planning and development, especially in the South, and the resulting growing awareness of the phenomenon of Urban Heat Islands in planning for sustainable development. The article by Lukas Beuster indicates that despite the wide-reaching effects and impact of urban heat islands on sustainable development, the causes, severity and spatial distribution thereof are still not fully recognized in urban planning. The article provides an analysis of urban heat islands in Cape Town. The findings confirm that green spaces can be effective at producing cooling effects, but under drought prone environments can also produce unexpected adverse effects. It illustrates that a more diversified strategy to mitigate urban heat, also incorporating cool surface technologies can provide similar, if not superior, cooling results. The findings confirm the importance of considering urban heat island effects when planning for sustainability.

We sincerely hope that you can enjoy this issue of IGLUS Quarterly. We invite you to join the discussion at iglus.org. If you feel there are innovative practices underway in your city/region and you would like to contribute to an upcoming edition of IGLUS Quarterly, we encourage you to contact us at umut.tuncer@iglus.org. You may also contact the editors of this issue through ddp@sun.ac.za and numanyanar@hotmail.com.

Danie Du Plessis and Numan Yanar

Conceptualising Sustainability in Spatial Planning in the Global South

Mariske van Aswegen*

Abstract: *The concept of sustainability has been challenging countries and cities across the world for almost half a century. This paper explores sustainability within the urban context, with a pertinent focus on three Global South countries, i.e. Brazil, South Africa and India. These countries are highlighted against the backdrop of the Sustainable Development Goals, in order to highlight the disparities between the Global North and the Global South regarding sustainable urban development. The paper concludes that the harsh realities and dire human needs faced by cities within the Global South, necessitates a fundamental focus on economic growth and infrastructure development (as part of the economic focus of sustainability) in the short and medium term, rather than overstraining themselves on idealistic environmental and social commitments.*

Keywords: *Sustainability; sustainable urban development; Global South, spatial planning; Sustainable development goals*

Author's Profile

Dr. Mariske van Aswegen is a qualified and professionally registered Urban and Regional Planner with 17 years' experience in the industry. She obtained her PhD in Urban and Regional Planning from the North-West University (South Africa) in 2018, and continued with a post-doctoral fellowship until 2021. She is currently employed as an extraordinary senior lecturer in the Unit for Environmental Science and Management, North-West University, at the Potchefstroom Campus. Her research work mainly focuses on resilience in the peripheral region. Other fields of interest include large urban systems (LUS), sustainability, regional policy and regional strategic planning. She has also been in private practice since 2004 with a focus on strategic planning, statutory planning, project management and property development. E-mail: mariske.vanaswegen@nwu.ac.za

Sustainability in urban planning

Half a century after the United Nations Conference on the Human Environment (McNamara, 1972), marking the conception of sustainability, the ambiguity of the concept has impacted on every aspect of our daily lives and is recognised across the world to be especially challenging in its implementation and operation on a daily basis (Gough, 2015). Exponential population and coupled economic growth in this time, is damaging many aspects of the physical environment, sometimes irreversibly. Spatial planning of our urban areas have become increasingly pivotal for a sustainable future, which is evident in the focus on a sustainable development approach by governments worldwide (Nour, 2015). This is of course strongly aligned to the Sustainable Development Goals (UN, 2015). Regionally, more than half of global population growth between 2019 and 2050 will be within sub-Saharan Africa (UN, 2019), furthering the imminent need for sustainable spatial planning of the urban areas in this region.

The most common definition, leaving much room for interpretation and assumption across different disciplines, referring to the "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED 1987, 8) as defined by the Brundtland Commission. Much debate has ensued questioning the wording of "needs" of the two generations mentioned, which led to several parallel definitions including those focused on the three widely recognised components of sustainability, i.e. the economic impact (Daly, 1990), an ecological viewpoint (Wackernagel & Rees, 1997), as well

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as the social approach (Bullard, 1990). Taking the focus to an urban level, the emphasis of sustainable urban development (SUP) has shifted to frameworks that are holistic in nature with a broad focus on the various sustainability principles as applicable to cities (Rauscher & Momtaz, 2014). The concept of SUP is influenced by varying schools of thought and principles believed to enhance the overall sustainability of a city, i.e. compact cities (Harasawa, 2002), smart cities (Washburn et al., 2009; OECD, 2019), resilient cities (Grabher & Stark, 1997; Pickett et al., 2004), liveable cities (Evans, 2002) and green cities (Harrison et al., 2014; Breuste, 2020). It is furthermore focused on establishing and adapting urban settlements to be more innovative, inclusive and safe, which is highlighted within the Sustainable Cities Programme (SCP) (UN Habitat, 2002). The resilient, smart, and compact cities views have a strong focus on enhancing the efficiency of cities (van Aswegen & Retief, 2022), whereas the liveability and green concepts are largely equity-focused, strengthening the environmental and societal components of sustainability. It is believed that taking all of these principles and their associated practical application will ultimately reach the all-encompassing goals of broader SUP.

Many of the sustainability issues are due to the continuous and rapid population growth and spatial planning for urban areas is regarded as a significant component of the solution to address many of the concerns associated with sustainable development (Cities Alliance, 2007). Notably, this growth is largely impacting on urban areas as centres of opportunity and employment. The UN (United Nations Human Settlements Programme, 2009) highlights the crucial impact that urban planning and urban governments can have on establishing a sustainable path through the management of the built environment and urban form. The direct impact that effective urban form and land use management has on counteracting issues such as urban sprawl, high carbon footprint, energy usage, and congestion could greatly assist in overcoming some of the concerns within cities (Alberti et al., 2018) and even enable cities to act as nucleus for sustainable development (World Bank, 2010). Godschalk (2004) rightly states that planning for sustainable development is dependent on resolving the conflict between sustainable (future focus) and liveable (present focus) to create a more sustainable city, as "urban sustainability challenges are thus global sustainability challenges" (Ramaswani et al., 2018, p. 10). Most countries in the Global South have fallen behind other regions in its focus on sustainable development; hence, this region has received special attention in numerous international policy approaches (UN, 2007; UN 2021). This article provides an overview of sustainability performance within Brazil, India, and South Africa as Global South case study countries.

Perspectives in the Global South

Developing nations, formerly labelled Third World Countries or "periphery" (Dados & Connell, 2012), but more recently referred to as the Global South, based in an overtly geographical setting in the Southern hemisphere. Many of the countries in the Global South were previously under European rule and are strongly focused on the concept of "decolonisation" or anti-colonisation of the previous colonial rule (Dicken, 2011; Dados & Connell, 2012). Typical challenges associated with countries in the Global South include rapidly growing populations, competing demands with the West and East, disconnection from key infrastructure, unstable politics, lingering effects of economic marginalisation, urban fragmentation, extreme poverty and associated socio-economic impacts (Koonings & Kruijt 2007; Watson, 2013). Dávila (2016) furthermore, recognises the exponential growth of inequalities between the affluent and the poor, which is prominent in cities across Latin America, India and Africa. This has led to ever increasing urban fragmentation between high-income low-density privatised expansion on the fringe of most cities, increasing the continuous sprawling outward growth and inefficient service delivery within these cities (Sotomayor & Daniere, 2018; Van Aswegen & Drewes, 2022). These characteristics further complicates the challenges associated with sustainable urban development.

From the preceding discussion on sustainability and,

more specifically, sustainable urban development it is evident that the manner in which cities react to the pressures of development (and specifically rapid urban development) is central to the long term sustainability, and short-term efficiency of the city. It is furthermore recognised that the type of pressure, coupled with the intensity of these pressures, distinguishes the urban areas of the Global South and those in the Global North (Du Toit et al., 2018). The city therefore acts as facilitator to a more sustainable urban future with a focus on the three components of sustainability in mind, i.e. economic, social and environmental dimension (Wheeler, 2013; UN, 2019). Developing nations in the Global South are challenged with numerous issues pertaining to the SDGs (Khalid et al., 2020) as highlighted in Table 1, including unaligned national priorities, funding constraints, lacking and quality of data, and poor capacity and follow-through in the implementation of goals.

Table 1. Typical issues and concerns in developing nations

General issues and concerns	Challenges of "Leave No One Behind" in developing countries
• Unrepresented perspectives, national priorities or process of national adaptation • Business as usual approach to growth or low ecological inclusiveness • High implementation cost and lack of finances • Data collection, data quality, standards, verification and data monitoring • Large verifiable targets as compared to few vaguely defined delivery targets for developed nations • Lack of scientific evidence-based approaches • Need of support for capacity building, implementation and data handling	• Demographic imbalance • Governance • Data gaps • Inequalities and discrimination • Shocks and fragility • Socio-economic status • Geographical location • Limited resources

Source: Bali Swain and Yang-Wallentin, 2020; Khalid et al., 2020; Leal Filho et al., 2019; Sachs et al, 2021.

From this table it is evident that numerous issues pertaining to the SDGs are hindering long-term sustainability in the developing countries and assistance will be required from international partners in assisting and funding sustainability initiatives in said countries. Developing countries do not have the capacity and innovative means to address many of the SDGs, which will require pertinent intervention in capacity building and continuous engagement with the Global North (Mensah 2019). Government structures are often weak and fraudulent, which necessitates a focus on education of government officials, strengthening good governance and establishing the necessary regulations to assist the government on all levels with the practical application of the broader principles (Collste et al., 2017; Breuer et al. 2019). Typically, countries in the Global South are not in the position to focus on the "soft" issues of environmental sustainability or societal development (SDG 5, 7, 10, and 12 to 17), as the struggles on a daily basis pertaining to basic needs, employment and service delivery are overwhelming (SDG 1 to 4, 6, and 8 & 9) (Drewes & Van Aswegen, 2013). The social and environmental aspects of sustainability strategies is often overlooked (Ghosh et al., 2019). In this regard the various stakeholders (both public and private) are key to include, address and implement the SDGs not always regarded as vital in these countries. Nour (2015) highlights that a focus on the environmental sustainability of cities will ultimately prepare and create cities which are more resilient to environmental disasters, which many of the Global South countries are victim to.

Spatial policy and strategy towards sustainable urban planning

In response to the challenges faced and reaching towards some state of sustainability, certain cities are embracing spatial policy and strategy as a tool of mitigation in an effort to be more reactive and responsible, securing a more sustainable and equitable future to all its citizens. Schenk (2013) concludes that master planning (strategic spatial planning for a city) is an approach that most governments prefer to follow to include sustainability principles on a localised level. Spatial policy and strategy is

regarded as key tools in setting strategic goals for regions or cities, with a strong focus on concepts of society, economy, environment, infrastructure and governance, all of which features prominently in the quest to sustainable urban development (UN, 2008). The aim of spatial planning policies and strategies is focused on combined efforts to spatially distribute development and investment in such a manner that the maximum benefit for local sustainability is achieved. Investment and development is often guided by core components of the urban space, i.e. housing, infrastructure, social services, transport and civil engineering services. In this regard policy frameworks and the vertical integration thereof, from the national and sub-national level, down to the local (city) level, impacts greatly on the sustainable future of cities. National policy frameworks provide guidance and sets the priorities for adoption on a local level over the medium to long-term, whereas local frameworks are focused on the implementation thereof. This in turn necessitates a form of horizontal policy integration to prevent policy-silos from forming and strengthen integration among the different partners (government, civil society, NGOs, local business) and the different sectors within the city (Lebel, et al., 2006; Niklasson, 2007; UN, 2007). Notably, the Sustainable Development Goals (SDGs) (UN, 2015) are the main focus of international policy guidance, with the prominence of sustainable urban development reflected within SDG 11, i.e. "sustainable cities and communities" posed as principle focused on establishing some form of socio-spatial justice within urban areas (Sotomayor & Daniere, 2018). The OECD (2020) maintains that 105 of the 169 sub-targets of the 17 SDGs are unattainable without integrated urban, sub-national and national frameworks. The 'Leave no one behind' strategy of the UN with the SDGs further emphasises a renewed focus on the Global South, with a pertinent drive to address additional concerns than those of the developed world. From an international perspective, the SDG`s can be regarded and translated to national spatial strategy, and filters down to the city level for a localised approach. Cities are recognised to have core responsibilities for sustainable urban development as part of their policies and strategies regarding housing, infrastructure and transport development and basic service delivery (OECD, 2020), but the support and integration from a sub-national and national level is the driving force behind the success of localised sustainability policies. The standardised measurement of SDGs on a localised level, is however a work in progress with varying approaches and indicators across the globe.

