Urban development

KEY MESSAGES

- **At 4.4 percent, Sub-Saharan Africa is the region with the fastest urbanization rate globally, with about 40 percent of its population living in urban areas, up from 22 percent in 1980.** With close to one billion urban residents, the growth will continue and double in number by 2050. On average, 60 percent of Africa's urban residents live in slums.
- **The COVID-19 pandemic is having severe economic impacts in Africa and its cities. Economic activity in Sub-Saharan Africa is estimated to have contracted by 2 percent in 2020.** The region has seen its first recession in over 25 years, with activity contracting by nearly 5 percent on a per capita basis. Local governments could experience a drop in local finances of 30–65 percent, on average.
- **Low-lying coastal areas have specific climate risks due to sea level rise and, in many areas, increased flood frequency.** Climate risks are compounded by demographic trends in coastal areas. About half of the African settlements with 1–5 million inhabitants are located in low-elevation coastal zones. By some estimates, Africa's populations in low-elevation coastal zones (LECZ) will rise at more than double the world's average.

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- **The early stages of urbanization in most Sub-Saharan African cities provide a unique opportunity.** The low levels (40 percent) of urbanization of the region and the low density of its large cities offer opportunities for low-cost actions that can prevent locking-in errors made by other highly urbanized regions of the world.
- **African cities can undertake a range of adaptation opportunities that require fewer financial resources** and can generate immediate and significant benefits or set up the planning basis for enhanced adaptation measures as part of their post-COVID recovery.

Climate change is disrupting the continent's agriculture and water supply, is threatening coastal zones and cities. Moreover, the Covid-19 pandemic is eroding recent progress in building resilience, leaving countries and communities more vulnerable. This is why we need to step up efforts for climate adaptation and resilience in Africa."

Flemming Møller Mortensen, Minister for Development Cooperation, Denmark
Leader's Dialogue on the Africa Covid-Climate Emergency, April, 2021

INTRODUCTION

This chapter reviews the current state, past trends, and project of urbanization in Africa. It analyzes present and projected climate risks in urban areas, focusing on floods, specific risks for low-lying urban centers, the impacts of droughts on water supply services, heatwaves, and coastal erosion and its linkage to sea level rise. The chapter then reviews adaptation options for African cities in three groups: (i) untapped opportunities and early wins; (ii) urgent adaptation actions in the post-COVID recovery; and (iii) medium- to long-term measures after the economic recession caused by the pandemic.

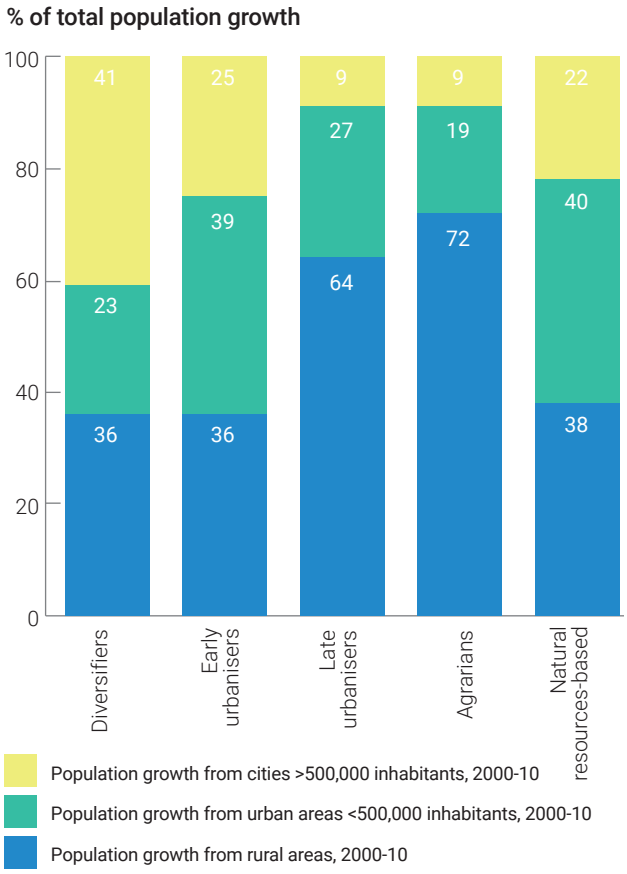
Photo: Andreas Marquardt/Shutterstock

State and trends of urban Africa

Africa is urbanizing fast. At 4.4 percent, Sub-Saharan Africa is the region with the fastest urbanization rate globally, with about 40 percent of its population living in urban areas, up from 22 percent in 1980. With close to one billion urban residents, the growth will continue and double in number by 2050. On average, 60 percent of Africa's urban residents live in slums.[1,2] Africa has 34 percent of its population living in cities with more than one million inhabitants.[3]

The urbanization path of different countries in Africa is quite diverse, ranging from early urbanizing countries in West Africa, to natural resources-rich countries with high urbanization concentrated in their capital cities, to late urbanizing countries in East Africa, and many agrarian countries at an early stage of urbanization like Chad, Niger, and Malawi. Figure 1 presents the contribution to urban growth in these categories of countries.[4]

Figure 1: Contribution to population growth by city size and rural-urban interface by type of African country, 2000–2010

