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THE CASE FOR INVESTMENT IN GREEN INFRASTRUCTURE IN AFRICAN CITIES

BRIEFING PAPER · MARCH 2020

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Design and layout:
Farm Design, www.farmdesign.co.za

Cover photograph:
Landscape architects: Square One, sq1.co.za

Citation:
Gulati, M & Scholtz, L (2020) *The case for investment in green infrastructure in African Cities*. Cape Town, WWF South Africa

Available online at:
www.wwf.org.za/report/investment_in_urban_green_infrastructure

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WWF-SA is a registered non-profit organisation, number 003-226 NPO.

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EXECUTIVE SUMMARY

Africa is undergoing a significant phase of growth, demographically and economically. Estimates suggest that the population of 1.1 billion will likely double by 2050, and most of this will happen in cities.[1] This frenetic and unprecedented pace of urbanisation means that urban growth is taking placing in the absence of adequate and prior planning with investment not keeping pace with the growth in demand for key services. This is placing stress on already stretched infrastructure, compounding the critical deficits in existing infrastructure.

African cities are also expanding in areas with sensitive, critical and fragile ecosystems like forests, low-elevation coastal zones and mega-deltas. As a result, urbanisation is altering the natural landscape of these cities, leading to a range of adverse ecological impacts such as deforestation, habitat fragmentation, habitat loss and soil erosion. The unprecedented climate stress facing African cities adds a further dimension to these challenges. Africa's urban areas are likely to suffer disproportionately from climate change, as the region as a whole is warming up 1.5 times faster than the global average.[2] These areas are becoming increasingly vulnerable to the impacts of climate change, such as droughts, increased precipitation, rising sea levels, more frequent and stronger cyclones and storms, and extreme temperatures.

It is therefore critical that there is a spotlight on **what** infrastructure gets built because of the sheer magnitude of the investment and associated impacts. If the vision of urbanisation is to achieve inclusive growth, reduce poverty and improve standards of living while making cities more resilient and sustainable, the support and regeneration of urban ecosystems must be integrated into urban infrastructure development.

There is an opportunity for African policymakers to invest differently in urban infrastructure, learning from the mistakes of developed countries. Part of infrastructure approaches must involve screening out risky or unsuitable projects. Decision-makers will need to apply tools to identify infrastructure projects that pose a risk to the overall resilience of a city and that should be halted, postponed or redesigned to respond to these risks. There is already a growing recognition of the reliance of cities on ecological infrastructure, not only because it provides crucial resources such as water but also because it can act as a bulwark against future climate change impacts.

Policymakers and planners need to factor in the natural environment and the ecosystem services which green infrastructure delivers to urban and peri-urban areas. Factoring in green infrastructure when planning new infrastructure or rehabilitating existing infrastructure will give cities a more balanced approach. In this way urban infrastructure can be developed while at the same time safeguarding sensitive ecosystems. This will increase the resilience of cities and help them to adapt and respond to climate change-related issues. Furthermore, green infrastructure projects hold proven social and other benefits for population groups in the low socio-economic strata.

At this stage, a limited understanding of the distinction between the different types of infrastructure – grey, sustainable, climate resilient and green infrastructure – means that policy and planning for urban infrastructure often do not recognise and understand when to promote which kind of infrastructure, how to build the business case for it, and how to ensure that infrastructure is designed to provide the intended benefits. A better understanding of

the definitions of the different types of infrastructure and how they interact and overlap with one another will help African cities to procure and build optimal infrastructure that addresses the challenges of urbanisation on the continent.

'Green infrastructure' is not simply an alternative way to describe conventional open and green spaces like parks. It includes a wide array of practices such as infiltration, evapotranspiration and rainwater harvesting; preserving and restoring natural landscape features such as forests, floodplains, wetlands, rivers and canals, including their banks; and site-specific features such as bioretention, trees, green roofs, road verges, permeable sidewalks and cisterns. It enhances the liveability and prosperity of cities by reducing adverse environmental impacts and increasing resilience. In so doing, it protects existing built infrastructure from the impacts of climate change and advances human and environmental health.

Green infrastructure can improve the quality of the urban environment; help to achieve social, economic, public health and environmental goals; help cities to attract investment, revive distressed neighbourhoods and encourage redevelopment; and provide recreational opportunities for residents.

By virtue of its nature as well as the numerous options available, green infrastructure offers localised and scale-dependent solutions to address the context-specific challenges of cities. It also allows for more flexibility in adapting to changes in climatic or socio-economic conditions and can provide less expensive options to manage urbanisation.

Benefits of green infrastructure projects in cities include the **provision of ecosystem services**, such as regulating urban temperature; augmenting water supply and improving water quality; strengthening flood protection and supporting sustainable drainage; and improving air quality.

Green infrastructure in cities can **generate economic value and employment for cities and city-regions**. These benefits can provide direct value by using previously developed, underused or neglected land to develop green infrastructure and so promote job creation in planning, designing, improving, developing and subsequently managing and maintaining these areas. It can provide indirect value by improving the aesthetic quality of cities, attract businesses and investment, and promote tourism. By reducing the damage from extreme weather events, it can avoid costs for the repair and rehabilitation of infrastructure. It can also play a role in risk management by lowering flood risk and so reduce insurance premiums for homes and businesses.

Green infrastructure projects in cities can **increase social cohesion and public health outcomes**, particularly for groups in the low socio-economic strata, by promoting social interaction and community building, improving health and well-being and reducing health inequalities.

Lastly, it can **unlock a range of financing mechanisms** such as public-private partnership models of financing, access climate-specific institutional investor groups and specialist green funds, and use innovative financing mechanisms. It can also unlock financing opportunities linked to innovation and provide opportunities for levy-based approaches.