The SDG`s have been put under scrutiny across the world for its broad and often elusive focus, and being overly ambitious, some referring to the goals as a to-do list with many inconsistencies (Easterly, 2015; Spaiser et al., 2016). This has been especially emphasized in developing countries with a different socio-economic makeup than developed countries, struggling with issues the first world has already adequately dealt with. Bali Swain and Yang-Wallentin (2020) highlight that the environmental concerns of the Global North are less pertinent within the Global South due to more pressing socio-economic concerns such as hunger, unemployment, slum areas, and slow economic growth. This is supported by Khalid et al. (2021) who conclude that developing countries should focus their exertions on two of the three goals of sustainable development, i.e. economic growth and social development, as these are the most pressing and neglected within these countries. The mutual relationship between national directives and funding, and localised sustainability efforts will differ in focus from developing and developed countries.

Case studies from the Global South

In order to provide an assessment of the compliance of Global South countries to the SDGs, three case studies are provided. These three countries are part of the BRICS grouping and their performance regarding the SDGs will subsequently be framed against the other two countries (China and Russia) in the BRICS grouping, forming part of the Global North. The short exploration will highlight these five countries` overall performance within the 17 SDGs, with a focus on SDG 11 which pertains directly to the urban space. Coincidentally, four of the five countries also form part of the G20 grouping. The G20 countries together make up for 60% of the

world`s population, 80% of the global GDP and 75% of global exports (G20, 2021).

Table 2. Case study countries SDG overall performance

Country	BRICS Country	G20 Country	Country SDG ranking (out of 165)	Country SDG Score
Russia	Yes	Yes	46	73.8
China	Yes	No	57	72.1
Brazil	Yes	Yes	61	71.3
South Africa	Yes	Yes	107	63.7
India	Yes	Yes	120	60.1

Source: Compiled from Sachs et al. (2021)

The table highlights the five countries` overall sustainability ranking (out of 165 countries) and score. This score is based on a measurement of all 17 SDGs and represents a % of SDG performance. Notably two of the Global South countries (highlighted in grey) are ranked much lower than the developed countries, with the exception of Brazil (Sachs et al., 2021). The subsequent table highlights each of the case study countries` overall performance in the 17 SDGs, indicated in the scale provided in the SDG Report (Sachs, et al., 2021), which ranges from SDG reached (green), challenges remain (yellow); significant challenges remain (orange) and major challenges remains (red).

Notably, the challenges as highlighted in Section 1 typically experienced in the Global South, also impacts on the attainment of the SDGs. UN Habitat (2021) states that 23% of the SDGs are focused on the local, or urban sustainability (Sachs et al., 2021). This necessitates the development of sub-national SDG reports, which are in preparation in many countries. From the table it is clearly visible that India and South Africa are experiencing significant problems with most of the SDGs, with Brazil to a lesser degree. Brazil is indicated as having "major challenges" in seven of the 17 SDGs; "significant challenges" in four; "challenges" in a further five goals, and having achieved one of the goals. South Africa experiences "major challenges" in eight of the goals, "significant challenges" in seven, "challenges" in two, and have not accomplished any of the seventeen goals. India is indicated as having "major challenges" in eleven of the goals, "significant challenges" in three and challenges in 2. India has achieved one of the goals as set out.

Table 3. Summary SDG goals per country

	Russia	China	Brazil	South Africa	India
SDG1 No Poverty	SDG achieved	SDG achieved	Challenges	Major challenges	Significant challenges
SDG 2 Zero hunger	Significant challenges	Significant challenges	Significant challenges	Major challenges	Major challenges
SDG 3 Good health & well-being	Significant challenges	Significant challenges	Major challenges	Major challenges	Major challenges
SDG 4 Quality education	SDG achieved	SDG achieved	Challenges	Significant challenges	Challenges
SDG 5 Gender equality	Significant challenges	Significant challenges	Significant challenges	Significant challenges	Major challenges
SDG 6 Clean water & sanitation	Significant challenges	Significant challenges	Challenges	Significant challenges	Major challenges
SDG 7 Affordable & clean energy	Challenges	Significant challenges	SDG achieved	Significant challenges	Significant challenges
SDG 8 Decent work & economic growth	Challenges	Significant challenges	Major challenges	Major challenges	Significant challenges

SDG 9 Industry, innovation & infrastructure	Significant challenges	Significant challenges	Significant challenges	Significant challenges	Major challenges
SDG 10 Reduced inequalities	Significant challenges	Major challenges	Major challenges	Major challenges	Major challenges
SDG 11 Sustainable cities & communities	Challenges	Significant challenges	Significant challenges	Significant challenges	Major challenges
SDG 12 Responsible consumption & production	Significant challenges	Challenges	Major challenges	Challenges	Challenges
SDG 13 Climate action	Significant challenges	Challenges	Challenges	Significant challenges	SDG achieved
SDG 14 Life below water	Major challenges	Major challenges	Major challenges	Major challenges	Major challenges
SDG 15 Life on land	Major challenges	Major challenges	Major challenges	Major challenges	Major challenges
SDG 16 Peace, justice & strong institutions	Major challenges	Significant challenges	Major challenges	Major challenges	Major challenges
SDG 17 Partnerships for the goals	Challenges	Significant challenges	Challenges	Challenges	Major challenges

Source: Adapted from Sachs et al. (2021)

The SDGs highlighted in grey (SDG 1 to 4, 6, 8 and 9) are directly correlated with the more pressing issues in the developing world as earlier highlighted (refer Section 2). It is clear that all three Global South countries experience these SDGs as a challenge, but it is especially pertinent in South Africa and India. SDG 7, and 12 to 15 are largely associated with the environmental component of overall sustainability, and is also highlighted as the areas in which the three developing countries have the biggest challenges. This is ascribed to the different focus and challenges these countries exhibit on development, which in many instances are focused on basic needs, i.e. poverty alleviation, hunger, health services and accompanying basic infrastructure delivery. With regards to SDG 11 focused on sustainable cities and communities, both Brazil and South Africa are experiencing significant challenges, whereas India is classified as having major challenges remaining. An important contributing factor is the continuous influx of people to cities for their livelihood, putting additional pressure on an already stressed infrastructure network and increasing the need for affordable housing.

Trend data from the same source indicates that Brazil remained stagnant within SDG 1, SDG 2, SDG 8 and SDG 9, and has been identified as one of three countries that have declined the most in terms of its sustainability score (Sachs, et al., 2021). Quality education (SDG 4) remains on, while SDG 3 and SDG 11 improved moderately improving since the previous report. The report also highlights 2021 as the first year (since 2015) that the average global SDG index have declined, ascribed to the enormous impact of the COVID19 pandemic. Within the South African measurement, it is worrying that the performance pertaining to poverty (SDG 1) and education (SDG 4) has decreased. This is the only country within the analysis that shows a decline in the individual measurement of two separate SDGs. SDG 2 and SDG 8 remained stagnant since the previous measurement, while moderate improvement was achieved in SDG 3 and SDG 9. India, ranked 120th of the 165 countries, shows moderate improvement within most of the SDGs forming part of the analysis. SDG 1, SDG 3. SDG 8 and SDG 9 in particular shows improvement since the previous year, and SDG 6 (clean water in sanitation) remains on track towards SDG achievement. The SDG of sustainable cities and communities and zero hunger remained stagnant, while a decreasing trend is visible in the attainment of quality education.

Conclusion

It has been established that the cities of the Global South are experiencing more pressing challenges in

the areas of spatial fragmentation coupled with spatial division, lacking and poor household services, slum conditions, inadequate public transport, and continuous sprawl. These cities and city governments have to focus more on the basic needs of their citizens, to such a degree that the overall sustainability of cities in some instances become a secondary-issue. The struggle of cities in the Global South, in essence is, that they are aspiring towards (and measured against) cities in the developed world, while struggling to address the basic needs of their rapidly growing population. The reality is that governments cannot focus on greening the city if the larger part of its residents do not have running water or sewage disposal. A government cannot focus on enhancing equality, if he largest part of its residents are unemployed. A government cannot focus on climate action for its future generations, if the current residents are without electricity. A government cannot focus on establishing peace, if amongst themselves fraud and deception takes place on a daily basis.

The development of cities in most parts of the Global South are decades behind that of their counterparts in the global North, and therefore, it is unrealistic to measure the cities in the Global South to the same principles and standards of those in the Global North (as per SDGs). The focus of the Global South regarding SDGs and sustainable development within the urban environment overall, will have to take a "back-to-basics" approach, with a focus on the most pertinent urban dilemmas, i.e. economic growth and employment. Confronting these issues will in turn impact positively on the other glaring matters of poverty, hunger and service delivery. True economic growth, with associated infrastructure development, will ultimately result in the attainment of socially and environmentally-focused goals (Drewes & van Aswegen, 2013). Leal-Filho (2019) suggests that more tangible results will be visible over the medium term in developing countries if a focus is placed on investments in SDG 4 (Education) and SDG 9 (Industry, innovation and infrastructure). More accountable government on the national level of Global South countries, will filter down to the local (city) level and impact positively in addressing the most pressing concerns, and dealing with the implications of decolonisation from previous rule has to be considered and sensitively addressed in this regard. The SDG Report (2021) refers to the "decade of action" launched in 2019 – maybe this should be the decade of action for cities of the Global South, truly focusing on the most pressing developmental needs within the urban space, assisting cities to catch-up on addressing basic human needs and dignity for their rapidly growing populations.

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Green(Er) Thinking, Green(Er) Cities: Embedding Sustainability As Part of Mainstream Spatial Planning

Juaneé Cilliers*

Abstract: *As the urban landscape is becoming more complex and confronted with multifaceted challenges, the call for an ecologically minded approach to spatial planning is gaining importance. The need to comprehend the integration between human and ecological processes, particularly within human-dominated environments, are crucial for reaching future sustainability goals, especially considering population growth and the sheer speed and scale of urbanization which is further inflating the challenge of creating a livable and sustainable future. Urban planning approaches are now progressively turning towards green planning solutions, drawing on the multiple benefits (related to ecosystem services) that green spaces can provide to cities and societies. In practice these greening approaches and innovations are still limited in application and scope, mostly approached in an ad hoc manner and in many cases not included as part of mainstream spatial planning. This could be attributed to financial limitations impacting decision-making, which is often driven by perceptions of green space value that inhibits the advancement of green(er) cities on a global scale. This research reflected on these challenges and identified how green(er) thinking could lead to green(er) cities. The research draws on 1) transdisciplinary planning approaches, 2) adequate green valuation methods, 3) articulated ecological considerations to inform policy and legislative frameworks and 4) a revised educational agenda to enhance ecological wisdom into context appropriate planning implementation strategies, as some recommendations in the quest of embedding green space planning as part of mainstream spatial planning.*

Keywords: *Green space planning; trans-disciplinary planning, resilience thinking, spatial planning, green cities.*

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Introduction: Towards green(er) cities

Contemporary urban landscapes are highly complex entities constantly dealing with interrelated processes of change, driven by forces of rapid urbanization, increasing population growth and climate change amongst others. As a result, spatial planning recently became more prominent in guiding sustainability thinking and direct the planning of a smart and resilient future (Cilliers, 2018). While cities are constantly dealing with socioeconomic and demographic change, they are now also embarking on strategies for the development of urban green-networks to improve the quality of urban life (Kasperidus et al., 2007:1), driven by the ecologically minded approach that attempt to understand how human and ecological processes could coexist in human-dominated environments, in the quest to reach future sustainability goals. Environmental considerations have thus become an integral part of this developmental thinking, as we increasingly understand that in order to reach a state of sustainability, more emphasis would need to be placed on environmental and related ecological systems (Thomas & Littlewood, 2010:212; Wright, 2011:1008; Van Zyl et al., 2021). Green city consciousness is at a high, with

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a focus to integrate multiple new, and at times paradoxical, ways of thinking and perceiving (Dekay & O'Brien, 2001), but although there is evidence of progress in terms of green city consciousness, it is still very limited in terms of scope and scale. In an attempt to build a case for green(er) thinking and green(er) cities, economic science is continually exploring new ways to determine the costs and benefits of green spaces in terms of the health, experience and pleasure (Ministry of Agriculture, Nature and Food Quality, 2006:34; Cilliers 2018). These benefits provided by urban green spaces are mainly divided in terms of direct and indirect benefits.