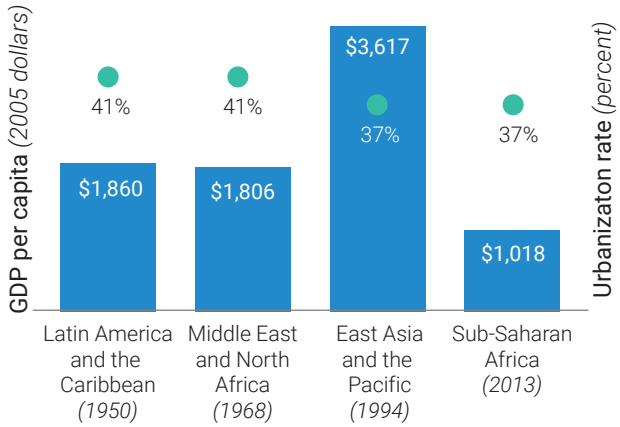


Source: African Development Bank, OECD, UNDP (2016), *African Economic Outlook*

The financial resources available to provide urban infrastructure services in Africa are quite limited. While urban infrastructure investment needs for Africa vary greatly, estimates indicate a requirement of about US$ 20 billion per year. Countries in the region would need to spend 5–7 percent of their GDP on public infrastructure, but only invested about 2 percent between 2009 and 2015.

A significant challenge for the region is that urbanization is taking place at lower levels of income compared to other regions. In 2005, dollars, the GDP per capita of Sub-Saharan Africa at close to 40 percent urbanization was about US$ 1,000. At that same rate of urbanization, the GDP per capita for the Middle East and North Africa was US$ 1,800, and for East Asia and Pacific it was US$ 3,600, as shown in Figure 2.[5]

Figure 2: Levels of per capita GDP in different regions when their urbanization level was about 40 percent



Source: Lall et al. (2017), "Africa's Cities: Opening Doors to the World"[6]

Note: years in parentheses are those with available data in which the region was closer to about 40 percent.

Furthermore, municipal governments have very little revenue to confront these infrastructure needs. Intermediary cities only spend about $1 per capita per year. Even large cities with more resources, like Addis Ababa with US$ 124/cap, or Nairobi with US$ 118/cap, do not have the resources needed to respond to the rapidly growing populations.

The urbanization process in Africa has not achieved its full economic potential. Economic transformation and growth have not followed urbanization in most of Sub-Saharan Africa. This discrepancy is related to the shape and density of cities. Even large cities have low density, and in many cases, the footprint of cities is growing faster than the population. This footprint

Photo: Salvador Aznar/Shutterstock

growth makes the provision of infrastructure services more expensive and the job opportunities more difficult. Around 60 percent of urban unemployment and over 90 percent of jobs are informal. African cities also have high inequality, with Gini coefficients at 0.54 in a sample of 12 countries.[7]

The COVID-19 pandemic is having severe economic impacts in Africa and its cities. Economic activity in Sub-Saharan Africa is estimated to have contracted by 2 percent in 2020. The region has seen its first recession in over 25 years, with economic activity contracting by nearly 5 percent on a per capita basis.[8] These impacts have the potential to erase the development progress of the last decade. In Africa, local governments could experience a drop in local finances of 30–65 percent, on average, depending on the severity of the crisis.[9]

PRESENT AND PROJECTED CLIMATE CHANGE IMPACTS ON AFRICAN CITIES

African cities face rapidly growing climate risks but with large variations across the continent that need targeted responses. Climate risks in urban areas of Sub-Saharan Africa include floods, droughts, sea-level rise, heat waves, and increased risks to diseases like malaria, cholera, and rodent-borne diseases (see the Health chapter).

Floods

Climate impacts fall disproportionately on the urban poor, in particular floods (see Water Resources Management, Floods, and Disaster Risk Management chapter). These risks are more pronounced in southwest Africa where poor households are overexposed, and in countries with large rivers in West Africa (e.g., Benin, Cameroon, and Nigeria). The topography of some cities, combined with deforestation and encroachment into floodplains, leads to multi-risk situations that are aggravated by climate change. The massive landslide in Freetown in August 2017 left more than 1000 missing or dead (see Box 1).[10]

Box 1: Multiple Factors at Play in Climate Risks – The 2017 Landslide in Sierra Leone

Sierra Leone is highly exposed to natural disasters and climate shocks. The Notre Dame Global Adaption Index ranks Sierra Leone 158 out of 182 countries in terms of vulnerability to climate change. In the last 15 years, four major floods have affected over 220,000 people. Freetown is a coastal city located on the mountainous Sierra Leone peninsula, in the west of the country.

On August 14, 2017, a massive landslide slipped into the Babadorie River Valley and exacerbated existing flooding in Freetown, affecting about 6,000 people of which 1,141 have been declared dead or missing.