However, to date there is no uniform understanding or definition of 'green infrastructure' under urban planning or policy frameworks. This is not to say that no attempts have been made to deal with the subject; there are examples, but these are the exception rather than the norm. Large-scale application of green infrastructure is also inhibited by existing barriers to investment in this kind of infrastructure. These barriers include a limited understanding of green infrastructure, brought about by the lack of a definition of green infrastructure in the planning and policy frameworks of cities, and little technical guidance for the implementation of green infrastructure in cities. Spatial planners, regulators and permitting agencies are also not adequately educated on the scope and role of green infrastructure in the urban sphere and there is a general lack of cross-departmental collaboration that is required for cross-cutting and interdisciplinary green infrastructure projects. In addition, quantifying the benefits of green infrastructure is not easy. This is exacerbated by the lack of Africa-specific data and case studies that provide evidence of the benefits of implementing green infrastructure in African cities. All of these barriers are amplified by land-use conflicts.

As demonstrated by the many case examples, green infrastructure is increasingly becoming a part of the economic, social and ecological narrative of urbanisation globally. However, there is no coherent narrative supporting the role this infrastructure has to play in promoting more sustainable urban development on the African continent. In fact, green infrastructure appears, at present, to be marginalised compared to built development needs in African cities. In order to change this and prepare the ground for African cities to adopt an integrated and coherent approach towards green infrastructure, the report makes the following recommendations: fostering a better understanding of green infrastructure; developing robust evidence of green infrastructure; building the economic case for green infrastructure; developing frameworks for context-specific green infrastructure; developing frameworks to assess the value of green infrastructure projects; and building a holistic case for green infrastructure in cities.

INFRASTRUCTURE RESPONSES TO URBANISATION IN AFRICA

Africa is undergoing a significant phase of growth, demographically and economically. Estimates suggest that the population of 1.1 billion will likely double by 2050, and most of this will happen in cities.[3] Estimates of future urban population as a percentage of total population range from between 56%[4] and 84%[5] by 2060. Unlike other parts of the world where urbanisation is being driven by rural-to-urban migration, urbanisation in Africa is being driven largely by rural transformation and natural population growth in urban areas.[6]

This frenetic and unprecedented pace of urbanisation means that urban growth is taking place in the absence of adequate and prior planning, with infrastructure investment not keeping pace with the growth in demand for key services. This is placing stress on the already stretched infrastructure, compounding the critical deficits in existing infrastructure. Cities are being built in an expansive rather than a compact form[7] and are physically fragmented and dispersed.[8] They are expanding in areas with sensitive, critical and fragile ecosystems like forests, low-elevation coastal zones and mega-deltas. As just one example, in the absence of guided and regulated growth, the majority of Kampala's population in Uganda is projected to live in flood-prone areas by 2030.[9]

The lack of public provision of infrastructure is giving rise to alternative, unregulated suppliers who operate in complete disregard of sustainable resource management. This is compounding the problems of air pollution and deterioration in the quality and quantity of water supplies. As a result of shortages in the provision of housing, informal settlements are mushrooming close to employment hubs. These settlements lack basic services and lead to unhealthy and unhygienic living conditions. The poor in particular are building homes in unsafe places such as on riverbanks and hillsides and in mangroves and coastal areas. This compounds risks such as highly polluted run-off flowing into water bodies and contaminating them. Where infrastructure is being built, the location and design have weak and often non-existent links with ecological infrastructure.[10] Impervious surfaces such as settlements and road and rail networks are replacing cropland, forests and wetlands with high ecological value.

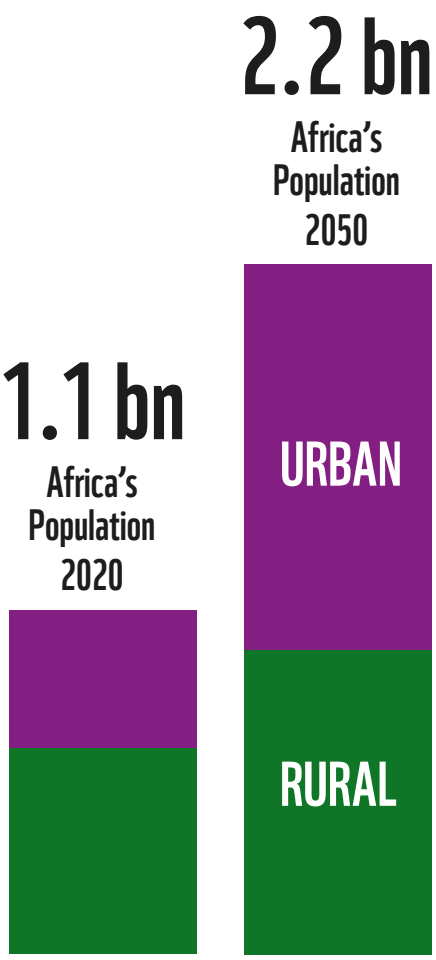
As a result, urbanisation is altering the natural landscape of African cities, leading to a range of adverse ecological impacts such as deforestation, habitat fragmentation, habitat loss and soil erosion. This increases the risk of landslides, sea-level rise, flash flooding, droughts and heat waves, leaving both citizens and urban infrastructure vulnerable. It is estimated that 70% of the population of Lagos in Nigeria lives in slums vulnerable to environmental hazards, including regular flooding.[11] These characteristics are not limited to capital cities or large urban centres; they also manifest in smaller cities and towns across the continent.

The unprecedented climate stress facing African cities adds a further dimension to these challenges. Africa's urban areas are likely to suffer disproportionately from climate change, as the region as a whole is warming up 1.5 times faster than the global average.[12] These areas are becoming increasingly vulnerable to the impacts of climate change such as droughts, increased precipitation, rising sea levels, more frequent and stronger cyclones and storms and extreme temperatures. A recent study observes that the fastest-growing cities on the continent are the most vulnerable to climate change globally.[13]

For cities to meet the needs of their residents, urban development needs a new perspective. Besides the deficit in urban infrastructure, it is critical that there is a spotlight on **what** infrastructure gets built because of the sheer magnitude of the investment and associated impacts. If the vision of urbanisation is to achieve inclusive growth, reduce poverty and improve standards of living while making cities more resilient and sustainable, the support and regeneration of urban ecosystems must be integrated into urban infrastructure development.