Indirect benefits include environmental and social benefits, pertaining to research in environmental psychology and more specifically psychological restoration (Van den Berg et al., 2007:1). Other social benefits derived from green spaces refer to aesthetic value, creating a qualitative living environment, and enhanced community cohesion (Kazmierczak & James, 2008; Cilliers et al., 2010). Both human, as well as mental health are also part of the social benefits of green spaces. Research by Kuo (2003) has determined that having trees in public housing neighborhoods reduces levels of fear, and furthermore promotes less aggressive behavior. It also led to better neighbor relationships. In terms of environmental benefits derived from green spaces, the augmentation of biodiversity might be the greatest contribution. The economic principle of deferred costs is often applied in an attempt to model environmental benefits. In a scenario where trees are not present within an area, the modelling assumes that residents or authorities would have to invest in additional engineered infrastructure or equipment to remedy potential environmental problems (Wolf, 2004:3). Direct benefits reflect the financial gain as a result of the green spaces and hedonic pricing methods are mostly used to determine these values, proving that an attractive environment is likely to influence house prices and neighborhood values (Luttik, 2000:1). In this regard, environmental resources are considered assets to a city and green spaces contribute to competitiveness and overall marketability.

Current green space planning approaches in practice

Sound strategic planning to guide green space planning has been emphasized in recent years (Swanwick et al., 2003). From a theoretical perspective four main approaches guides the planning of green spaces in practice, including 1) the economic approach which views green space in terms of the economic benefits it can provide to society, 2) the development approach which views green spaces as options for future development, 3) the ethical approach which views nature as having value independently of any utility to people and 4) the utilitarian approach which views green spaces as service providers, which support eco-system functions. These four approaches hold implications for green space planning as it provides different valuation perspectives of green space value and positions green space within strategic spatial planning discussions. The economic approach focusses on direct valuation methods, translating green space value to financial terms. The development approach considers real estate value and the impact of the aesthetic appeal of the surrounding landscape, thus more of an indirect gain as a result of green space provision. The ethical approach departs from the understanding that natural values are invaluable and would thus be morally wrong to put a price tag to such spaces. It implies green space planning should be an integral part of any spatial planning approach, aligning to the provision of basic human services. The utilitarian approach states that humans cannot survive without green spaces, green space benefits are infinite and therefore it should be considered part of the total value of the eco-system.

These approaches were further influenced by the outcomes of the Brundtland Report, where planning's focus shifted from environmental management to an explicit normative goal to achieve sustainable development (Van Zyl et al., 2021). As a result, spatial planning approaches increasingly turned towards various open space planning approaches and associated conservation planning approaches (Compaan et al., 2017) in a quest to enhance the vision of green(er) cities. Movements

such as new urbanism and smart growth were further influenced by more sustainability-minded orientations (Lategan & Cilliers, 2013), while initiatives such as urban biodiversity corridors (Burton et al., 2017), climate adaptation plans (Roberts et al., 2012), water-sensitive urban planning and design (Fisher-Jeffes et al., 2017), urban agricultural practices (Steenkamp et al., 2021), and local-level planning actions targeting site specific urban greening initiatives (Sachikonye et al., 2016) were likewise highlighted. The concept of Green Infrastructure has also emerged internationally to approach the planning of the urban green network in totality, thereby including all natural, semi-natural and artificial ecological systems within, around and between urban areas and at all spatial scales (Tzoulas et al., 2007). It provided an appreciation of how green assets and ecological systems function as part of the infrastructural fabric that supports and sustains society, and contributes to build resilience (Harrison et al., 2014:67). Despite the progress made in literature, recent studies confirmed that scholarship on the application of ecological aspects in planning is still limited (Cilliers et al., 2021). In practice the push towards green(er) cities is currently perceived to be more ad hoc and limited to specific contexts or geographical locations, often subject to individual decision-making authorities and their approach to green space planning. While the environmental, economic, and social benefits are extensively captured in literature (Pauleit et al., 2011), and continuously expanded with more and elaborative results to build a case for green(er) cities, in practice it remained unfamiliar and often overlooked by urban planners (di Marino et al., 2019; Hansen et al., 2017). This paper argues that perceptions about green space value might be part of the problem.

Perceptions of green space value and 'thinking' about green spaces

Apart from financial limitations and a lack of implementation strategies put forward as reasons for the slow response towards green(er) cities (Cilliers, 2019; du Toit et al. 2018) the lack of knowledge and perceptions about green space value are argued to be main factors in this regard.

Knowledge: Low to moderate knowledge and awareness amongst planners and professionals working in the Built Environment, which specific reference to ecological aspects in planning, are preventing the integration of greening initiatives (green space planning, green infrastructure planning, nature-based solutions etc.) into mainstream spatial planning (Van Zyl et al., 2021). The lack of knowledge and awareness about the substantial benefits of green spaces, implies a one-dimensional perception of green space value, where the value of these spaces is mostly undervalued or not understood. Several studies have noted the misconceptions regarding urban ecological concepts such as Green Infrastructure in terms of terminology, examples, benefits, and implementation strategies (La Rosa, 2019; Cilliers, 2019) that prevent broader incorporation into conventional planning practice (di Marino et al., 2019). Research of Van Zyl et al (2021) illustrated that Planners in a specific case study were more familiar with the "multi-functionality as urban land-use concept," than "multi-functionality as a Green Infrastructure planning principle". While more could be done to better describe planning concepts and approaches (such as Green Infrastructure), more research on the interface between urban ecology and planning are also needed, to emphasize the overlaps and where planning can articulate ecological principles, and to facilitate the translation of ecological knowledge into context appropriate planning implementation strategies (Steiner, 2016; Van Zyl et al., 2021).

Perceptions: The misconception as green spaces being a 'luxury good', rather than a 'public good' and necessity, is contributing to green spaces being susceptible to land-use changes and degradation of their environmental qualities (Cilliers, 2019). Individual views of Planners were also found to impact the extent to which they would include green initiatives in their planning activities and approaches (Van Zyl et al., 2021), as green space value is subjective to an individual's perception and preferred approach (economic approach, development approach, ethical approach or utilitarian approach) to valuing green space. Professionals which a better understanding of the contribution of ecosystem services would tend to follow the ethical or utilitarian approach. To

further build the case for green(er) cities, more should be done to sensitise communities to understand the value of green spaces (in attempt to augment the societal demand for these spaces), but also likewise to sensitise governments to understand the value of green spaces (in attempt to enhance the commitment to delivery of these spaces). It draws back to bridging the gap between the disciplines of Urban Ecology and Spatial Planning to ensure mutual gains.

In the quest towards planning for sustainability these challenges pertaining to a) knowledge and b) perceptions should be considered as part of the spatial planning process, understanding the limitations and scope and adequately dealing with these challenges, recognising that the need and perspectives linked to the value of green spaces might differ from one context to another, echoing findings of Wendel et al (2012) which calls upon culturally desirable use of green spaces. By addressing the challenges of a) knowledge and b) perceptions of green space, a pathway towards urban sustainability is strengthened, linked to the research of Irvine et al (2009) that suggested that decisions to increase biodiversity in urban green space can generate ecological and psychological benefits through enhanced soundscape quality, ultimately contributing to urban sustainability.

Initiating a change towards sustainability, embedding green(er) thinking in Spatial Planning

Despite the expanding scientific understanding that green spaces are substantially beneficial to urban communities and cities, along with the limited evidence that some global cities are making progress to include nature as part of mainstream planning, more could be done to excel the quest towards green(er) cities and more should be done to reach to global sustainability goals. As a point of departure, more research should inform the interface between Urban Ecology and Spatial Planning to enable the translation of ecological knowledge to inform broader mainstream planning approaches. It could also integrate the views of the economic approach, development approach, ethical approach and utilitarian approach to streamline the thinking and articulate the subjectiveness of value. The perceptions of green space values should also be taken into consideration as a key factor impacting the successful realization of green cities.

To embed green(er) thinking as part of mainstream spatial planning the understanding of the value of green space and nature for cities and citizens would need to be reinforced. This would imply to expand valuation methodologies to capture the benefits of green spaces across socio-economic gradients and cultural borders to ensure an inclusive approach and comprehensive understanding. Currently research is mainly focused on case studies in the Global North, and does not comprehensively consider the context of the Global South. Some case studies in the Global South rejected the proximity principle (which states that property values increase as proximity to green spaces increase) and although more research should be conducted to substantiate these findings, it is evident that green space value are context-based, and could differ between communities, geographical locations and cultures (Cilliers, 2019). Ecological considerations (especially ecosystem services) would also need to be better articulated in spatial planning policy and legislative frameworks, especially to reclaim nature in cities and prioritise urban green spaces and Green Infrastructure networks. Development applications should include these ecological details with reference to the direct and indirect benefits that the proposed development (and environment) will provide to the host society. It calls for a more detailed approach to sustainability thinking, by including these ecological principles as part of spatial planning and not as an addendum to the planning proposed. Ultimately, the educational agenda needs to be strengthened to contextualise ecological considerations as part of broader planning approaches, corresponding to the "ecological wisdom" that urban planners need to plan the cities of the future. Green(er) thinking in this sense could enable the quest towards sustainable cities, embedding green(er) thinking as part of mainstream spatial planning.

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Mainstreaming Green Infrastructure in Planning for Sustainability: The Cape Town Experience

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Abstract: *The global escalation in urbanization levels and associated increased spatial concentration of the demand for various resources have a significant impact on urban ecosystems at multiple scales. The resulting urban challenges require contextually appropriate ecological service solutions incorporated within urban planning processes, and the concept of green infrastructure is increasingly considered as an appropriate response. Although green infrastructure is widely studied in various disciplines, its integration with mainstream urban planning is still a developing field of research and practice impacted by a number of challenges. The main challenges for integrating green infrastructure into mainstream urban planning practices are identified as a lack of conceptual clarity, limited knowledge base of appropriate methods to adequately assess the economic value of ecosystem services provided by green infrastructure, institutional fragmentation of responsibilities and historical path dependencies, lack of consistent integration into urban policies and plans, and insufficient recognition of the importance of the connectivity aspect of green infrastructure in spatial planning. The manner in which green infrastructure has been considered and incorporated in Cape Town's urban planning processes and plans provide potentially useful lessons to other cities facing similar challenges and could contribute to more sustainable urban outcomes.*

Keywords: *Green infrastructure; urbanization; Integrated Development Plan; Spatial Development Framework; Climate Change Strategy; implementation barriers.*

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The concept of Green Infrastructure and its role in planning for sustainability

The world is becoming increasingly urbanized and the global level of urbanization is expected to increase to 60 percent by 2030 (UN: DESA, 2019). This implies an increased spatial concentration of the demand for resources such as land, water, energy, food, infrastructure, services, and consumer goods. The resulting impact on the natural and physical environment drives ecological challenges such as climate change, environmental degradation, loss of biodiversity, and an increase in pollutants (Geertman & Stillwell, 2020; Musakwa & Moyo, 2020; UN: DESA, 2019). In response to these challenges, the concepts of urban sustainability and resilience rose to prominence in global development agendas, and the notion of sustainable and resilient cities is now firmly embedded within global agreements such as the 2030 Agenda for Sustainable Development and the New Urban Agenda (NUA). Contextually appropriate ecological service solutions (also referred to as nature-based solutions) that can be incorporated within urban spatial and infrastructure planning is considered a key element in pursuit of this goal of sustainable and resilient cities (Andersson

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et al., 2019; Shackleton et al., 2021; UN-Habitat, 2020). Nature-based solutions is an umbrella term for ecosystem-based approaches to society's broader challenges through the delivery of ecosystem services (Bush & Doyon, 2019). The concept of green infrastructure (GI) falls under this umbrella of nature-based solutions and has strong linkages with related concepts such as disaster risk reduction, climate adaption and mitigation, and natural water retention measures (European Commission 2021) all aimed at planning processes and outcomes supporting urban sustainability.