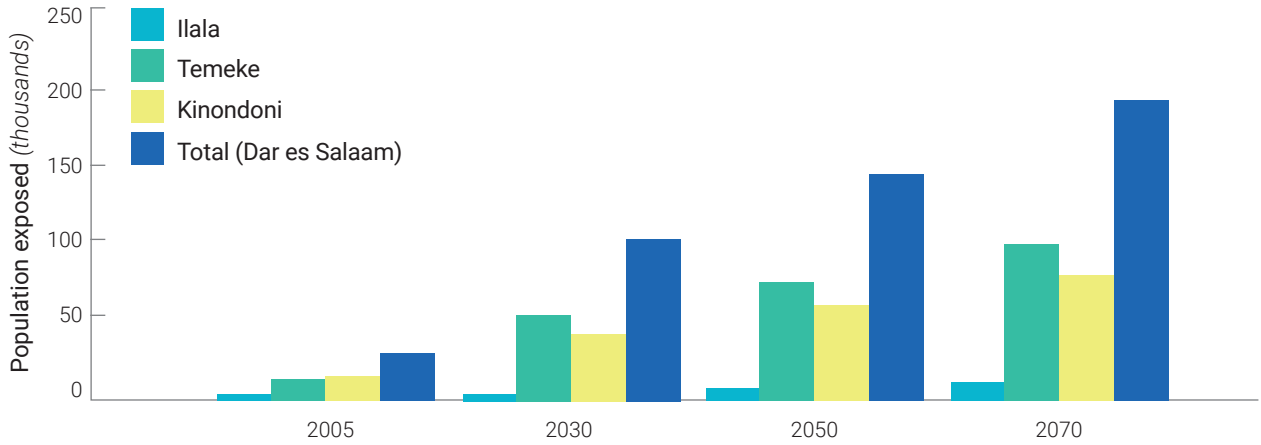
Following three days of intense rainfall, a mountain valley side slope in the Regent area below Sugar Loaf, the highest peak in the north of the Western Area Peninsula, collapsed and caused a major landslide. Up to 40 cubic meters traveled from high up of the slope with huge energy and momentum. The main landslide caused major destruction of infrastructure in the upstream areas of the river, while flooding in areas outside the landslide zone affected 55 percent of the households in the Culvert and Dwazark neighborhoods of Freetown on the same day.

The damages and losses to housing (about US$ 15 million) was higher than that of the other infrastructure sectors, which is typical of a disaster caused by a natural hazard event in an urban area. Damage impact also varied by geography, with lower income settlements being at the recipient end of the floods. The more upstream housing close to the landslide were better built and larger in size. The total damage and lost estimate of the disaster was close to US$ 32 million.

Source: World Bank (2017) Sierra Leone Rapid Damage and Loss Assessment of August 14th, 2017 Landslides and Floods.

The rapid urban growth of African cities has also led to a substantial transformation of open space areas. All cities face a strong demand for housing close to the city center and its employment opportunities. The lack of adequate transport options means that central land faces substantial pressures, including wetlands and river floodplains. Despite the high risk of flooding, low-income communities are built in these areas. For example, in Dar es Salaam, informal communities along the riverbanks and floodplains of the Msimbazi River system are at high risk. Figure 3 shows the projected exposed population under current trends without adaptation measures or changes to urban growth patterns.[11]

Figure 3: Exposed population in Dar es Salaam to a 1 in 100-year flood event, 2005–2070



Source: White et al. (2017)[12]

Photo: Romas_Photo/Shutterstock

Coastal cities

Low-lying coastal areas have specific risks. Climate risks are compounded by demographic trends in coastal areas. About half of the African settlements with 1–5 million inhabitants are located in low-elevation coastal zones. The density in these zones is much higher than inland, and the projections indicate further concentration. For example, Senegal had 20 percent of the population living in these zones but is projected to have about 50 percent by 2060. By some estimates, Africa's populations in low-elevation coastal zones (LECZ) will rise at more than double the world's average. LECZ populations are at high risk from current and projected climate change. About 30 million Africans live within the flood hazard zone around the Atlantic and Indian Oceans.[13]

Furthermore, about 56 percent of the coastlines of Benin, Côte d'Ivoire, Senegal, and Togo are eroding rapidly, and sea-level risk, while not a dominant factor today, will exacerbate the impacts of coastal erosion and ultimately threaten the livelihoods/settlements of millions of people (see Box 2).

Box 2: Coastal Erosion in West Africa


Photo: Africanway/istock

West Africa's coastal areas generate 56 percent of its GDP and host about one-third of the population. Coastal areas face rapid urbanization with all its demands on land, water, and other natural resources. In addition, infrastructure and sand extraction have contributed significantly to coastal retreat.[14] Coastal erosion is caused by a combination of poor management of coastal sediment flow around infrastructure such as ports, retention of sediment in dams, mining of riverine and beach sand, and loss of coastal habitat that would otherwise physically protect or slow down retreat of the coast. Furthermore, coastal erosion is a regional issue. Modeling by Deltares and the World Bank shows that the effect of coastal infrastructure on sediment movement could be seen up to 50 km downdrift.[15]

The coastal degradation in Benin, Côte d'Ivoire, Senegal, and Togo cost US$ 3.8 billion, or 5.3 percent of the four countries' GDP, in 2017. In Nigeria, the cost of coastal degradation amounts to US$ 9.7 billion, or 8.1 percent of the GDP in Cross River, Delta, and Lagos States in 2018.[16] Climate change exacerbates the coastal erosion issue. Projections indicate that by 2050, Mauritania and Senegal could experience 60 cm of sea level rise, while in Togo and Benin it would be about 30 cm.[17]

West Africa is one of the regions in the world with the most mobility, with migration of people deeply embedded in local economies and traditions. Without concrete climate and development action, initial estimates indicate that the region could reach a high of 27.3 million climate migrants (3.4 percent of the total projected population) by 2050 under a pessimistic scenario with continued high emissions and unequal development pathways.[18]

Responding to the request from West African countries, the World Bank set up a ten-year program of support to manage coastal erosion in the region, the West Africa Coastal Areas Management Program (WACA). The program was launched in 2018 and it now works across nine countries, supports coastal protection at 22 sites and works with over 1,000 microprojects. The program is designed to operate at four levels in parallel: (i) country-led national projects; (ii) regional integration and capacity-building of regional institutions to manage environmental flows across borders and create common policies (via regional economic commission and the Abidjan Convention); (iii) a scale-up platform where institutions with compatible instruments mobilize to accelerate knowledge transfer and simplify investment processing; and (iv) partnerships.