There is an opportunity for African policymakers to invest differently in urban infrastructure, learning from the mistakes of developed countries. Part of the greening infrastructure approach must involve screening out risky or unsuitable projects. Decision-makers will need to apply tools to identify infrastructure projects that pose a risk to the overall resilience of a city and which should be halted, postponed or redesigned to respond to these risks. There is already a growing recognition of the reliance of cities on ecological infrastructure, not only because it provides crucial resources such as water but also because it can act as a bulwark against future climate change impacts. In addition, many African urban centres have expressed ambitions and committed to meeting the 1.5 °C pathway of the Paris Agreement. Urban ecosystems can play a critical role in achieving this ambition.

Africa's population will likely double by 2050, and most of this will happen in cities.



BEYOND THE JARGON

As urbanisation becomes the centrepiece for sustainable development on the continent, the term 'infrastructure' is acquiring new connotations.

Conventional infrastructure is now referred to as 'grey infrastructure' to distinguish it from ecologically sound approaches to infrastructure, which are referred to as 'green infrastructure'. Then there is 'climate-resilient infrastructure' and 'sustainable infrastructure'. An unintended consequence of this is that the proliferation of terms sometimes creates more confusion than clarity. This does not benefit the discourse on envisaged urbanisation that aims to harmonise physical infrastructure with ecosystems to maximise social cohesion, the urban economy and human well-being.

Moreover, a limited understanding of the distinction between the different types of infrastructure means that policy and planning for urban infrastructure often do not recognise and understand when to promote which kind of infrastructure, how to build the business case for it, and how to ensure that infrastructure is designed to provide the intended benefits. A better understanding of the definitions of the different types of infrastructure and how they interact and overlap with one another will help African cities to procure and build optimal infrastructure that addresses the challenges of urbanisation on the continent. Important to note, these different types of infrastructure are not mutually exclusive, but collectively contribute to the overall infrastructure in modern cities.

Grey infrastructure

Grey infrastructure refers to man-made, engineered systems, relating to transport (such as motorways, roads, car parks, railways, ports/freight terminals, canals, airports and dams) and utilities, and the distribution of services (such as sewers, cables, water and gas pipelines, waste management and landfills, sewage treatment and energy generation). It also includes commercial infrastructure (such as factories and industrial offices, retail establishments, mines and quarries) and social infrastructure (such as schools, hospitals, housing, coastal defences and flood control).

Climate-resilient infrastructure

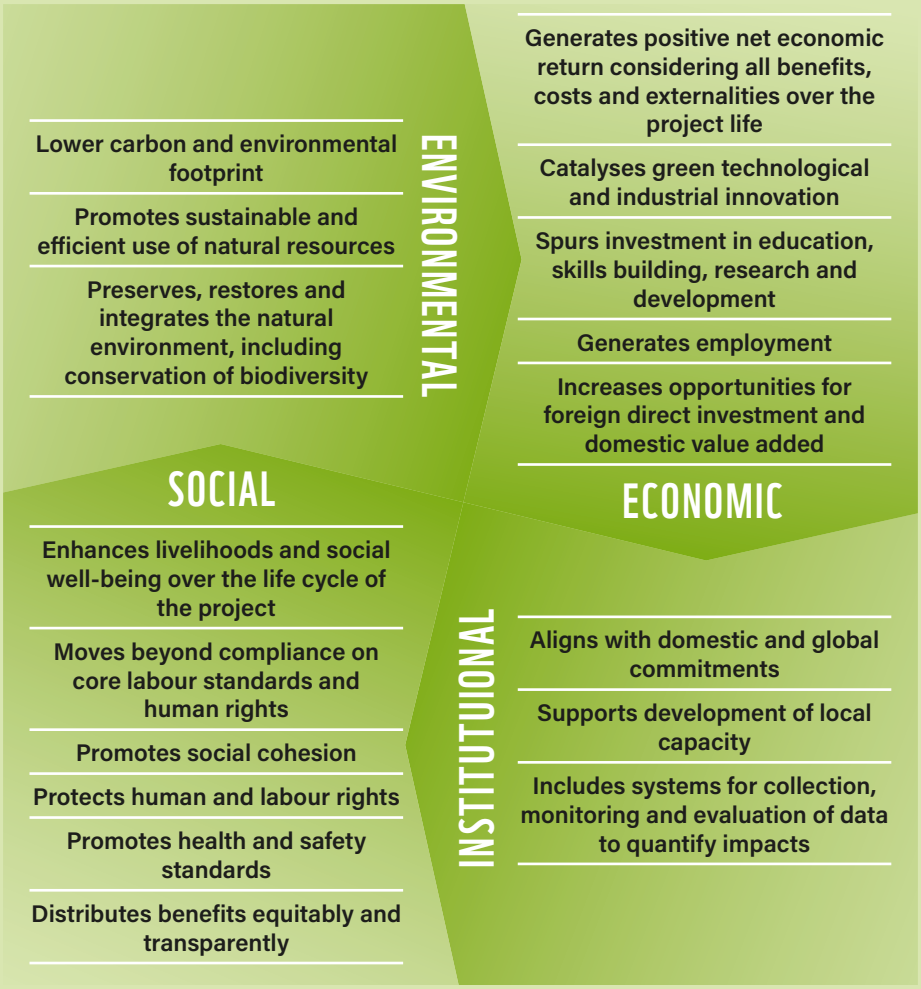
Irrespective of the choice of infrastructure, it is imperative that infrastructure should be climate resilient. Climate-resilient infrastructure refers to infrastructure that is planned, designed, built and operated in a way that prepares for the projected impacts of climate change such as storms, floods, heatwaves and extreme cold weather, and adapts to these risks.[14] This type of infrastructure can endure disruptions caused by climate change-induced extreme weather conditions and can be either grey or green infrastructure or a combination of the two. It reduces damage to the infrastructure itself and can minimise interruptions in the services delivered. Thus infrastructure that is climate-resilient improves the reliability of service provision, increases the life of the asset, reduces the economic cost of climate change and protects returns on assets. However, it may not fully eliminate these risks or disruptions.[15]

Both existing and new infrastructure can be made climate resilient – existing infrastructure through a range of measures such as maintenance regimes. The vulnerability of new infrastructure can be reduced by making better decisions about the location, design, construction and operation of infrastructure.[16]

Sustainable infrastructure

Sustainable infrastructure is defined as infrastructure that is economically, socially, environmentally and institutionally sustainable,[17] calculated over the entire life cycle of the infrastructure. Infrastructure projects are planned, designed, constructed, operated and decommissioned along the broader principles of sustainability. As such it accounts for complexity, assesses direct and indirect impacts, identifies synergies and ensures sustainability, as illustrated here.