One of the challenges when considering the concept of GI from a broader urban planning perspective is the different interpretations of GI and the resulting difficulty to formulate a generally accepted definition. As a result the term GI is often used interchangeably as a 'generalizing' term whose meaning is interpreted and applied differently depending on the context under consideration. Despite this challenge there is however broad agreement around the key principles underlying the semantic understanding of GI. These principles can be described as its connectivity and network-character, multi- functionality, as well as the spatial provisioning of ecosystem services (Seiwert & Rößler 2020). These principles are clearly reflected in the European Commission's definition of GI as a "*strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services such as water purification, air quality, space for recreation and climate mitigation and adaptation*" (European Commission 2021). This definition is widely used in academic and other literature. What is clear from these three principles is that the concept of GI is not simply an alternative way to describe conventional open and green spaces, but also include a wide array of practices such as rainwater harvesting, infiltration, preserving and restoring natural landscape, and site-specific features such as permeable sidewalks, green roofs, trees, and road verges (Gulati & Scholtz, 2020).

Challenges to the incorporation of GI into mainstream urban planning

Green infrastructure is increasingly considered as an appropriate response to provide contextually appropriate ecological service solutions incorporated within urban planning processes. Although green infrastructure and ecosystem services have been studied in various disciplines, its integration with mainstream urban planning is still a developing field of research and practice (Marino, 2019) and a number of critical challenges impact the effectiveness of fully integrating GI (and its associated ecosystem services) into mainstream urban planning practices.

As outlined in the introduction, urban planners and other built environment practitioners are often confronted with a lack of conceptual clarity regarding GI. The term GI are often used interchangeably with various related (but different) concepts such as ecological infrastructure, metropolitan open space systems, and urban greenery (Pasquini & Enqvist, 2019). Officials in urban governance and regulating agencies are not always adequately informed about the scope and role of GI in the urban sphere, leading to over-simplification of GI and misconceptions about what it can achieve. The result is that GI is often perceived as subservient to seemingly more growth-orientated options such as the provision of basic services (du Plessis, 2014) and hence undervalued and reduced to its recreational and aesthetic cultural services functions (Gulati & Scholtz, 2020). This problem is further exacerbated by a lack of clear GI design standards and can lead to uncertainty around how best to plan, implement, and maintain GI (Sinnett et al, 2017).

A second challenge is the limited knowledge base regarding appropriate tools and instruments required to adequately assess the economic value of ecosystem services provided by GI (Schäffler & Swilling, 2013). GI approaches are generally used less extensively compared to traditional grey infrastructure, and information on actual operational and maintenance costs are not that broadly documented. Urban planners and

finance departments in city governance are thus often not adequately equipped to quantify aspects such as return on investment and risk management factors (Alberta Water Portal, 2021). Moreover, despite the need for GI to be planned, designed, and financed similarly to grey infrastructure (Monteiro et al., 2020), it is however not always clear who is responsible for investment in GI and how to quantify the GI benefits (Zuniga-Teran et al., 2020). In the case of African cities specifically, a lack of data on the ability to generate revenue and the cost saving potential implies that the benefits of GI initiatives are not being systematically captured and considered in urban planning processes (Gulati & Scholtz, 2020).

A third obstacle to mainstreaming GI in urban planning processes and policies is the separation of responsibilities amongst different functions related to GI often prevalent in urban governance structures (e.g. parks and open space, environmental management, climate change). This requires a response that fosters cross-departmental collaboration in the planning, management and funding of green infrastructure (Gulati & Scholtz, 2020). The need for collaboration is not only limited to formal city governance structures, but also extend to collaboration with the private sector. This can take the form of creating innovative incentive and funding mechanisms for GI such as subsidies or tax rebates to promote the installation of rainwater harvesting systems (Rostad, Foti, & Montalto 2016). GI is also generally more effective when implemented on a wider scale on both public and private land, and a broad acceptance by communities and a willingness to pay for GI is thus crucial (Zuniga-Teran et al., 2020). This challenge of institutional fragmentation of responsibilities is often the result of historical path dependencies shaping planning standards and regulations favouring conventional infrastructure over GI (Pasquini & Enqvist, 2019). There are however few jurisdictions around the world that have clear processes in urban governance structures for regulating GI and its assumed benefits (Zuniga-Teran et al, 2020). In cities of the Global South, it is particularly important to recognise and show that GI benefits all sectors of society to ensure that unequal access to GI does not result in environmental justice issues where GI is disproportionately distributed across different density and poverty distributions (Fernandez-Alvarez, 2017).

Fourthly and closely associated with the separation of responsibilities and historical path dependencies is the lack of consistent integration of GI in key urban policies and plans. The GI concept is often perceived as a sectoral 'environmental' issue relegated to sector specific plans and policies such as environmental strategies or bioregional plans. This results in it not receiving the required attention in broader strategic level urban planning and decision-making processes. One approach to integrate GI into broader urban planning processes is through embedding it in climate change policies (Pasquini & Enqvist, 2019). Other approaches of a transversal nature can include the revision of existing or creation of new city by-laws to introduce standards that enforce GI design regulations, setting out specific conditions of establishment in the approval of new developments, incorporating GI standards into building plan requirements, and through homeowner association rules.

A final challenge is that the importance of the 'connectivity' perspective of GI (and not confining it to green spaces) is often overlooked. It is critical that the spatial planning of GI be considered within the complete mosaic of land uses and their management in urban systems, including the three dimensions of spatial heterogeneity, organizational connectivity, and temporal contingency (Grove et al 2015). The ecological benefits of connecting GI projects at the city scale are increasingly recognized and should be considered in frameworks for design standards (Zuniga-Teran et al., 2020).

Cape Town's approach to incorporating GI into mainstream urban planning

Contextual setting

Cape Town is a city of 4.5 million people with an av-

erage household size of 3.2 people per household and covering an area of 2461km2 (CoCT, 2021a). The city is internationally renowned for its natural assets such as Table Mountain and Cape Point and its abundant ecological diversity. The Cape Floristic Region is recognised as a global biodiversity hotspot and one of the 25 most-threatened ecosystems in the world (CoCT, 2018a). From an economic perspective the city generates a gross geographic product of over R300 billion and is the second largest urban economy in Southern Africa. Despite a Human Development Index that is significantly higher than the national average, it also faces significant socio-economic challenges including a significant housing backlog and an expanded unemployment rate of 29% (CoCT, 2021a).

As illustrated on Figure 1, the key strategic urban planning policies and plans in Cape Town are the Integrated Development Plan (IDP) and the Spatial Development Framework (SDF). The Integrated Development Plan (IDP) provides strategic direction and aligns the efforts of various spheres of government. It is a strategic five-year plan that guides and informs all municipal level planning and is operationalised through strategic policies, as well municipal budgets informed by departmental business plans (CoCT, 2021a). The municipal SDF provides a common spatial agenda for the IDP and its supporting sector plans (such as the Climate Change Strategy, Human Settlement Plan) and can be viewed as the spatial expression of the IDP. The SDF essentially translates the vision and strategy of the IDP into a desired spatial form that should inform public and private investment decisions (CoCT, 2018b). The overall municipal SDF of Cape Town is further supported by eight more detailed district level SDFs that guide land-use and environmental decisions regarding preferred types and location of development, and include mechanisms such as Environmental Management Frameworks (EMFs). The integration of the District SDFs and EMFs attempts to promote green infrastructure, environmental sustainability and climate resilience approaches and principles (CoCT 2020). As indicated in the previous section, GI can be integrated into broader urban planning processes through embedding it in climate change policies. In the case of CoCT the Climate Change Strategy and the Action Plan provides high-level strategic guidance for decision making, planning, and project development in respect of climate change and includes specific goals and implementation actions related to GI (CoCT 2021b; CoCT 2021c).

Incorporating GI into strategic urban plans and policies

Although green open space have historically always been integrated within the city's strategic urban plans, the recognition of GI as an important distinguishable element has only much more recently been considered and included in these plans and policies. This section reflects on how the CoCT has responded to the challenges of incorporating GI in the mainstream urban planning processes referred to in the previous section. As an overall point of departure the concepts of 'sustainability' and 'resilience' are both embedded as two of the six overall guiding principles identified in the IDP. These guiding principles of the IDP are operationalised through 11 priorities, one of which is defined as 'resource efficiency and security' that specifically recognises the importance of managing the city's GI (CoCT, 2021a). The need for conceptual clarity and a common understanding of GI is recognised and a shared official definition of GI is used consistently across the various policies and plans. This definition of GI is "*an interconnected set of natural and constructed ecological systems, green spaces, and other landscape features that provides ecosystem services. It includes both indigenous and exotic trees, wetlands, parks, greenbelts and green open spaces, and nature reserves and biodiversity sites, as well as building and street-level design interventions that incorporate vegetation*" (CoCT, 2021b:54). The municipal and district SDFs also identified 'green Infrastructure and critical natural assets' as one of the four main structuring elements used in these plans and are viewed as contributing significantly to the future resilience of the city (CoCT 2018b; CoCT 2020).

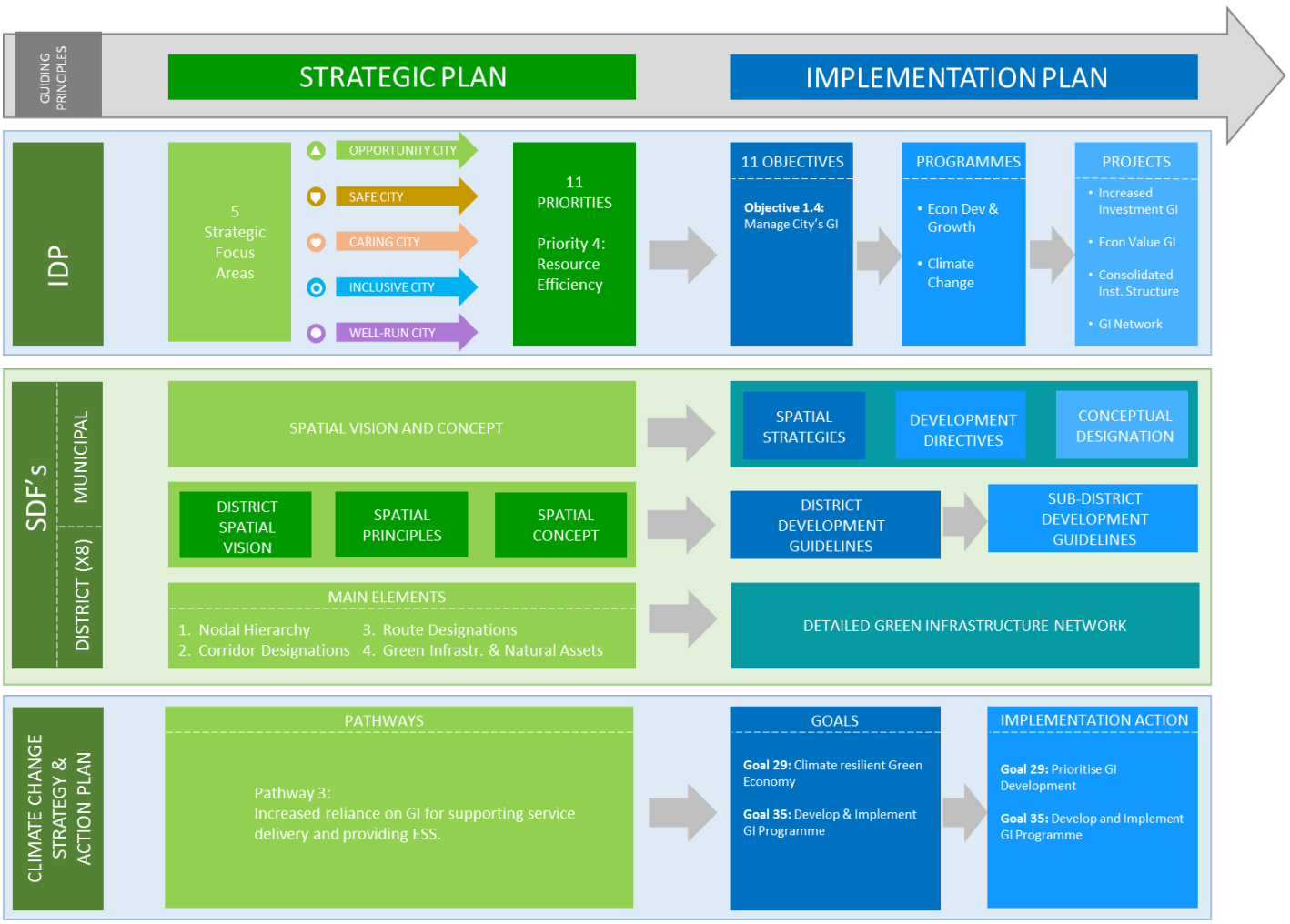

Figure 1. Conceptual representation of the integration of GI in CoCT's strategic urban planning framework
Source: Author

All three these plans recognise the socio-economic value of ecosystem services that GI provide. The IDP proposes the greater deployment of GI as one of its objectives and specifically recognises its cost-effectiveness in aspects such as storm water management and the carbon sequestration potential through a citywide greening strategy. The latest 2021/2022 revision of the IDP specifically added a new initiative to consider the economic value of the city's GI by (CoCT 2021a):

- further evaluating the value of the city's natural assets
- quantifying the socioeconomic benefits of the City's environmental management services and initiatives
- exploring mechanisms for attracting increased investment and funding for environmental management, GI, and climate adaptation.