The 2019 Call for Innovation generated 20 innovations, of which three were awarded as transformational. These were: the WAC-App to model impact on coastal sediment from infrastructure, the Trans-Sand mechanism for a pooled dredging capacity and governance to ensure sediments are being conserved in the coastal zone and not dropped where they do not serve natural processes, and the Port-System-Approach that engages affected stakeholders in port development processes.

Droughts

One of the urban services that will be most affected by climate change is water supply. Access to piped water supply has progressively increased in Africa (from 82 million urban dwellers with piped water in 2000 to 124 million in 2015). However, given the rapid urban population growth, the percentage of urban dwellers receiving piped water actually declined from 40 percent in 2000 to 33 percent in 2015. Most of the increase came from increased access to piped water off premises and self-supply.

As informal settlements have grown swiftly, informally, and without adequate urban planning or space, the provision of water infrastructure is complex. The residents of most African cities receive water services from a range of formal, informal, or self-provided systems. Low-income residents generally pay more for unsafe water sources. The performance of water utilities in Africa is generally weak, although there are examples of well-performing agencies. Most utilities register an efficiency of 0.30 (which is far below the highest score of 1).[19]

Droughts are expected to become stronger in many parts of Africa, as discussed in the Present and Projected Climate Risks chapter. Droughts will have significant impact on water utility services. A recent example was the water crisis in Cape Town which received global attention as it came close to being the first major city in the world to have run out of water. After a continuous decline of water levels in the major dams serving the city, the crisis peaked in 2017–18 when the city approached "Day Zero," a reference to the day when municipal water supply could not function.[20] The city implemented broad and significant water restrictions and a massive behavioral change campaign that reduced daily water usage by more than half, thereby averting the crisis.

An additional important challenge for many African water utilities is the reliance on watersheds outside the administrative responsibility of the municipalities they serve. Urban water utilities cannot undertake effective resilient measures without elevating the adaptation agenda to the national or river basin authorities, as discussed in the Water Resources Management, Floods, and Disaster Risk Management chapter. For cities to tackle water resilience, they need to engage with stakeholders that are not traditionally seen as part of the water sector such as land management agencies, planning, farmers, and forestry, among others.[21]

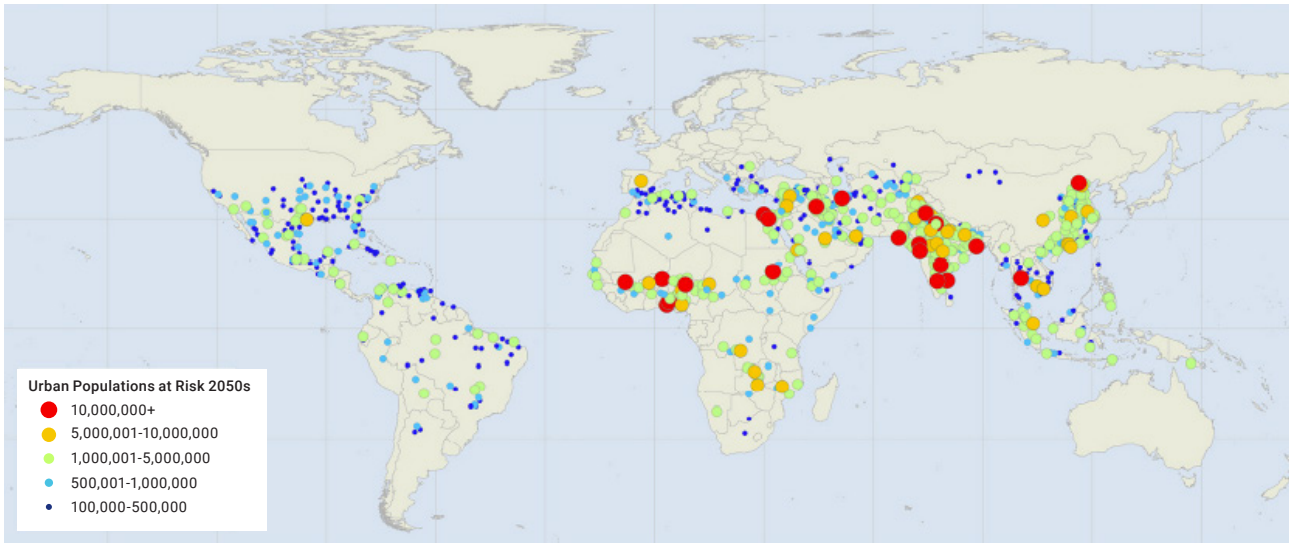
Photo: Jjumba Martin/Flickr

Heatwaves

The impact data of heatwaves is limited in Africa, but the trends are worrisome. Combining temperature and population growth projections for 150 large African cities, a recent study showed that the number of people that will be subject to dangerous and lethal heat conditions will be 20 to 52 times higher at the end of the century compared to current conditions.[22] Heatwaves have particularly strong impacts on residents of informal settlements, those who work outdoors, and children and the elderly. Figure 4 shows the estimated urban populations at risk of extreme heat by 2050. The Health chapter reviews in greater detail the impact of heatwaves on African populations.