Sources: IDB,[18] WWF & IISD[19]



Green infrastructure

Green infrastructure is a network of natural or man-made environmental features that deliver ecosystem services within the built environment, through natural or ecological as well as man-made infrastructure. Ecosystem services refer to benefits such as clean water, clean air, climate regulation, flood prevention, pollination and food production, among other things. Green infrastructure is found primarily in urban or peri-urban areas and is planned and implemented through strategic and coordinated infrastructure and urban development initiatives.

'Green infrastructure' is not simply an alternative way to describe conventional open and green spaces like parks. It includes a wide array of practices such as infiltration, evapotranspiration and rainwater harvesting; preserving and restoring natural landscape features such as forests, floodplains, wetlands, rivers and canals, including their banks; and site-specific features such as bioretention, trees, green roofs, road verges, permeable sidewalks and cisterns. It enhances the liveability and prosperity of cities by reducing adverse environmental impacts and increasing resilience. In so doing, it protects existing built infrastructure from the impacts of climate change and advances human and environmental health.

Examples of green infrastructure interventions include:

- Redesigning river channels to enhance the functioning of the stormwater system
- Installing soak-away gardens to prevent flooding in areas without formalised stormwater infrastructure
- Restoring rivers in cities to lower the temperature of the surrounding area
- Planting street trees to remove carbon dioxide, dust and particulate matter from the air
- Installing green roofs to reduce stormwater run-off and reduce heating, ventilation and air-conditioning costs
- Improving streetscape greenery to give residents a greater sense of community and belonging
- Improving greenery in schools to improve behaviour and scholastic achievement
- Improving access to green spaces to give the mental and physical health of residents a boost
- Creating permeable sidewalks, rain gardens, grass swales, artificial ponds and wetlands to prevent flooding
- Planting indigenous trees to restore degraded areas in catchments

Box 1: Ecologically sound urban infrastructure can help to alleviate poverty

Urban infrastructure that integrates the protection and enhancement of water resources can alleviate the water poverty problem in cities. While this may appear small in the context of one city, the impact at scale can be sizeable, given that 40 billion hours are lost annually in collecting water in sub-Saharan Africa. The lack of access to clean, safe water and proper sanitation is one of the main reasons for poverty due to its implications for health, education and food production.[20]

Box 2: Green infrastructure provides context-specific solutions

Several examples of localised green infrastructure solutions are emerging from South Africa. In the case of Atlas Spruit, a river in Ekurhuleni, Gauteng, green infrastructure took the form of redesigning the river channel and the adjacent park to enhance the functioning of the upgraded stormwater culvert. Property values have increased as a result of this intervention and home owners are once again able to reinstate home insurance policies that had been cancelled.[21] Another example can be found in Diepsloot in Johannesburg, which is prone to flooding due to the absence of formalised stormwater infrastructure. Green infrastructure in the form of soak-away gardens, developed by a community-based organisation, has helped to address the challenges and risks from standing water and flooding by absorbing excess surface water.

BENEFITS OF GREEN INFRASTRUCTURE FOR CITIES

Supporters of green infrastructure argue that policymakers and planners need to factor in the natural environment and the ecosystem services which the infrastructure delivers to urban and peri-urban areas.

Factoring in green infrastructure when planning new or rehabilitating existing infrastructure can help cities to follow a more balanced approach. In this way urban infrastructure can be developed while at the same time safeguarding sensitive ecosystems. This increases the resilience of cities and helps them to adapt and respond to climate change-related issues.

As already highlighted, rapid and unplanned urbanisation in Africa poses several serious challenges relating to the overall development, liveability and resilience of cities. Cities are already struggling to meet the demand for good air quality, adequate water supply, access to energy, public transport, housing and recreation opportunities. Increased urbanisation accompanied by an increased demand for natural resources and services will put even greater pressure on current infrastructure and supply systems. These challenges are likely to grow as the climate continues to change, putting additional strain on public infrastructure and disrupting services. Repairing and/or building replacement grey infrastructure that carries high capital costs will be expensive and will stretch municipal budgets.

Green infrastructure offers a range of responses to these challenges. It can improve the quality of the urban environment; help to achieve social, economic, public health and environmental goals; help cities to attract investment, revive distressed neighbourhoods and encourage redevelopment; and provide recreational opportunities for residents (see Box 1).

By virtue of its nature as well as the numerous options available, green infrastructure offers localised and scale-dependent solutions to address the context-specific challenges of cities (see Box 2). It also allows for more flexibility in adapting to changes in climatic or socio-economic conditions and can provide less expensive options to managing urbanisation (see Box 3). Grey infrastructure, conversely, is more expensive and difficult to reverse or modify to meet changing conditions once built.

Box 3: A more flexible approach and less expensive option for meeting the demands placed by urbanisation

A study by the United States Environmental Protection Agency (EPA) on 17 case studies[22] of developments that include green infrastructure practices for stormwater management found that total capital cost savings ranged from 15% to 80% for projects using these practices. Although in some cases the initial project costs were higher than those of conventional stormwater management practices, these projects will more than pay for themselves in the long term.

In the city of Philadelphia, green practices designed to deliver similar stormwater performance to conventional practices in several watersheds were evaluated. The additional economic and social benefits from a community-scale programme of green and conventional stormwater practices attributed an additional benefit of more than USD2.7 billion to the option that used 50% green infrastructure practices.