The SDF also recognises the socio-economic value of the city's biophysical assets, both from an economic perspective providing the foundation for a thriving tourism economy, and its ecological services value in aspects such as storm water drainage and attenuation and providing recreational spaces and non-motorised transport links

(CoCT 2018).

The need for more effective collaboration and institutional cooperation is addressed in the latest 2021/22 revision of the IDP that recommends the consolidation of the coastal, biodiversity, and green infrastructure functions into a single department within the Spatial Planning and Environment Directorate to reduce institutional fragmentation. It is envisaged that this restructuring will contribute to economies of scale and support a strategic, coordinated approach to the management of critical natural assets and GI through the alignment of relevant specialised skills and resources.

The Climate Change Strategy plays an important role in establishing GI as a key component of the city's strategic planning policies. One of the critical pathways identified for achieving the vision of the Climate Change Strategy is the recommendation of increasing reliance on nature-based solutions and GI for supporting service delivery and providing ecosystem services. GI is also a key element in Goal 29 (support the development of a climate-resilient and carbon neutral green economy through city operations) and Goal 35 (develop and implement a GI programme that supports climate change response, protects biodiversity, and enhances ecosystem goods and services). One of the implementation actions identified as part of Goal 29 is to prioritise GI that supports the creation of green jobs. The development and implementation of the Green Infrastructure Programme (GIP) as a key implementation action to be included in strategic planning documents such as the IDP and SDFs (CoCT 2021b; CoCT 2021c). This Green Infrastructure Programme (GIP) is also incorporated as a strategic project in the IDP and the SDF with the aim to (CoCT 2018; CoCT 2021a):

- Identify and map the city's GI assets and sites;
- Promote and implement projects to protect, enhance or create GI
- Inform land-use planning and decision making;
- Develop best practice guidelines in support of GI.

A series of GIP best practice guidelines are being developed and a comprehensive policy and by-law review process with the intention to embed GI principles and approaches transversally within the City are being conducted (CoCT 2021a).

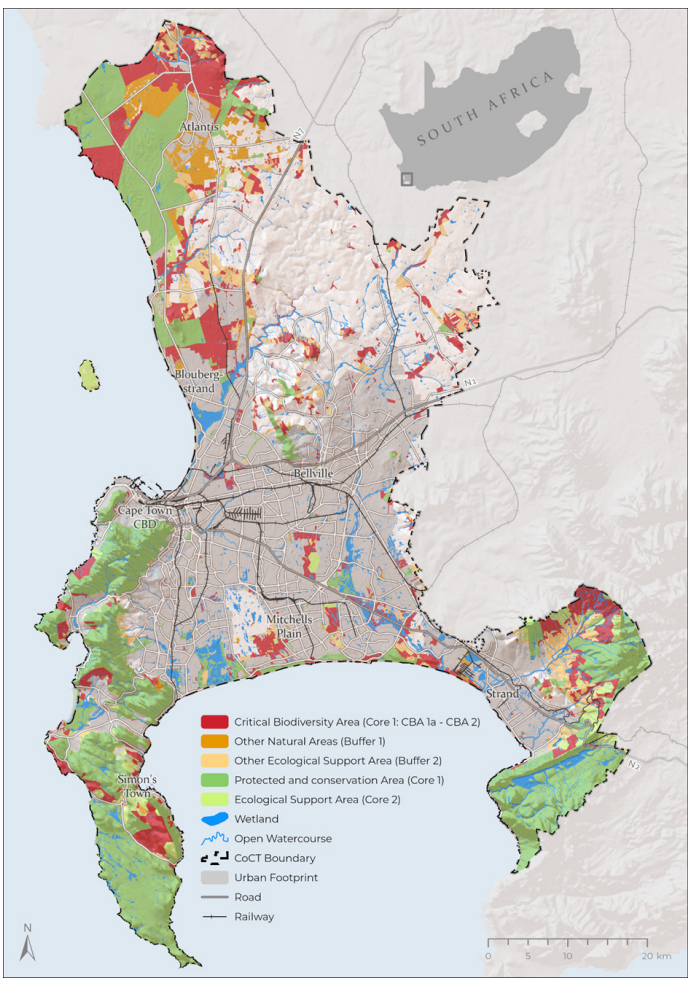

Figure 2. Key elements of Cape Town's Green Infrastructure identified in the Municipal SDF

Source: Author (based on data sources available from the CoCT Open Data Portal)

The 'connectivity' perspective of GI is prominently recognised in the district level SDFs that specifically considers the role of the green infrastructure network (GIN) as identified by the GIN mapping project in the spatial de-

velopment of the city. The GIN is used as an informant for planning and management interventions, and the identification of priority implementation programmes. The concept of 'green corridors' is a prominent element applied in these District SDFs. The concept is operationalised through two components – 'green corridors' and 'tentative green corridors'. Existing 'green corridors' indicate connections through existing conserved areas and open green spaces, while 'tentative green corridors' indicate where links are required and where potential exists to create these links. Where possible, the identified corridors ran between GIN green spaces. Where this was not possible, preference was given sequentially to smaller (preferably unfenced) areas of public open space, other watercourses (not already included in GIN polygons), sports/school fields, thereafter large vegetated road verges, and finally vegetated private land as a last resort (CoCT, 2020). The GIN provides a key structuring element for the spatial development frameworks.

Conclusion

The concept of green infrastructure (GI) falls under the umbrella of nature-based solutions to society's broader challenges through the delivery of ecosystem services. Although GI is increasingly considered as an appropriate response to provide contextually appropriate ecological service solutions to a range of urban development challenges, its integration with mainstream urban planning is still a developing field of research and practice, especially in the Global South. A number of critical challenges impact the effectiveness of fully integrating GI (and its associated ecosystem services) into mainstream urban planning practices. The responses of CoCT to overcome these challenges provide potentially useful lessons for other cities facing similar challenges and could contribute to more sustainable urban outcomes.

The over-simplification of GI and the misconception that it is simply an alternative way to describe conventional open and green spaces like parks often underlies the inability to embed GI consistently across the various urban planning activities. Establishing conceptual clarity and a shared understanding of the interpretation of GI across an organisation is an important stepping stone to advancing GI in urban planning processes. GI approaches are used less extensively than traditional grey infrastructure, and much less documented information is available on its economic benefits, and aspects such as operational and maintenance costs. Urban planners and finance departments in city governance are thus often not adequately equipped to quantify these aspects and it impacts their ability to craft convincing arguments with the necessary political resonance regarding the benefits of GI initiatives. Dedicated research focussing specifically on the economic value of GI initiatives will be crucial in the wider adoption and funding of GI projects. In some instances institutional restructuring will be required to reduce fragmentation of responsibilities and better align relevant specialised skills and resources to support a strategic, coordinated approach to the management of GI. An institutional wide Green Infrastructure Programme (GIP) cutting across various urban planning processes and functions can support the promotion of GI as an integrated policy initiative. This can be further supported by the development of best practice guidelines and comprehensive policy and by-law reviews to ensure that GI is embedded transversally across all strategic urban planning policies and processes. The 'connectivity' perspective of GI (beyond the traditional narrow interpretation of green open space) should specifically be incorporated into urban spatial planning frameworks and policies to fully consider the role of the GI networks in the spatial development of cities.

The integrated approach adopted by the CoCT has resulted in meaningful progress towards effectively integrating GI into the city's mainstream urban planning practices. These initiatives to overcome the identified challenges provide potentially useful lessons for other cities facing similar challenges and could strengthen urban planning processes and outcomes towards urban sustainability.

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The Challenge of Planning Green Spaces in the Global South

Herman Geyer*

Abstract: *Informal settlements often occupy green spaces considered unsuitable for formal urban development. This includes settlements in undeveloped natural areas, within floodplains, against steep slopes, along major transport and services servitudes, or in undeveloped brownfield development areas. The inevitable environmental degradation associated with these settlements pose particular challenges to urban planners and creates several social problems including significant health effects from the concentration of solid and toxic waste, contaminated soil and groundwater, the alteration of natural drainages patterns, and unchecked littering resulting in flooding and raw sewage spills. The implications are important at two levels. Overall, at the regional and city scale these settlements negatively impacts the urban ecosystem services provided by a broader urban green space network. Conversely, at a local level there is also a need to recognise the potential green space functions within informal settlements. This paper investigates how the city of Cape Town Metropolitan municipality, South Africa have responded to these challenges, and how the implementation of local community initiatives can contribute to informally developing context appropriate strategies.*

Keywords: *Green spaces; informal settlements; community consultation; urban planning; informality*

Author's Profile

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Introduction

Green space is a central concept in urban planning that focusses on developing semi-natural green-space matrices within urban and urban fringe landscapes (Mell 2010) and can be defined as an interconnected network of multifunctional green spaces that support both ecological and social activities and processes (Shackleton, et al. 2016). It provides a range of complimentary benefits supporting ecological processes adapted to urban environment, providing recreational and amenity value for users, and creates economic and aesthetic value to open spaces and physical infrastructure networks (Chatzimentor 2020). However, there is often a disconnect between theoretical best case practice on the one hand and in-situ realities prevalent in informal settlements occurring in many cities in the global South on the other hand. It is estimated that in 2018 more than one billion people resided in slums and informal settlements, the vast majority of these in the global South (UN-Habitat 2020) where informal settlements are a widespread feature of many cities. The challenge is that green space as a functional resource of significant amenity value is often interpreted differently by these informal communities than it would be in the North. This article analyses the challenges experienced in planning for green spaces in the South and the manner in which green spaces are perceived in the Southern context. The analysis employs a case study in Cape Town, and the results highlight principles that could be implemented to improve the sustainable planning of green spaces and make it more

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relevant for local communities in the South.

Green space challenges in the Global South

Green space concepts are well established and experientially tested in the North, but in the global South urban planners are faced by many challenges to implement these concepts successfully, particularly in informal settlements. The different social, technological, ecological and institutional contexts in the global South requires a different approach to green space. The challenge is that the form of urban spaces, planning frameworks, urban politics and even the perceived amenity value of green spaces is radically different in developing countries, requiring an idiosyncratic approach closely linked to community consultation. Hence, a more comprehensive overview of green space and associates concepts such as green infrastructure in the global South is long overdue (Wolff et al. 2019).

A number of differences between the Northern and Southern interpretations of green spaces can be identified. Firstly, the idea of green space as a common resource of significant amenity value is not as well established in the global South. In the South, open spaces are primarily viewed as a social and economic resource to acquire firewood, building materials, food, sports and social gatherings (Shackleton et al. 2016) and not primarily for its amenity value. It is not that green spaces are not valued, but green space is valued in terms of its functional utility. Consequently, most open spaces are sub-optimally utilised by residents as informal soccer pitches, informal dump sites or as places for urban agriculture.

Secondly, the degree of connectivity between spaces are far more restrictive in the global South. In the North the extensive connectivity of green space components generate spatial and functional cohesion between ecological habitats and non-motorised transport networks through a patchwork of green space corridors (Meerow 2017). In the global South, however, open spaces that are not guarded by hard barriers of concrete pillars, chain-link fences and barbed wire are often appropriated through informal settlements. Since many residents are accustomed to renting small spaces for self-help backyard housing, an unguarded servitude is often conveniently settled at little or no extra rent. Therefore, between land invasions and hard barriers there is a general lack of connectivity between green spaces.