The rapid population growth of African cities and the current and projected climate risks compound economic risks. A combined analysis of population growth projections and climate vulnerability in cities worldwide shows that cities in Africa are growing the fastest (86 of the 100 fastest growing cities), and 79 of these cities fall in the "extreme risk" category of their climate index. A total of 15 African capitals has significant combined risk factors of rapid population growth, economic growth, and climate risk, including Addis Ababa (Ethiopia), Luanda (Angola), Dar-es-Salaam (Tanzania), Kampala (Uganda), and Lagos (Nigeria), among many others.[23]

Figure 4: Urban population at risk of extreme heat by 2050[32,33]



Source: UCCRN – Urban Climate Change Research Network (2018), *The Future We Don't Want – How Climate Change Could Impact the World's Greatest Cities*

> **We do not lack ideas, we lack actions on the ground."**
>
> **Mohammed Adjei Sowah, Mayor, Accra, Ghana**
> High-Level Dialogue "An adaptation acceleration imperative for COP26", September, 2021

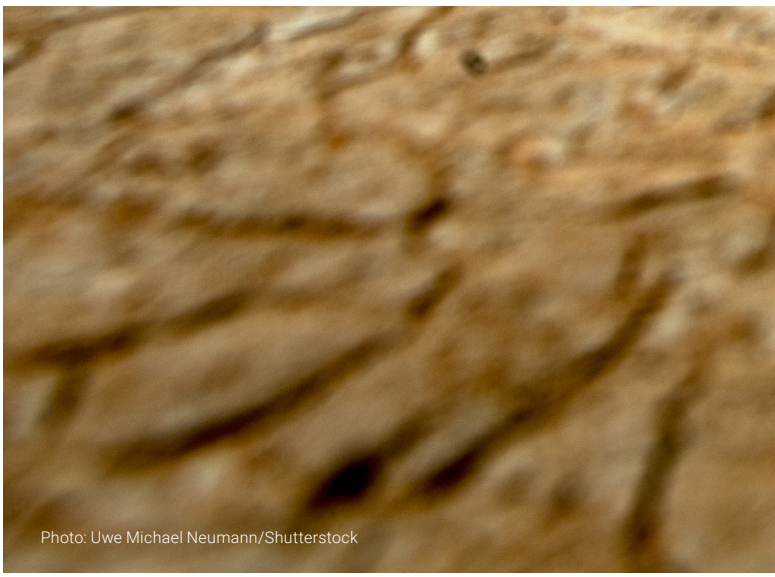


Photo: Uwe Michael Neumann/Shutterstock

CLIMATE ADAPTATION IN AFRICAN CITIES

The early stages of urbanization in most Sub-Saharan African cities provide a unique opportunity. The low levels (40 percent) of urbanization of the region and the low density of its large cities offer opportunities for low-cost actions that can prevent locking-in errors of other highly urbanized regions of the world.

The IPCC Special Report on Global Warming of 1.5°C (SR1.5), and its accompanying Summary for Urban Policymakers,[24] reviews five important climate adaptation transitions for urban infrastructure systems of direct relevance to African cities: (i) sustainable land-use and urban planning; (ii) sustainable water management; (iii) green infrastructure and ecosystem services; (iv) building codes and standards; and (v) disaster risk management. The report recognizes the challenges of implementing these transitions due to a range of tradeoffs, particularly for cities in low-income countries and cities with limited financial resources.

Through effective land management and city planning, up-to-date knowledge of current and future risks based on cost-effective data collection, and effective education and engagement with communities, most African cities can significantly reduce the impact of climate change. The prioritization of investments based on climate risks and bottlenecks, combined with an approach that focuses on resilience jobs, SMEs, and market creation, can help cities reduce risks and leverage opportunities for a climate-smart urban development and economic growth.

The limited financial resources available to African cities impose significant constraints that require a balanced approach to climate adaptation and resilient urban development. City authorities and communities need to tackle most of the climate impacts described in other chapters of the report. They also need to localize most of the recommendations presented in this chapter. At the same time, cities in Africa should provide the economic opportunities to their citizens not only to escape poverty but also to prosper. Climate change is already a drag on these opportunities, so it deserves an appropriate level of attention and resources, alongside the many other challenges that urban centers in Africa face.

The local implementation of the Sendai Framework (see Water Resources Management, Floods, and Disaster Risk Management chapter for more details) is a good roadmap to support the journey towards enhanced resilience and adaptation at the city level. Box 3 presents the "Ten Essentials" for disaster risk reduction in urban areas.

An essential area of work to enhance the resilience and climate adaptation of cities in Africa is urban planning. Several cities have prepared resilience strategies. There are still opportunities to strengthen the connection between these local planning exercises with the National Adaptation Plans and the updated Nationally Determined Commitments for better vertical coordination between different levels of government. Box 4 presents an example of the city resilience strategies recently developed.

Box 3: The Ten Essentials – Implementation of the Sendai Framework at the City Level

Photo: Viktoriia Vyshnevetska/Shutterstock

1. Organize for disaster resilience
2. Identify, understand, and use current and future risk scenarios
3. Strengthen financial capacity for resilience
4. Pursue resilient urban development and design
5. Safeguard natural buffer to enhance the protective functions offered by natural ecosystems
6. Strengthen institutional capacity for resilience
7. Understand and strengthen societal capacity for resilience
8. Increase infrastructure resilience
9. Ensure effective disaster response
10. Expedite recovery and build better

Source: UNISDR (2017), *How to Make Cities More Resilient: A Handbook for Local Government Leaders*

Box 4: The Lagos Resilience Strategy

Photo: FOTOGRIN/Shutterstock

The 100 Resilient Cities (100RC) was established by The Rockefeller Foundation in 2013. The program enabled participating cities to hire a Chief Resilience Officer, develop a resilience strategy, and receive global support. The Resilient Cities Network continues to work with these cities in future-proofing their communities. In Africa, the participating cities include Accra, Addis Ababa, Cape Town, Dakar, Durban, Kigali, Lagos, Luxor, Nairobi, and Paynesville.