Green streets in Seattle have demonstrated lower requirements for pavements, reducing pavement costs by 49%.[23]

Providing ecosystem services

Well-planned and -managed green infrastructure provides indispensable benefits and services for the functioning of cities, such as:[24]

- **Regulating urban temperature**: Green infrastructure such as trees and parks can reduce the urban heat-island effect that results from the proliferation of dense concentrations of concrete and built infrastructure in African cities. Reduced temperatures mean air conditioners are not used as frequently, which reduces the energy demand. This is particularly relevant for African cities that often have erratic and inadequate access to electricity as a result of inadequate generation capacity in many African countries. Box 4 provides examples of cities where green infrastructure has provided regulation services of this nature.
- **Augmenting water supply and improving water quality**: Cities in southern Africa are already experiencing droughts. Meeting the surging demand for water by urban residents and businesses is becoming increasingly difficult. Green infrastructure can augment water supply in various ways. It can sustain aquifers and river flows, use rainwater harvesting, and improve water quality by removing pollutants from water. In so doing, it also addresses electricity constraints. It reduces the need for energy-intensive water-treatment plants and mitigates the effects of less electricity from hydroelectric plants due to lower rainfall that causes a drop in water levels.
- **Strengthening flood protection and supporting sustainable drainage**: As urbanisation in African cities increases, so does the prevalence of hard or impervious surfaces in urban areas. Coupled with the increasing and variable extreme precipitation brought about by climate change, this is posing water management challenges in these cities because stormwater infiltration is reduced. Green infrastructure such as green roofs, swales, permeable paving and rain gardens can provide natural stormwater management and drainage services by allowing water to permeate the ground. This reduces both the volume and the rate of water run-off and helps to prevent flooding.
- **Improving air quality**: African cities are planning or putting in place urban transport infrastructure to meet the demands of residents, which is expected to increase air pollution. Green corridors, urban forests and vegetation can filter the air to reduce the exposure of pedestrians and urban residents to pollution. It also reduces air temperatures and dampens noise in urban settings.

Box 4: Green infrastructure delivers ecosystem services in cities

Many examples can be found of ecosystem services being delivered by green infrastructure in cities. The restoration of the Cheonggyecheon River in Seoul, South Korea, which had been erased by a three-lane stretch of elevated highway, has lowered ambient temperatures along the restored blue-green corridor to 3 °C lower than the average in the city.

Energy savings due to shading and climate effects from street trees in Lisbon in Portugal, Berkeley in California and Cheyenne in Wyoming, have amounted to USD6.16/tree annually, USD15/tree annually and USD11/tree annually, respectively.[25] Tree cover in Washington, DC is estimated to remove 20 million pounds of pollutants from the air every year.[26] Each square foot of green roof in the City of Portland is estimated to remove 0.04 pounds of dust and particulate matter from the air.[27]

In Chicago, green infrastructure approaches diverted over 70 million gallons of stormwater from the central sewer system in 2009.[28]

ENERGY SAVING IN USD PER TREE ANNUALLY

6.16	15.00	11.00
Lisbon, Portugal	Berkeley, California	Cheyenne, Wyoming

Stimulating economic activity

Green infrastructure in cities can generate economic value and employment for cities and city-regions. These benefits take the following form:[29]

- **Direct value**: Using previously developed, underused or neglected land to develop green infrastructure promotes job creation in planning, designing, improving, developing and subsequently managing and maintaining these areas. The extension, rehabilitation and maintenance of urban forests and wetlands specifically stimulate economic activity such as agriculture and forestry, thereby generating livelihoods for the urban poor.
- **Indirect value**: By improving the aesthetic quality of cities, green infrastructure can attract businesses and investment, and promote tourism. This leads to increased economic activity and job generation. Investment in green infrastructure can also increase the value of property and land nearby, generating higher returns for home owners and the city.
- **Avoided costs**: By reducing the damage from extreme weather events, green infrastructure can avoid costs for the repair and rehabilitation of infrastructure. By providing good-quality, accessible green spaces, it can improve levels of physical activity and health, and promote psychological health and mental well-being. This leads to savings in healthcare costs for governments and reduces health inequality. In the context of the difficulties cities face when it comes to financing the maintenance and efficient management of existing and new infrastructure, the economic benefits and savings generated and the costs avoided can ease the financial burden on them.
- **Risk management value**: By lowering flood risk, green infrastructure can reduce insurance premiums for homes and businesses.

The economic value-add and savings from green infrastructure can ease the pressure on public budgets for many African cities that are already finding it difficult to raise financing for even the most basic infrastructure (see Box 5).

Box 5: Green infrastructure delivers cost savings to cities

Many cities are already experiencing the benefit of cost savings. Examples can be found from as early as the 1990s. New York City avoided spending USD6–8 billion on new grey infrastructure water filtration and treatment plants by instead purchasing and protecting watershed land in the Catskill Mountains for USD1.5 billion.[30]

Green roofs in the City of Chicago have the potential to yield annual savings ranging from USD29.2 million to USD111 million.[31] The City of Portland estimates that eco-roofs generate a net benefit of USD404 000 over a 40-year lifespan on account of a one-off and ongoing reduction in stormwater management fees, cooling and heating costs and HVAC (heating, ventilation and air conditioning) equipment sizing costs, as well as avoided stormwater management facility costs and roof replacement costs.[32]


Photo: Greenpeace Africa

Increasing social cohesion and public health outcomes

Green infrastructure projects in cities increase social cohesion and public health outcomes, particularly for groups in the low socio-economic strata:[33]

- **Promoting social interaction and community building**: Green corridors and green spaces can have positive effects on the creation and growth of communities by promoting social interaction and community building. Increasing the provision of green corridors and green spaces in low-income areas particularly has a positive effect, since communities in these areas spend more time in their neighbourhoods.
- **Improving health and well-being**: Green infrastructure, particularly green spaces like parks, can have a significant impact on the health and well-being of urban residents. Green spaces have been proven to increase physical activity and reduce blood pressure, the risk of a stroke, cardiovascular disease, obesity and the level of stress in residents who have better access to these spaces.
- **Reducing health inequalities**: Like social cohesion outcomes, the health benefits of green infrastructure are higher for residents from the lowest socio-economic groups. Therefore, green infrastructure can reduce health inequalities.