Thirdly, in the global South the accessibility of open spaces are often limited. In the North, green infrastructure is planned around universal accessibility, providing buffer zones to blend the transition in land uses and linkages to these spaces, and locating green spaces around radial routes and strategic nodes (Wang 2018). In the global South however, green space is generally perceived as uncontrolled spaces generating negative externalities such as litter and crime. Consequently, accessibility to available green space is either closely guarded, with the open spaces surrounding public and private buildings, school grounds, church yards and servitudes separated by hard barriers that isolate the potential user from the space, or these spaces are not well maintained (Adegun 2018). Southern green space thus often lacks functionality, either being preserved but segregated to be utilisable, or deteriorated to the extent of not being utilisable.

Fourthly, in the North the social, environmental, institutional and economic integration of green spaces is generally a key principle of urban development at various regional, city and local scales in a complimentary manner (Mell 2010). Green open space is included in local plans and policies, focussing on maximising the cohesion of the different types of potential users (Tzoulas 2007). As indicated earlier, green space in the South is often physically segregated by hard barriers. The result is that these spaces are spatially segregated in inopportune locations creating a haphazard, disconnected patchwork of spaces with little or no functional integration between them. Often very little attention is given to integrating these spaces into the larger ecosystem or a regional network of interconnected spaces (Roy et al. 2018) as part of urban

planning processes. This patchwork of green spaces are often also disconnected from the actual needs of the community at different scales.

Finally, in the North green space provides various recreational, cultural, economic and aesthetic functionalities, resulting in a range of different benefits to its users, both material and immaterial (Tzoulas 2007). In the global South however, green space tend to be mono-functional since each space is reserved for its primary specific social, recreational or resource purpose, to the exclusion of other possible polyvalent functionalities. A possible reason for this mono-functionalism is to preserve these open spaces due to the difficulties of regulating externalities, particularly in the case of land without proper entitlement.

Planning for green spaces from the perspective of informality

As indicated earlier more than one billion people live in slums and informal settlements, the vast majority in cities in the global South. This implies specific challenges for urban planning processes in these regions regarding the effective incorporation of green spaces as part of sustainable urban environments. Most residents in informal areas have an insufficient understanding of the value of green space (Suri 2017). Cognitively, green space is often regarded as a luxury, and thus is given a low priority relative to other, more pressing social issues, particularly poverty and the lack of housing and basic services (Schäffler and Swilling, 2013). This is despite the potential social value that green space could serve in flood mitigation, urban agriculture, and greywater treatment, social functions and sport opportunities. Moreover, due to the lack of private open space, the residents of informal settlements are more likely to actively use well-managed green space, since they are often the most enthusiastic and active users of green space in the inner cities where they work (Roy et al. 2018). The irony is that the residents in informal areas often have a closer connection to natural ecosystems (Adegun 2018). There is a significant demand for green space, but also a general lack of supporting social and institutional mechanisms to create and manage such spaces.

A significant hurdle is the weak urban planning capacities, dysfunctional land use and regulatory enforcement, as well as the challenges in regularising tenure (Wisner et al. 2015). Implementing green spaces in informal areas requires robust engineering, community consultation, and sound land use management due to the myriad of environmental feedbacks in informal areas. Unfortunately, the concept of green space is often poorly understood by local planners, and consequently receives a low priority in terms of investing public funds (Shackleton, et al. 2016). Planners are sometimes reluctant to implement green space projects, since it often requires the removal of existing informal settlements along watersheds, in parks or along servitudes (Roy et al. 2018). In much of Africa, informal development occurs in peri-urban areas without planning approval. In these spaces, little forethought is given to green spaces, since the primary goal of development is residential, and each illegal occupant is only concerned with their individual housing needs. This haphazard mode of development does not promote interconnected green spaces which requires coordination and integrated planning.

There is also the issue of externalities. Without sound management, natural systems, combined with widespread deprivation often result in significant health and safety hazards, and ultimately in physiological impairment or physical damage (Mulligan et al. 2020). Due to poor sanitation and the illegal disposal of household waste and hazardous chemicals, 'green' space is a regular source of water and waste-borne diseases (Dodman et al. 2011). Under these conditions green spaces are often a source of vermin and the invasive roots of trees regularly damage water and sewerage pipes and housing foundations (Roy et al. 2018), and informal encroachment on floodplains and riparian zones also contributes to flooding. Moreover, because these spaces do not belong to an individual, green space is often a source of criminal activities (Donaldson-Selby et al. 2007). There is consequently

little inherent community valuation of the ecological aspects of green space and thus open spaces are only maintained with respect to its primary social or economic utilities (Adegun 2017). Ineffective regulated informal development both reduces the versatility of natural ecosystems and undermining human-nature interactions (Adegun 2018). Instead, open spaces are often appropriated for social and cultural uses, either as informal soccer pitches, church yards, community gathering places, or as informal dump sites, especially if there is insufficient disposal facilities nearby (Roy et al. 2018).

The challenge for urban planning under these conditions is to alter the deeply ingrained perception of green space as unsafe (Adegun 2018). There is a significant cognitive barrier in conveying the value of green space to local communities, and consequently communities themselves do not maintain green spaces. On the other hand, the challenges faced in informal communities are also often not understood by planners, who devise unsuitable Western designs and risk mitigation strategies based on a limited knowledge of local conditions (Matthews et al. 2015). Once these conceptual barriers are bridged, it is entirely possible for informal communities to own and maintain green spaces, and provide better social welfare at a lower cost than current initiatives.

Analysis of green spaces in Cape Town informal settlements

The case study is the result of extended interviews with over 60 residents and officials in the townships of Nomzamo, Lwandle, Zola and Greenfields, Cape Town, as indicated in Figure 1. Some of the results are sourced from two earlier studies on informal land use regulation and the illegal dumping of waste in the study area, and additional follow-up semi-structured interviews were conducted with the participants on green space issues. Randomised convenience sampling was used to select persons of various genders, nationalities and ethnicities. The study area is primarily an informal housing development on which a number of residents also established backyard structures locally known as 'hokkies'. The original settlement was designed with plentiful open spaces, including corner parks, children's playgrounds and open spaces around institutional buildings such as council offices, sports grounds, museums and churches. There is a riparian system consisting of non-perennial streams and seasonal wetlands throughout the area and unfenced private development plots along the periphery of the settlement that serve as green spaces.

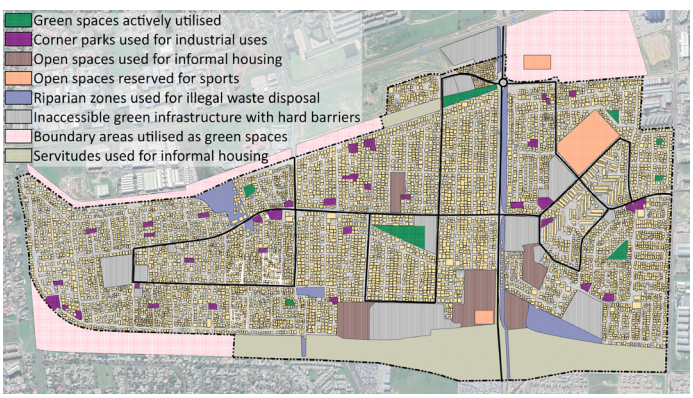

Figure 1. The study area
Source: Author

What is immediately noticeable is how many of the inappropriate green spaces were repurposed. Most of the corner parks were incrementally appropriated for piecemeal commercial development, since their small size and lack of functional use meant that the local communities repurposed these spaces as workspaces in the motor industry, or occupied by mobile shipping containers modified as shops (See Figure 2). Corner plots were repurposed since these spaces did not serve a clear community function or have exclusive community ownership. Since these plots were located at the crossroads of several small street committees, there was no authority to control these spaces. Without a community authority, these disused spaces became vandalised as community members removed fencing, paving, furniture and trees which were reutilised in their homes or sold for scrap. Without appropriate fencing, these spaces were repurposed for other

uses.

Figure 2. Corner plots repurposed as commercial areas
Source: Author

The green space that remained in use had strong community functions, particularly sports grounds and children's play parks, even if their overall condition deteriorated. Since most play parks were located in central block locations with a single street entrance, these remained in good order because they had exclusive community control through the local street committee in whose territory they were located (see Figure 3). The local communities generally protected these parks from misuse of facilities, although certain facilities were vandalised. These play parks, however, were mostly located in communities with dysfunctional street committees that did not have the ability to regulate misuse.

Figure 3. Midblock children's play parks
Source: Author

Although there is a significant amount of green spaces in and around public institutions, such as schools, clinics, and municipal offices, these were segregated from the green spaces by hard barriers, including concrete pillars, palisade fences, chain link fences and barbed wire. The purpose of this is to preserve the green space for a particular set of users. These spaces are only open to the public during certain events such as the Heritage Day celebrations. Due to the shortage of adequate green open spaces, privately-owned land adjacent to informal settlements are often used for social uses, including sporting events that require space and religious services that require solitude (see Figure 4). In these spaces, the property owners often permit these activities, since the community is nascent to intrude upon these highly regarded social functions out of respect for religious and sporting traditions, and will not construct informal housing or commercial facilities on spaces reserved for these events. Other open spaces adjacent to these seettlements are reserved for urban agriculture and livestock corrals, an activity which also prevents the erecting of informal housing.

Figure 4. Sporting events on open spaces adjacent to informal settlements
Source: Author

Since riparian systems did not have a specific social or economic function these were almost universally degraded and used for waste disposal. Due to a lack of wheelie bins for backyard housing and a shortage of state-supplied disposable garbage bags in informal settlements, each street committee has a specific community-designated waste disposal site, which invariably is located in open spaces away from residential and commercial facilities. Since the municipality regularly supplies workers to clean riparian zones, many community members view this as a potential source of local employment. Every large park has a designated waste disposal site usually

located at the entrance of the park away from the park facilities (See Figure 5).

Figure 5. Dumping sites in the corner of a play park. The shipping containers are used for waste disposal
Source: Author

Although the parks in informal settlements may not be as safe and sanitary as those in formal settlements, if valued as a legitimate community function, these facilities are adequately regulated by street committees against criminal activities, malicious vandalism or theft of materials. However, there are still serious health and safety challenges in green spaces that planners should be cognisant of. Open spaces not under the direct control of street committees are vulnerable to violent crimes, including armed theft, and physical and sexual assault, particularly in areas where workers travel to and from work. In areas close to drug houses, the parks are frequented by Tik and Nayope[1] users. Children playing in green spaces regularly encounter dead animals, medicalised waste and dangerous materials. Parks also attract noisy parties that continue until late at night. It is particularly difficult to predict how the community will interact with green spaces, since it depends on the strength of community bonds. There is no single formula recipe to create successful green spaces, and thus extensive community consultation and coordination is essential for planning in these local contexts.

Informally privatising green spaces often yields some positive results. In one instance, a riparian zone was utilised as a DJ facility and eatery selling meat for local barbecue functions. The owners kept the riparian zone clean, employing local workers to clean litter dumped in the riparian zone and forcefully removing criminal elements from the area. Commercial activities was contained in a mobile container and the sides of the canal was decked with repurposed crates and pallets to create a deck for weekend barbecue picnics. In another instance, urban agriculture was combined with a local takeaway, so that the space also provided a clean and secure spot for public picnics. Although small trees and shrubs are often removed from parks for private use, this also provides an opportunity for the community to provide green cover along local streets. Another potential opportunity is providing laundry lines in spaces along the sides of public parks. Most park fences are covered by laundry, and thus laundry lines will enable greater public use of this facilities while providing vigilance against criminal activities.

Conclusions

There are subtle differences in the use of green spaces in the North and in the South. In the case study area at least, the most successful parks are those with limited accessibility. Green space that serve as thoroughfare also serve as a convenient location for criminal activities, beyond the control of street committees. Another difference is that in the South amenity may supplement value to spaces, but the amenity value of green spaces is not a value in itself. Well-maintained green spaces optimise the visual appeal of the space to attract local users. However, when those efforts are placed in areas where there is no functional utility for the community, such as in corner parks, the space becomes vandalised in a short period of time. Whilst green spaces in the North requires connectivity and accessibility, in the South, the hard barriers and patchwork patterns of segregated green spaces creates a sense of security and prevents the instances of vandalism found in more accessible facilities.