As an example, the Lagos Resilience Strategy, published in 2020, is the State's first urban resilience strategy document. Lagos State joined the 100RC in 2016. The Lagos Resilience Strategy was produced collaboratively with engagement from civil society, academia, private sector, government, and community groups from across the state.

With a GDP of US$ 137 Billion (about 26 percent of Nigeria's GDP), Lagos is the fourth-largest city economy in Africa. Its population was estimated to be 26 million in 2018 and increasing by nearly 3,000 persons a day, making it the fastest growing city in Africa. Water bodies and wetlands cover over 40 percent of the total land area of Lagos and an additional 12 percent is subject to seasonal flooding.

Among the most critical climate-related shocks affecting Lagos' resilience are storm surges and flooding. Climate change and the city's location at sea level increase the flood vulnerability of Lagos. The city's barrier islands and sand spits are shrinking, due to coastal erosion. In addition, flooding has been a recurrent challenge for the city, due to inadequate storm water drainage systems and improper waste disposal into open drainage. The city has limited mechanisms for predicting and managing the occurrence of flash flooding. The city's resilience strategy indicates that many past efforts have tended towards engineering solutions, which have not yielded the desired results.

Some of the most significant measures proposed in Lagos' Resilience Strategy related to climate change shocks include community participatory flood management, strengthening the state's emergency response system, strengthening the information management and disaster preparedness for the state, and enhancing the city's resilience through land-use planning.[25]

POLICY RECOMMENDATIONS

Adaptation in the post-COVID recovery of cities

Given the limited financial resources African cities currently have, it is important to prioritize the adaptation actions that are feasible and have the greatest impact. Our GCA analysis has grouped these possible avenues in two groups: (i) the untapped opportunities and early wins; and (ii) the urgent options in the recovery.

African cities can undertake a range of opportunities that require fewer financial resources and can generate immediate and significant adaptation benefits or set up the planning basis for enhanced adaptation measures as part of the post-COVID recovery. The first group of measures includes:

- Rapid climate risk assessments that gather recent disaster information, infrastructure bottlenecks, and information gaps for a rapid evaluation of critical weaknesses of the city, some of which could be resolved with less financial resources, and others that will require deeper evaluation and technical designs.
- Community engagement, including the youth, for resilient action in the low-cost measures identified in the rapid climate risk assessments. Many of these measures can be undertaken through social entrepreneurs and resilient SMEs that will create new jobs and enterprises (see Jobs chapter for further details).
- Basic urban planning, to reduce uncontrolled sprawl in areas of high climate risk. This is a measure that requires active community engagement and a plan to offer alternatives to the growing population of the city.
- Early warning systems by connecting the city to the national warning systems and hydrometeorological agencies to ensure that the information on upcoming climate disasters is received by municipalities, transmitted to the communities, and acted upon. This requires building the capacity of communities to understand the information provided in the warnings, and drills to ensure every household knows what actions to take to protect their lives and assets.
- Individual and community resilience, including behavior change, climate risk communications, children education, and women and youth empowerment for resilience and disaster preparedness.
- Maintenance of existing infrastructure and enhanced safety measures for non-networked water and informal waste solutions. Keeping drainage canals, ditches, and other flood evacuation infrastructure before the rainy seasons can provide the capacity to reduce the impact of high-water levels. Geotechnical monitoring of steep hills during the rainy season can provide early warning to communities.
- Land and property rights and urban planning are indispensable elements of a resilient city. The first basic steps of mapping and data collection can be done at low cost and serve as the basis for a long-term transformation process. Box 5 presents an example of this type of programs being undertaken in several African cities.
- Leveraging the resilient power of nature by protecting existing buffers like mangroves, wetlands, and floodplains. These green spaces are rapidly disappearing in African cities and the cost of building gray infrastructure in future years to compensate for the disappearance of the natural buffers will be expensive. Box 6 presents an example of these measures in the city of Beira, Mozambique.


Photo: THEGIFT777/iStock

Box 5: Open Data for Urban Resilience and Disaster Risk Management in Africa

Urban planners and community leaders cannot design adaptation plans and take informed adaptation actions without vital knowledge on who, what, and where is at risk. The World Bank and the GFDRR Labs are supporting The Open Cities Africa initiative that currently works with 12 cities in Africa to systematically gather and share critical risk data.

This initiative connects local community members with geospatial experts to undertake a bottom-up risk data in disaster-prone areas. This data is made open and accessible through a range of user-centered platforms, from web applications like OpenStreetMap to paper atlases. The Open Cities Africa program uses drone imagery capture and open-source community mapping techniques. So far, the initiative has collected data on more than half a million buildings, mapped over 30,000 kilometers of roads, and captured hundreds of square kilometers of drone imagery.

An important feature of Open Cities Africa is capacity building. The program has trained more than 500 people in digital cartography. Young people develop skills that they can leverage in the growing geospatial technologies job market.

The initiative also fosters sustainable communities. For example, the Pointe-Noire OpenStreetMap community in the Democratic Republic of Congo now counts with over 50 mappers. In Tanzania, the local Red Cross is using real-time flood data to respond more effectively to disasters. In Ngaoundéré, Cameroon, community groups are utilizing paper atlases developed as part of this initiative to facilitate risk reduction efforts at the local level.[26]

“Now is the time for us all to come together and focus on delivering a landmark COP setting the trajectory for the next crucial decade and the tools that will help us all deliver on our commitments. Adaptation and resilience must be in that future.”