Box 6: Social and health benefits of green infrastructure

- A study carried out across Europe found that urban residents with access to large amounts of green space were three times as likely to be physically active as those living in areas where there is little green space.[34]
- A study carried out in the Netherlands found that improved streetscape greenery led to greater neighbourhood-scale social cohesion and promoted a greater sense of community, trust and feelings of being accepted and belonging.
- Research links high levels of greenery at home and at school with improved cognitive development in school children via better progress in working memory and reduced inattentiveness. In the United Kingdom (UK), a survey of schools that have improved their school grounds to include more greening indicates that 65% of schools have observed improved attitudes to learning; 73% of schools have experienced improved behaviour in pupils; 64% of schools reported reduced bullying; and 84% of schools reported improved social interaction among learners.[35]
- Improving access to green space can enhance mental and physical health and produce major economic benefits. In the UK, illness as an outcome of physical inactivity has been calculated as costing the National Health Service close to GBP1 billion annually, with indirect costs been as high as GBP8 billion per annum. Even a permanent 1% reduction in the UK's sedentary population can deliver a benefit of up to GBP1.44 billion annually in economic benefits to the UK's economy.[36]

Unlocking a range of financing mechanisms

Given the myriad and multiple benefits of green infrastructure, African cities can access a wide range of possible financing sources and innovative financing mechanisms at different levels to develop the infrastructure needed to meet the surging challenges and demands of urbanisation. Urban infrastructure projects in African cities tend to be financed largely from public funding sources. The general deficit in urban infrastructure, combined with the fiscal health of African countries and cities, is posing acute challenges for the financing of urban infrastructure development in African cities.

The diverse benefits of green infrastructure can open options for public-private partnership models of financing (see Box 7). Cities can also access a broader set of financiers and financing sources such as climate-specific institutional investor groups and specialist green funds, or use innovative financing mechanisms (see Box 8). Transport corridors that incorporate green infrastructure to reduce air pollution and noise can access traditional finance as well as finance that supports the reduction of air pollution in cities. Similarly, stormwater management solutions that incorporate both grey and green measures can access finance that supports cities in building their climate resilience. Innovative options such as debt-for-nature swaps can also become available to cities.

Box 7: Development through public-private partnerships

The City of Wuhan in China was able to transform 3.8 km² of the Nanganqu Park into a 'sponge site', with permeable sidewalks, rain gardens, grass swales, artificial ponds and wetlands involving a total investment of CNY1.26 billion. The city contributed only 20% of the total investment.[37] The remaining 80% came from the private sector.[38]

The City of Bilbao in Spain has also financed a new flood-proof district that includes a flood-protection barrier in the form of structural rehabilitation of the river bank and stormwater tanks through a public-private partnership.[39]

Box 8: Green infrastructure opens a range of innovative financing mechanisms for urban infrastructure development

Santam, the largest agricultural insurer in South Africa, is providing support to an international not-for-profit organisation called Living Lands to plant more than 3.7 million indigenous carbon-sequestrating trees that will retain water during periods of low rainfall. The aim is to reduce land degradation and restore the water catchment system that provides water to the city of Port Elizabeth.[40]

Green infrastructure can also provide financing opportunities linked to innovation. This could be in the form of innovative planning approaches, the design of urban elements that improve biodiversity, combinations of technologies that enhance ecosystem services, or the development of products and services and system innovations to better protect ecosystems.

The amenities provided by green infrastructure may open opportunities for levy-based financing approaches. The upfront costs can be underwritten by public sources but over time these costs can be managed through contributions from users of the green infrastructure (see Box 9).

Box 9: Levy-based financing approaches to green infrastructure

Victoria in Australia finances metropolitan parks through a 'parks charge' levied on domestic, commercial and industrial properties.[41]

The City of St Louis in Missouri, USA issued bonds worth USD17 million to improve the Forest Park. The bonds were repaid through a city sales tax.[42]


Photo: Shutterstock.com

ASSESSING THE STATE OF URBAN GREEN INFRASTRUCTURE

A quick scan of the understanding and definition of green infrastructure, even a working one, as used in African cities or even in the general African context indicates that there is no uniform understanding or definition of 'green infrastructure' under urban planning or policy frameworks.[43] This is not to say that no attempts have been made to deal with the subject; there are examples, but these are the exception rather than the norm.

In addition, studies have been conducted on opportunities for green infrastructure or on restoring the urban green environment in leading African cities.[44] However, they are few in number. Most studies on urban green spaces are concentrated in Europe and North America because higher priority is given to green spaces in the development agenda of those regions.

National policy

As an example of green infrastructure in national policy, an analysis of planning documents from Ethiopia suggests a good understanding of the ability of green spaces to provide multiple functions and services in almost all the documents.[45] Proposed interventions for green infrastructure go as far back as 2011. The Green Infrastructure Based Landscape Design Supporting Manual of 2011 proposes street tree plantings for shade, mitigating the urban heat-island effect and reducing run-off. Ethiopia even established the Ethiopian National Urban Green Infrastructure Standard in 2015. The aim was to create ecologically well-functioning and socially beneficial green spaces in cities and provide ecologically viable green spaces to meet the recreational, social, economic and environmental needs of communities. However, there is limited evidence of these policies being implemented.

Municipal planning and policy

Cities and city-regions, mostly in South Africa, have also begun to advance the case for greater adoption of green infrastructure in provincial and municipal planning. The South African Cities Network has examined the topic in the context of South African cities and created a planning guide that suggests ways of guiding future green infrastructure planning and management in South Africa.[46]

The Gauteng City-Region Observatory has prepared a framework for a green infrastructure planning approach in the Gauteng City-Region with the objective of informing the Gauteng Integrated Infrastructure Master Plan.[47]

The City of Cape Town Metropolitan Municipality has established a green infrastructure plan for the protection and enhancement of existing natural assets and the promotion and creation of new green infrastructure assets. The aim is to enhance the city's living environment and improve its resilience to the effects of climate change.[48]

The eThekwini Metropolitan Municipality in KwaZulu-Natal has established the South Durban Basin Greening Programme to improve an environmentally compromised area, create jobs and improve the health, security and safety of residents living in the area.[49] The programme involves, among other things, landscaping and the management of key transport corridors, rivers and canals, and improvements to parks and recreational facilities.