Regardless whether green space in the global South has coherence at regional and city scales, it is essential to appeal to the functionality of the space at a social, economic or institutional level, even if it makes the space monofunctional. The preservation of certain spaces only occurs due to community associating that space

[1]Tik is a cheap form of methamphetamine combined with various household chemicals commonly found in the Western Cape. Nyope is similarly a local combination of heroin, cannabis and various household chemicals prevalent in South African cities.

with a particular activity held in high regard, particularly religious or sport activities, preventing community members from infringing or denying those uses. Privatising certain functions without limiting public accessibility also works well, since the operators usually keep the space safe and secure. Combining public uses with ancillary functions such as laundry lines and play parks also yielded some positive results. Furthermore, reserving spaces for urban agriculture and livestock farming serves to protect the space from land invasions and the illegal dumping of household waste. An easy quick win solution could also include providing more wheelie bins and plastic bags for household waste, and providing cheap trees allowing residents of these settlements to green their own spaces. The greatest challenge however, is planning green spaces with extensive community consultation, since these communities generally understand what is required to make green space development successful within their local context.

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Urban Green Spaces And The Mitigation Of Surface Urban Heat Islands In The City Of Cape Town

Lukas Beuster*

Abstract: *Modern urban environments create distinct local climates and build up excess heat as a result of materials used, their spatial configuration, and often also their lack of green spaces. This effect, where temperatures in some areas are noticeably higher than surrounding areas is called the Urban Heat Island effect. This article provides an overview of the causes and effects of the phenomenon, a first look at the extent and severity, as well as an assessment of the efficacy of mitigation measures like green spaces and cool surfaces in the City of Cape Town, South Africa. The study shows the importance of considering UHI effects when planning for sustainability. Results indicate severe heat build-up in the city – with 5,5% of the land within the urban edge exhibiting significantly higher temperatures than their immediate surroundings. Green spaces specifically play an important role in both heating and cooling the city, based on their quality and availability of irrigation. The study finds additional mitigation potential in the use of cool surfaces which are not recognized in local policy and planning instruments. Specifically in drought prone environments, a more diversified approach should be taken, mitigating UHI effects and adverse outcomes for energy efficiency and human health. Urban greening and sponge city approaches should be complemented by integrating cool surfaces in both policy and practice.*

Keywords: *Urban heat islands; green spaces; cool surfaces; mitigation strategies; climate change.*

Author's Profile

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Introduction

Modern urban spaces are at odds with the natural environment. Due to concentrations of non-permeable surfaces such as tar and concrete, and a subsequent lack of vegetation there is a build-up of heat with areas showing an above-average increase in temperature in many parts of modern cities. This can be described as the phenomenon of Urban Heat Islands (UHI). This increase in temperature results from a variety of factors, including the structure, materials and positioning of buildings and infrastructure, the morphology of the land as well as the lack of green spaces. The Surface Urban Heat Island (SUHI) specifically is negatively influencing the habitability of urban environments including adverse impacts on human health and productivity, increases in energy consumption as well as higher emissions of pollutants and greenhouse gases (Estoque, Murayama & Myint 2017).

Up until recently, the phenomenon of UHI did not receive much attention on the African continent. However, the growing awareness of the impact of climate change on urban planning and development is starting to change this perception. The City of Cape Town (CoCT) is one of these examples. Exposed to a Mediterranean climate, the city is already vulnerable to droughts and heat-waves – which has been exacerbated by rapid growth over the last decades (Sorensen

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2017; City of Cape Town 2021a). This article sets out to surmise the causes and effects of UHI, its current extent and severity in the CoCT in South Africa, the most effective mitigation strategies as well as the current local policy response to urban heat. The goal is to assert implications for sustainable urban planning to address the phenomenon.

Urban heat islands and their relevance for sustainable urban planning

UHI can be classified into two broad types that are interconnected, the one being a result of the other: The Surface Urban Heat Island (SUHI) and the Atmospheric Urban Heat Island (AUHI) (Voogt & Oke 2003). While the AUHI does contributes to the UHI phenomenon, available data is generally sparse due to the difficulty and cost associated with its collection (e.g., collecting point data using weather balloons). For the purpose of this study, only the SUHI is analysed to gain a large-scale overview of the UHI phenomenon in the study area – and point towards its relevance in planning theory and practice. The SUHI describes the phenomenon of warmer relative surface temperatures exhibited in different parts of cities as well as along the rural-urban interface characterised by different land uses and infrastructure. It varies in intensity relative to seasonal differences in the amount of solar energy, different types of land use, land cover as well as cloud cover, atmospheric water content and precipitation (Hardy & Nel 2015; Monama 2012). UHI's occur due to changes in the natural energy balance as urban spaces expand. Urban land cover, its configuration and materials used in construction, as well as human activity such as transportation systems and energy usage for lighting, heating and cooling, are all factors that alter the energy balance and the atmospheric state of the city (Roth 2012). During colder months, this can produce positive effects, with benefits such as reducing the financial and environmental burden of heating and decreasing the amount of cold-related deaths and illnesses. These positive effects, however, are severely outweighed by the negative effects. Increased urban temperatures escalate the occurrence of heat-related illnesses and increase mortality. They also intensify air pollution and significantly increase energy demands for cooling – in turn increasing greenhouse gas emissions (Roth 2012). To put this into perspective: A review of existing studies on UHI impacts on individual buildings showed increases in cooling energy consumption of up to 120%, while decreases in heating energy consumption only ranged up to 45%. There was significant spatial variation between cities in the study – with the median of cooling energy consumption at 19% and heating at 18,7% - but the extreme cases highlight the potential impact and the need to identify the most vulnerable cities, neighbourhoods and buildings (Xiaoma *et al.* 2019). The UHI phenomenon also significantly influences the health of the population, with an increase of cardiovascular and respiratory diseases as well as increased mortality and a decrease of years lived in good health, particularly for vulnerable populations.

Mitigating surface urban heat islands

A variety of mitigation strategies can be used to combat the UHI phenomenon and reduce its effects. Although awareness has increased, cities are still underutilising their UHI mitigation and climate change adaptation potential and have not yet formalised requirements in traditional planning processes – likely due to the complexity of challenges faced as well as underestimating potential impact. Adaptation of mitigation measures and their integration into planning and practice, however, do not have to be complex or expensive. Green spaces specifically can make cities more resilient to climate change and extreme weather events, including excess heat. Public green spaces are also known to have positive effects on peoples' mental and physical health – thus positively influencing their well-being (Akbari & Kolokotsa 2016; World Health Organization 2016). Additionally, greening provides the opportunity to upgrade existing buildings cost-effectively, reduce cooling and heating loads as well as life-cycle costs and as such, increase the energy efficiency of the built environment (Kontoleon

& Eumorfopoulou 2010). This might prove especially valuable for resource poor environments in the Global South. The combined benefits of urban greening justifies prioritising the extension of green spaces in urban areas (Song et al. 2018).

However, merely proving the extent of the cooling effect of green spaces is insufficient to guarantee their success as a heat mitigation strategy. Successful mitigation strategies are often hindered by a lack of formal instruments and financing models for the provision as part of urban planning and management (Sun & Chen 2012; Yu *et al.* 2017). Early adoption of new technology is always challenging and in the case of green technology, such as green roofs and walls, active support from governments can play a significant role in promoting the development and implementation of these systems. The current political and economic climate are increasingly conducive to the diffusion of green technology with populations gradually more aware of climate change processes and the importance of sustainable development. Urban areas are also in a constant flux, with buildings being re-roofed, pavements being maintained, upgraded, or replaced and new developments changing the urban landscape (Akbari & Kolokotsa 2016). Making the integration of cool roofs and pavements commonplace can jointly affect more than 50% of urban land cover, emphasising the mitigation potential of these solutions. In some cases, the establishment of so-called ventilation corridors, where the spatial configuration increases airflow, might also provide additional mitigation capacity.

UHI in Cape Town – the role of green spaces

In addition to the influx of people and the continuous demand for housing and infrastructure, the climate of the CoCT is also changing. Over the past decades, hot days have become more frequent and increased in intensity, indicative of significant warming trends. Projections forecast a drying trend for the entire Western Cape region, including an incremental rise of mean temperatures by between 2.5 and 4°C under high mitigation scenarios and >4°C under low mitigation interventions until the end of the century – with lower temperatures expected closer to coastal areas (min. 1.5°C) (Department of Environment, Forestry and Fisheries 2019; Midgley *et al* 2005). In CoCT specifically, a decrease in average rainfall, an increase in the number of very hot days and the frequency and intensity of heatwaves (three days or more of 32+ °C) are predicted for the mid-future period up to 2050 (City of Cape Town 2021b). While an incremental increase does not sound dramatic, this trend could exacerbate the UHI-phenomenon in the future, trapping more pollutants in the air and increasing heat stress.

As the main concern of this study is SUHI, satellite imagery was used for the analysis. Using satellite imagery to calculate Land Surface Temperature (LST) has proven one of the most efficient ways of assessing surface temperatures on a regional scale, offering the ability to deduct relationships between land use, land cover changes and variations in temperatures as previously exemplified for the City of Tshwane Metropolitan Municipality, South Africa (Monama 2012). A similar approach was followed for this analysis, using Landsat 8 OLI/TIRS Imagery and land cover data. For the purpose of this article, the focus is on the results of Getis-Ord GI* (Hot-Spot) Analysis using the derived surface temperature values. Looking at the entire area of the CoCT, pixels are identified that have significantly different temperature values (lower or higher) from the expected value in a given area – these are then identified as hot- or cold-spots relative to their surroundings. In order to derive the areas that show consistent statistically significant hot and cold spots throughout the year, the seasonal Getis-Ord Gi* results obtained throughout the study period were intersected to reveal areas of overlap. Figure 1 shows these consistent hot and cold spots, defined as areas where temperature values are significantly higher or lower throughout different seasons during the study period. Of the ~990km² inside the urban edge, 54km² (5.5%) are classified as consistent hot spots

and 62km² (6.3%) exhibit consistent cold spots.

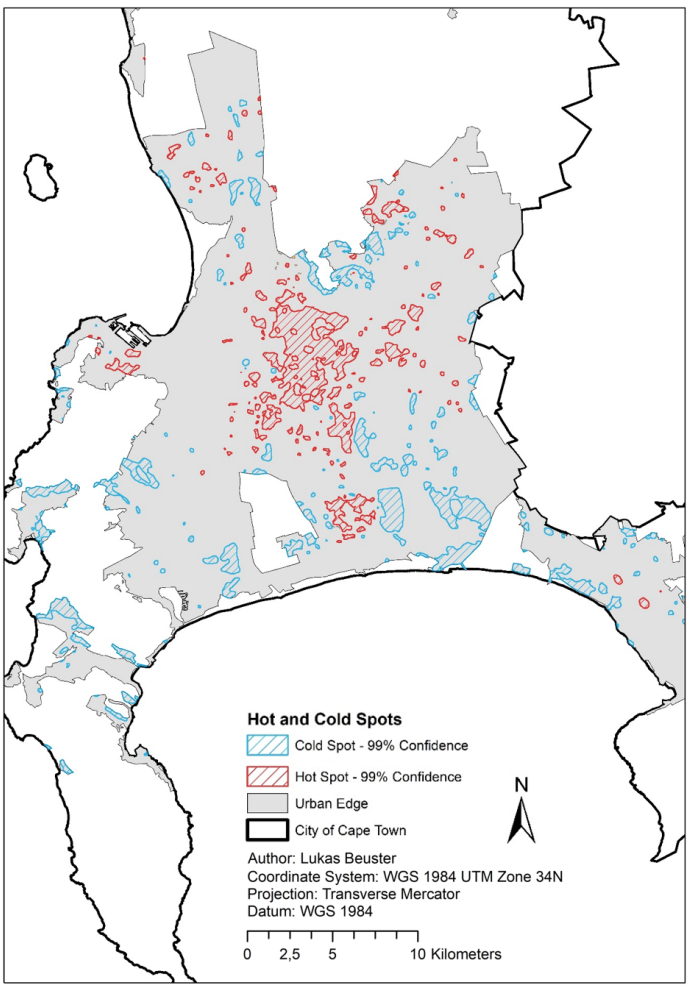

Figure 1. Consistent hot and cold spots in the CoCT

Source: Author

In the case of the CoCT, the highest share (>20%) of consistent hot-spots within the urban edge is covered by natural vegetation. Considering the location of these hot spots it becomes apparent that they are dominated by sparsely vegetated grassland instead of diverse vegetation. The most visible examples of the heating effect of vegetation can be seen around large open areas, such as around the Cape Town International Airport. Closer to the City Bowl and situated below Table Mountain the area known as District 6 – a residential area known as a site of Apartheid forced removals and destruction – shows the same effect. Both the airport and District 6 are predominantly covered by open grass. Although natural vegetation makes up a large part of the consistent hot spots (22.8%), it also represents the dominant majority of land cover within the identified consistent cold spots within the urban edge (41.8% of land cover within consistent cold spots). This effect is more noticeable in the densely vegetated areas towards Table Mountain and in the wetlands in the Cape Flats, showcasing that green spaces can contribute to both UHI and Urban Cooling Islands (UCI) – depending on their quality and composition. For a summary of all land cover categories identified as consistent hot or cold spots and their respective share, see Figure 2.