Anne-Marie Trevelyan, UK Minister and International Champion on Adaptation and Resilience for the COP26 Presidency
High-Level Dialogue “An adaptation acceleration imperative for COP26”, September, 2021

A second group of adaptation and resilience measures requires more financial resources, but their urgency resides on the avoidance of growth patterns that will lead to the need for retrofits, or in the high benefit-to-cost ratios in terms of lives saved or assets protected. These measures include:

- A comprehensive urban resilience and adaptation master plan that considers the various climate risks of the city, combines them with urban growth needs, and provides a climate-smart development path in the medium term.
- Prioritized infrastructure retrofits and enhancements that solve the critical bottlenecks and priority risks for the city for the more recurrent climate shocks, such as floods and related landslides. Small targeted civil works, enhanced maintenance and repair of infrastructure, and simple prevention measures can go a long way to prevent damages to households and communities.
- Resilience business and market opportunities associated with the infrastructure actions above, designed to support the creation and growth of SMEs that would generate new jobs for adaptation and resilience. SMEs providing infrastructure maintenance services, climate risk monitoring services, early warning and mobilization, and rapid repairs after disasters can reduce the impacts of climate change and generate the jobs needed by African youth.
- Continuous capacity strengthening of city officials, both municipal staff and delegated staff of national agencies, in the areas of climate adaptation and resilience. City adaptation programs require multi-disciplinary and cross-agency actions. These require, in turn, staff with the understanding, tools, and skills necessary to design and undertake these programs and actions.
- Climate adaptation project preparation, to ensure engineering designs and bidding documents for the most critical medium- and large-size projects are ready when the economic conditions recover after the COVID pandemic.

Box 6: Nature-based solutions in Beira, Mozambique


Photo: Victor Espadas Gonzalez/Shutterstock

Mozambique is subject to high levels of coastal and river flooding and is among the most vulnerable countries to current and projected climate risks. Several development partners have supported gray and green infrastructure solutions to enhance the resilience of the city of Beira, Mozambique. Beira has a population of over half a million inhabitants. Due to its exposed coastal location (low-lying land and high tidal range), its vulnerable infrastructure and population, Beira is one of the cities most threatened by climate in the region.

One of the green infrastructure projects supported by the World Bank, with funds from the Pilot Program for Climate Resilience (PPCR), and by the German Cooperation through the KfW Development Bank, is the Green Urban Infrastructure (GUI) intervention.

The first phase of the project restored the natural drainage capacity of the Chiveve River, a 3.5 km long tidal river flowing through Beira's central business district and low and medium-income residential neighborhoods. A second phase focused on further restoring the river's ecosystem (in particular, its mangroves and other natural habitat on the riverbanks). In addition, the river was upgraded to be a green urban park for dual purposes of climate resilience and recreation.

The planned green and grey infrastructure is intended to stop further encroachment into the Chiveve River floodplain and protect this sensitive environment. Income-generating facilities related to the park space were included in the design to provide financial resources for maintenance.[27]

Priority actions for urban water services

As discussed earlier, water services are one of the municipal services that is at higher risk from climate impacts.

The global total is about US$ 73 billion per year through to 2050, and the additional cost to adapt to climate impacts on water availability are estimated at about US$ 12 billion per year. Most of these costs would be incurred in developing countries and the highest costs would be in Sub-Saharan Africa.[28]

As discussed in the Present and Projected Climate Risks chapter, water utilities in Africa will face more frequent or more severe floods and droughts, higher temperature ranges, different rainfall patterns and seasonal shifts. Incorporating climate projections in water utility planning is not an easy task because of limited knowledge about the potential risks to operations over multi-year cycles, and inadequate access to relevant climate and weather information that is useful for infrastructure design, operations and maintenance, and business continuity and resilience plans.

Climate models are not able to specify with sufficient precision the changes in flood and drought characteristics at the level of a city and for the expected life of water utility assets. Utilities need to plan for an uncertain future not only because of climate change, but also due to rapid demographic changes, different economic conditions and future shocks, and new technological innovations. Utilities need more systematized approaches to deal with the deep uncertainties associated with climate change.[29]

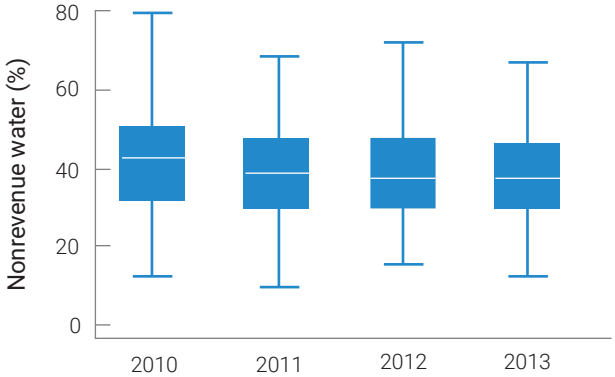
Dealing with the uncertainty of the specific trajectory of climate change impacts at the city level requires a vulnerability analysis to identify threats that may affect specific elements of the water supply system and the possibility of individual or joint failure due to specific climate shocks. The design of more robust systems is built around scenarios that apply diverse stress tests to determine critical elements over a range of future scenarios.

Most water utilities globally do not integrate crisis responses and master planning efforts. The new challenges brought by climate change cannot be handled with the traditional reactive contingency plans.