Planning documents for Addis Ababa in Ethiopia also proposes the development of a green infrastructure based on principles such as integration and multi-functionality. However, there is no evidence of implementation.[50]

Existing urban projects

When it comes to actual examples of green infrastructure investments or projects, information is patchy. While a web-based global repository for projects in the areas of urban resilience indicates the existence of several projects across the continent, the basic description of many of these projects is not available. However, there could be more examples of green infrastructure on the continent that have not been documented.

As early as 1995, Durban in KwaZulu-Natal, South Africa embarked on a multiple-use park system. It used the park's retention ponds and artificial wetlands to partially treat wastewater rather than building concrete channels.[51] In 2000 the eThekwini Metropolitan Municipality, which includes the city of Durban and surrounding towns, was established. It initiated more projects, including the ecological infrastructure project in the Umgeni River catchment with the aim of using ecological infrastructure to improve the quantity of water delivered to the Metro.[52] eThekwini Metropolitan Municipality as well as the City of Cape Town are both implementing dune rehabilitation projects to manage the impact of storm surges on their coastlines and reduce the resulting damage to property and infrastructure.[53] However, systematic quantification of or reporting on the benefits of these projects could not be found.

There are also examples of actors other than cities pursuing green infrastructure projects. One example comes from Nairobi in Kenya, where the trade unions affiliated with the forestry and construction sectors, together with international partners, started planting trees on industrial sites to moderate temperature, restore value to the mines and enhance the aesthetic value of the sites. The overall objective was to improve health and safety conditions for workers.[54] Once again, no data has been found to illustrate the impact of this initiative on the health of workers.

BARRIERS TO INVESTMENT IN GREEN INFRA-STRUCTURE

African cities face unprecedented challenges resulting from the pace and nature of urbanisation. Urban planning is not keeping up and spatial development is becoming uncontrolled.

The historical underinvestment in cities, coupled with the challenges cities face in accessing finance, is impairing the ability of cities to cope with the demands of urbanisation. The absence of a transparent and predictable fiscal and financial framework for urban infrastructure investment and management further impedes the ability of cities to take up this challenge. The gap between infrastructure and services already built and what is required is growing. Pursuing green infrastructure under these circumstances becomes more difficult. The main barriers to investment in green infrastructure in African cities are as follows:

- **Lack of clarity and technical guidance**: To begin with, the lack of a definition for green infrastructure in the planning and policy frameworks of cities or more generally within the context of Africa's urbanisation means that there is little technical guidance for the implementation of green infrastructure in cities. Spatial planners, regulators and permitting agencies are not adequately educated on the scope and role of green infrastructure in the urban sphere. This not only leads to over-simplification of green infrastructure or misconceptions about what it is and what it can do but also puts green infrastructure on the periphery of urban planning.
- **Difficulty in quantifying benefits**: The benefits of green infrastructure are not easily quantifiable. Green infrastructure approaches have not been used as extensively as grey infrastructure, so actual operational and maintenance costs are not well documented. City planners and finance departments find it challenging to measure return on investment, asset life and depreciation for green infrastructure.[55]
- **Insufficient data for Africa**: The lack of Africa-specific data and case studies on urban green infrastructure that provide evidence of the benefits of implementing green infrastructure in African cities inhibits investment into green infrastructure. Where examples are documented, the quality of evidence is poor. This has meant that green infrastructure practices are often perceived as emerging approaches with a limited track record or as untested practices in African cities. Opportunities to improve these assets or maximise their benefits are not being taken up. It is not that green infrastructure initiatives are not being implemented on the continent, but the implementation and the benefits of these initiatives and their ability to save costs and generate revenue are not being systematically captured.
- **Lack of cross-departmental collaboration**: Green infrastructure projects are cross-cutting and interdisciplinary in nature, in line with the range of services they provide. This necessitates inter-departmental coordination when it comes to planning, design, construction, maintenance and management. More importantly, there is an issue of shared costs for both the initial funding and the maintenance of the infrastructure. Different departments in cities focus insularly on their own mandates and are reluctant to get involved in functions performed by other departments or allow other departments to intervene in their work. Cities will need to make existing governance structures conducive to cross-departmental collaboration to foster multifunctional and transdisciplinary planning, management and funding of green infrastructure.
- **Limited understanding of green infrastructure**: Inadequate understanding of the functions and values of many types of green infrastructure[56] among decision-makers and urban residents alike leads to socio-political uncertainty, which hampers the acceptance of green infrastructure. Green infrastructure is sometimes viewed as a luxury good rather than a public good that improves liveability in cities and the prosperity of urban residents.
- **Land-use conflicts**: Population growth and urbanisation pressures increase the pressure on available land, creating conflicts between different users and uses of land. Not surprisingly, when presented against seemingly more growth-orientated options, green infrastructure is often reduced to landscape value and consequently undervalued. Sometimes the larger spatial footprint of green infrastructure adds to this conflict.

RECOMMENDATIONS: ADOPTING AN INTEGRATED APPROACH TOWARDS GREEN INFRASTRUCTURE

As demonstrated by the case examples, green infrastructure is increasingly becoming a part of the economic, social and ecological discourse of urbanisation globally. However, there is no coherent narrative supporting the role this infrastructure has to play in promoting more sustainable urban development on the African continent.

In fact, green infrastructure appears, at present, to be marginalised compared to built development needs in African cities. Changing this and preparing the ground for African cities to adopt an integrated and coherent approach towards green infrastructure necessitate the following:

- **Fostering a better understanding of green infrastructure**: Green infrastructure has now been well defined in many developed countries. Extensive literature and evidence on green infrastructure in cities are also available in developed countries. In Africa, on the other hand, there is still a lack of definition, a basic gap in awareness of the types of green infrastructure that already exist and an understanding of how green infrastructure can be developed around existing grey infrastructure. A comprehensive guide to this end that establishes definitions and the typology and scope of green infrastructure will go a long way in educating spatial planners, political decision-makers and even urban residents on the scope of green infrastructure.
- **Developing robust evidence of green infrastructure**: As a start, more primary studies of interventions already undertaken in African cities to establish, maintain and improve green infrastructure are required to determine how this infrastructure can address the unique contextual challenges of African cities. These case studies will establish the scale and proven benefits of green infrastructure for the continent's urban areas as well as the business case for green infrastructure. The case studies will also provide baseline and performance data for cities that can help them establish future targets and facilitate subsequent monitoring of green infrastructure projects. More importantly, it will improve the capacity of cities themselves in planning, designing and implementing green infrastructure projects.