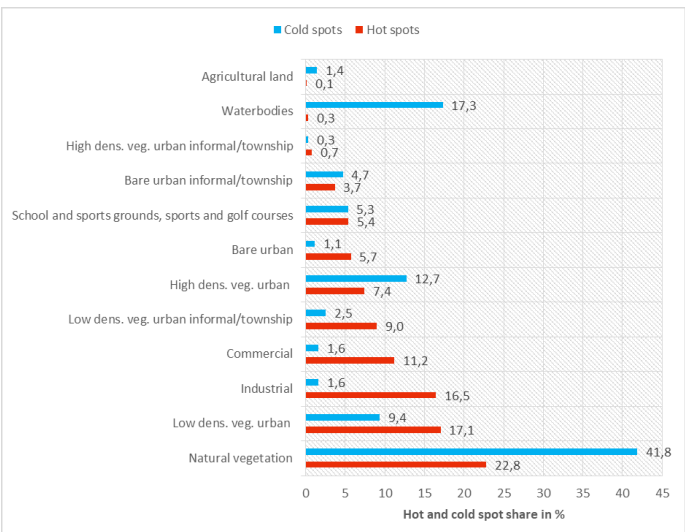

Figure 2. Land cover share of consistent hot and cold spots within the urban edge

Source: Author

The data also reveals that the natural vegetation inside the urban edge is on average -0.4°C cooler than the other landcover categories. This value is substantially lower than the -0.94°C average calculated as part of a 2010 meta-analysis of green space temperature differentials during the day in 45 cities (Bowler *et al.* 2010). In comparison, while green spaces in the CoCT reveal wide-reaching cooling capacities and exhibit minimum temperatures of up to 3.9°C lower than all other landcover categories – a report in Lisbon showed a decrease of 6.9°C, almost double the reduction (Oliveira *et al.* 2011). Interestingly, the natural vegetation in the CoCT

can reach surface temperatures of up to 2.2°C higher than any urban surfaces on average. This is most likely to be explained by the dominant vegetation type in the study area. Most of the vegetation in and around the CoCT is light and naturally vegetated areas consisting mostly of bush and shrubs which falls dry during the summer – changing the soil matrix, reducing evapotranspiration and ultimately increasing the heat build-up (McCarthy *et al.* 2010; Oleson 2012). Despite some exceptions, the CoCT lacks wide-spread lush and dense vegetation to facilitate a cooling effect on a large scale. About 20% of the consistent hot spots throughout the urban edge are covered by sparsely vegetated grassland. While green spaces dominated by grass might exhibit insignificant temperature differences or even a cooling effect during the rainy season in winter, they transform into dry areas and contribute to excessive heating during the summer months. Some of these grassy areas are also significantly hotter throughout the year, increasing surface level temperatures in the surrounding areas. The vacant land within District Six in the city bowl is a prominent example of this (See figure 3). Emphasizing the importance of taking evapotranspiration into account is the fact that over the course of the next decades, solar radiation is expected to increase in intensity – leading to reductions in overall humidity.

Figure 3. Permanent hot spots in the city bowl. Bo-Kaap, District 6, and Foreshore

Source: Author, Image layer credit: Esri

Large scale irrigation, which could make up for a shortfall in precipitation, are unsustainable in a drought-prone environment such as the CoCT. Instead of extending green spaces for cooling purposes, the immediate focus should be on preserving existing parks, wetlands and the remaining indigenous vegetation. In order to facilitate the extension of green spaces as part of thermal management, the city would first have to impose new efficiencies in its water management approach. Re-evaluating a combination of thermal and water management and culminating in sponge-city approaches (retaining rainwater within the city bounds, used to irrigate vegetation and to keep groundwater levels high) should be further investigated (Chan, Griffiths, Higgitt, Xu, Zhu, Tang, Xu & Thorne 2018; Jiang, Zevenbergen & Ma 2018; Liu & Jensen 2018).

UHI in Cape Town – the role of cool surfaces

In addition to urban greening, recent advances in cool surface materials might prove a worthwhile alternative. Looking at the hot spots around the CoCT, industrial areas are among the hottest areas overall. However, small sections of these areas – centred around specific buildings - stand in contrast to this heat build-up and exhibit minimum temperatures that are up to 6.7°C lower than the rest of the urban area combined, even cooler than the most effective green spaces. Looking at some of the industrial areas the reason for this noticeable discrepancy can be found in the usage (whether purposeful or accidental) of highly reflective roofing materials. The Cape Town Market in Epping Industria 1 is one of the most prominent examples of the potential of cool surfaces within the CoCT. The surface temperature of the roof is consistently cooler than the surrounding areas in all seasons. Thus, whilst large sections of Epping Industria show significant hot spots, the market stays cool. It is argued that between 20%-25% of a city's area is covered by roofs (USA Environmental Protection Agency 2012a). Implementing cool roof provisions according to the examples set by cities such as Los Angeles, Chicago and or Toronto could yield dramatic increases in the overall albedo (reflectiveness) of the city. Similarly, many of the UHI within the city boundaries are located around ma-

jor intersections and other transportation infrastructure. The citywide application of cool surfaces could theoretically increase the albedo of between 55-70% of the cities land cover (on average 25% of overall landcover in urban areas are roofs, 30-45% are pavement (USA Environmental Protection Agency 2012a,b)) dramatically altering the temperature experienced within the city. Only slight increases in albedo could yield temperature reductions of 0.5 to 1.5°C overall, with extreme increases potentially between 1°C and 2.2°C – as shown in a modelling approach for Athens, a city with a similar climate to the CoCT (Santamouris 2014). This indicates that the CoCTs roofs and pavements offer vast potential for UHI mitigation. However, adaptation of cool surface strategies into the building codes is heavily reliant on public will and the availability of materials. In the CoCT, a combined approach of redressing both industrial and commercial surface areas could alone positively influence as much as a third of the consistent hot spots exhibited within the urban edge. Addressing reflectance in both low density vegetated urban surfaces, as well as their informal/township equivalent, could potentially increase this number to over 50%. Applying cool surface strategies in these areas should thus gain priority status in the CoCTs UHI mitigation.

Cape Town's urban heat agenda in planning for sustainability

Combating climate change and its impacts is a key element of the global SDG goals and targets and is specifically recognised in Goals 1, 11, and 13. Of specific importance is Target 11.b of Goal 11 that calls for an increase in the number of cities and human settlements that develop and implement integrated policies and plans towards mitigation of climate change. Managing the effects of UHI should inherently form part of any climate strategy or plan. Although awareness about the UHI phenomenon and mitigation measures to reduce its effects has increased, cities such as Cape Town are still underutilising their UHI mitigation potential and have not yet incorporated and formalised requirements in traditional urban planning processes. Over the past few years, the CoCT has made some progress in recognizing the issue of UHI and taking steps towards understanding and mitigating the issue. After recognizing UHI loosely in the Smart Building Handbook (City of Cape Town 2012) and Climate Change Policy (City of Cape Town 2017), without putting forward clear goals or instructions, more recent publications explicitly target urban heat. This might also be related to the city's participation in the C40 Cities Climate Leadership Group and the Resilient Cities Network, with support to working towards the Paris Agreement and SDGs. The CoCT's Climate Change Strategy, for example, identified urban cooling and heat responsiveness as a strategic focus area (SFA 1), calling for increased understanding and vulnerability assessments as well as plotting concrete steps for their mitigation. These steps mainly focused on tree planting initiatives, noting their limitation in the need for sustainable irrigation methods (City of Cape Town 2021a). The Climate Action Plan is supposed to put this into practice with actions such as drafting a heatwave and high-heat day action plan (and developing a network of cooling centres – facilities that provide cooling services to residents and visitors (City of Cape Town 2021b). Both actions are currently only in planning and concept stage, but are pointing in a promising direction.

The primary strategic urban planning policies and plans in Cape Town are the Integrated Development Plan (IDP) and the Spatial Development Framework (SDF). The Integrated Development Plan (IDP) provides strategic direction and guides all planning and investment decisions in five-year cycles. The municipal SDF provides the spatial expression of the IDP and outlines the desired spatial form that should inform public and private investment decisions. Although mitigation of UHI is recognised in the climate change action plan, and both the IDP and District SDFs refer to a citywide greening strategy and green corridors that has the potential to reduce climate impacts by reducing the heat island effect, no formal planning requirements have yet been incorporated in these two plans. Integrating a formal process for heat impact assessments into environmental impact studies of developments might be a sensible option for governments to keep unwanted heat-

ing in check as planners need to better understand the impact of green spaces and cool surfaces on mitigating UHI effects. This is even more important when considering that new developments often exacerbate the UHI effect as urban planners don't have the awareness or tools available to assess heat impact. Sensible densification can yield lower increases in temperatures, especially with the inclusion of cool surfaces like green or cool roofs in the development process (Doan *et al.* 2016).

Discussion and conclusion

Urban Heat Islands are a global phenomenon. Resulting from the materials, spatial configuration and activities within urban environments, and exacerbated by climate change, its occurrence and mitigation will increase in importance over the course of this century. Despite its wide-reaching effects and impact on sustainable development - affecting energy use as well as physical and mental health -the causes, severity and spatial distribution are under recognized. The combination of causes and effects, as well as the scale of current and projected development in an increasingly urban world clearly establishes the need to act decisively to mitigate adverse outcomes of the Urban Heat Island effect. Inadequate recognition of heat build-up in urban areas ultimately inhibits the goal of planning for sustainability in the Global South and beyond. Local governments, practitioners and citizens will have to take UHI mitigation into consideration if they are aiming to design sustainable and healthy urban environments. In achieving greater climate resilience, nature-based solutions such as urban greening can also offer synergetic effects and have a variety of beneficiaries as well as furthering general sustainability outcomes. Different interrelated political goals like emission reduction, ecosystem protection, increased circularity and energy efficiency can be pursued simultaneously when taking nature based solutions into account, often at lower costs than comparable traditional methods.

Urban greening can however not be considered as the sole long-term solution where UHI is recognized as a problem. As this study of the CoCT has confirmed, green spaces can be effective at producing cooling effects. Green spaces are, however, also able to produce adverse effects, specifically in drought prone environments, exacerbating heat build-up rather than producing desired cooling effects if they are of low quality, density and diversity. Taking limitations in the availability of sustainable irrigation sources into consideration, a more diversified strategy is required to mitigate urban heat. As shown in this assessment of the CoCT, cool surface technologies can provide similar, if not superior, cooling results than green spaces. Considering that around 20-25% of surface area in urban environments are covered by roofs, and an equal portion by pavements – both of which need regular maintenance and can thus be improved over time - the strategic importance of the use of cool surface materials in creating cooler, more energy efficient and healthier cities should receive more attention. Cities facing similar environmental conditions such as Cape Town should pay special attention to this fact when designing UHI mitigation strategies and putting forward planning requirements and future-proofing their assets.

Based on these results UHI mitigation should become commonplace in development policy and be integrated into urban planning and policy processes, building codes and common planning practice in order to ensure sustainable urban environments, increase resilience and facilitate increased well-being and the creation of healthy cities along the way.

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