- **Building the economic case for green infrastructure**: Proving the cost effectiveness of green infrastructure and quantifying its direct and indirect monetary benefits can be the single biggest factor influencing the integration of green infrastructure as part of mainstream spatial planning. Therefore, there is an urgent need for city-focused studies that quantify the ecological, economic and social benefits of this infrastructure. At the same time, it is necessary to examine and establish whether the implementation of green infrastructure is actually cheaper than grey infrastructure in African cities, and whether any risks could arise from the implementation of green infrastructure.
- **Developing frameworks for context-specific green infrastructure**: Investments in urban infrastructure need to be responsive to the specific development scenarios and requirements of each city. The quest is not for the perfect green infrastructure, but for the type of green infrastructure that would work best in the context of a specific city. Cities will also need to determine how to screen out risky or unsuitable projects. They will need help with tools and frameworks that could assist them on both counts.
- **Developing frameworks to assess the value of green infrastructure projects**: Cities currently find it difficult to properly evaluate the type of investment needed for green infrastructure projects and why it is needed. Tools and methods that help measure the value of investment in green infrastructure will make it possible to evaluate and support policies to better integrate green infrastructure in the existing urban environment. These tools and methods will also benefit the future planning of African cities, as well as specific project proposals, with clear evidence (see Box 10). They can also serve to orientate and sensitise planners, policymakers and urban residents about the value of green infrastructure.
- **Building a holistic case for green infrastructure in cities**: While individual green interventions can address specific challenges, the benefits of adding green infrastructure to cityscapes can make cities resilient, protect urban residents from climate change impacts such as extreme temperatures and floods, and improve the availability and quality of basic goods and services such as water. Building and communicating a case for green infrastructure at the landscape level (see Box 11) can therefore make the case for including green infrastructure as one of the mainstays of long-term planning strategies in African cities. Studies that examine the attendant problems of climate change in specific cities and provide an overview of the green infrastructure strategies that can be used to adapt and mitigate these challenges will lay the groundwork for green infrastructure planning approaches.

Box 10: Examples of tools to evaluate the environmental, social and economic costs and benefits of infrastructure projects

Using monetary assessments or cost analyses can help quantify the benefits of or avoided costs from green infrastructure approaches and build the business case for inclusion of green infrastructure in urban planning. Several tools are now available to support these analyses. The Sustainable Asset Valuation (SAVi) simulates the systemic impacts of infrastructure projects by identifying both positive and negative externalities and providing a monetary value of these externalities. It also identifies the economic, social and environmental risks facing the project and simulates how these risks will change and affect project cash flows across the asset life cycle.

Sustainable Asset Valuation (SAVi) has been applied to many projects. One example is the valuation of the ecosystem services provided by two nature-based assets in Manitoba in Canada: Stephenfield Reservoir and Pelly's Lake. Manitoba experiences frequent flooding due to its topography and the hydrological dynamics in its watershed. The Stephenfield Reservoir is a civil-engineered reservoir that was built for irrigation and domestic water supply. Pelly's Lake is a natural wetland that is being actively managed for flood control. SAVi was used to compare the capital and operating costs of these two nature-based assets against those of a business-as-usual civil-engineered solution. It was also used to evaluate the benefits provided by these assets that would not be availed by civil-engineered solutions. The valuation indicated the following:

- **Benefits of the Stephenfield Reservoir**: The irrigation and water-storage services provided by the Stephenfield Reservoir will enable economic activity worth CAD6.07 billion between 2019 and 2050 as against a total operating and management costs of CAD256 000 for the same time frame. The capital cost of building new grey infrastructure to provide the same water storage and irrigation services that are being provided by the Stephenfield Reservoir would be CAD5.3 million with maintenance costs estimated at CAD300 000. This is higher than the current reservoir maintenance costs.
- **Benefits of Pelly's Lake**: Ecosystem benefits such as nutrient removal, carbon sequestration and flood protection provided by the lake between 2019 and 2050 are estimated at CAD60 million as against a total operating and management costs of CAD176 416 for the same period. The capital cost of new grey infrastructure to provide the same services as Pelly's Lake is estimated at CAD37 million.

Source: IISD[57]

Photo: RM / Shutterstock.com

Box 11: Building awareness of green infrastructure in cities

Much work is needed to educate residents, communities, planning professionals and decision-makers on how green infrastructure delivers a higher-quality urban environment and underpins the socio-economic development of cities. Green infrastructure generates jobs and spurs the economy in the same way as grey infrastructure. Cities themselves need to be sensitised to these aspects of green infrastructure. Improved data, more Africa-focused case studies and building the business case for green infrastructure will be critical to this end and will also help cities explain trade-off decisions about land-use conflicts.

Removing structural barriers for the stakeholders to access information by presenting information in simple language and in an easy-to-find manner will be key. More importantly, cities will also need to stress that green infrastructure is not a replacement for grey infrastructure. The issue is not a choice between grey or green infrastructure. Grey infrastructure will be required for water transportation, for mobility and dwelling, and for guaranteeing water quality for drinking.

Engagement of local communities and businesses in the planning and design of green infrastructure via consultations can be an effective tool to foster support while addressing any concerns communities might have. When targeting stakeholders, cities must involve financiers and insurers at the planning, project preparation and design stage. This will serve the dual purpose of ensuring that cities themselves understand the different financing demands of green infrastructure projects and that projects are designed to be bankable. It can also help lay the foundation for developing new finance and insurance products that support the proposed types of green infrastructure. Furthermore, it can enable financiers to aggregate projects in a manner that improves the financial viability of those projects.

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