For water utilities and cities with limited financial resources, it is important to identify near-term no-regret projects that can be undertaken today without reducing the flexibility needed to adapt as future climate conditions evolve. Dealing with every possible risk and scenario is extremely costly and unfeasible. The traditional approach of safety factors cannot be the only adaptation solution. The decision to balance between improving the resilience of the system (and its associated costs) with the expansion and improvement of water supply services is not an easy one. Leveraging nature-based solutions, as discussed later in this chapter, can provide enhanced resilience with an overall better cost-benefit ratio.[30]

An important climate adaptation measure for water utilities in Africa is to reduce nonrevenue water (NRW). One measure of NRW is the percentage of water production that is lost due to technical or billing reasons. Figure 5 shows the levels of NRW in 119 water utilities across Africa. The level of NRW is very high compared with global benchmarks. The reduction of NRW is a difficult technical and managerial challenge for utilities. As climate shocks increase the frequency and intensity of droughts, utilities operating in areas of high-water scarcity will need to focus on NRW improvement programs. The data shows that in Africa, in general, larger utilities tend to have higher NRW losses than smaller utilities, possibly related to the more recent installation of network systems in smaller cities. Finally, utilities with 24 hours of supply tend to be associated with significantly lower levels of NRW.[31]

Figure 5: Nonrevenue water as percentage of water production in Africa



Source: World Bank (2017), *Performance of Water Utilities in Africa*

POLICY RECOMMENDATIONS: ADAPTATION AND RESILIENCE AFTER THE COVID ECONOMIC CRISIS

In the medium- to long-term, our GCA research indicates that African cities need to undertake a more comprehensive adaptation and resilience strategy based on the following nine areas:

- Strengthen the capacity of all city stakeholders to minimize the economic impact of disasters through early planning, preparedness programs, community engagement, and rapid reconstruction using "build-back-better" principles. The shorter the interruption of economic activity caused by climate disasters, the smaller will be the economic impact on the city, its residents, and businesses.
- Deepen the resilience of the private sector, as discussed in the Private Sector chapter. The resilience capacity of SMEs, in terms of understanding, preparedness, and continuity plans for climate disasters is low. The municipality can take an active role to encourage and support the building of that capacity through information and training, ideally in partnership with larger enterprises with more knowledge and capacity, as these companies will benefit from stronger supply chains and economic continuity after disasters.
- Explore new financial mechanisms for enhanced resilience, beginning with simple ones such as insurance for the most critical municipal assets, PPPs for resilient infrastructure, land-value capture to finance flood control infrastructure, and others described in the Finance chapter of the report.
- Scenario planning, based on continuous data collection and partnership with scientific bodies and network of cities with more experience in robust planning and climate projections at the local level. This also requires continuous data collection of climate, environmental, and urban growth trends, among others, that are indispensable to understand current and projected climate risks.

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- Multi-level government coordination, as many of the climate risks of the city require coordination and action with other jurisdictions such as neighboring municipalities in metropolitan areas, or river basins for watersheds providing water to the city or flood protection.
- Progressive institutional reform and continuous capacity building that approaches adaptation and resilience as a cross-departmental platform.
- Leverage new technologies and bring the best elements of smart cities and disruptive digital technologies to improve the preparedness of citizens and enterprises to climate disasters, expand the data and knowledge base of climate risks, and reduce the cost of adaptation measures.
- New alliances to ensure adaptation and resilience are seen as everybody's job and not only a responsibility of the municipal government. The ability of the municipal administration leadership to connect vertically with higher and lower levels of government (from the national to the community), and horizontally with sectoral ministries and neighboring municipalities is critical. Equally important are the partnerships with expert bodies, universities, and researchers, as well as international financiers, city networks, and UN agencies.
- Inclusive approaches to adaptation to ensure that socially vulnerable groups, from persons with disabilities to unemployed youth, migrants, and internally displaced populations, are all part of the resilience plans and programs of the city.


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Developing Adaptive Capacity in Productive Coastal Zones of Tanzania

Geography: Tanzania (Dar es Salaam, Pangani, Bagamoyo, Rufiji, Mijni and Mkoani districts along the eastern coast, reaching 36 communities).

Adaptation measures: This project implemented green-gray infrastructure and restoration measures to protect against sea level rise and inundation, through construction of sea defense structures and restoration of mangrove and coral reefs. It also improved access to water during climate extremes via boreholes and additional rain harvesting and storage capacity devices.

Key outcomes: The project has benefited 526,000 people through improved sea defenses,[34] including 10,000 people who have improved access to drinking water during climate extremes; it resulted in a 20 percent increase in water availability to communities in dry periods.

Partners and funding: UNEP, Global Environment Facility, Adaptation Fund, Government of Tanzania (Vice President's Office, Division of Environment), Ministry of Water, University of Dar es Salaam and NGOs Network/Consortium, District Councils, and other implementing partners. Least Developed Countries Fund. 2012–2019. US$ 3.4 million (for Developing Core Capacity to Address Adaptation to Climate Change in Productive Coastal Zones). Adaptation Fund. 2012-2019. US$ 4.4 million (for Implementation of Concrete Adaptation Measures to Reduce Vulnerability of Livelihoods and Economy of Coastal Communities of Tanzania.

PROJECT SUMMARY

Sea level rise and an increased occurrence of flooding, often combined with storm surges, pose a major threat to livelihoods and communities along the coastal belt in Tanzania, where 25 percent of the country's population (approximately 14.5 million people) reside.[35] In the densely populated metropolis of Dar es Salaam (population 4.3 million), about 143,000 people and US$168 million worth of assets are based within the city's low-elevation coastal zone[36]. In total, Dar es Salaam has approximately US$ 5.3 billion worth of assets at risk from projected future floods.[37]

Moreover, communities in Tanzania are also grappling with saltwater intrusion as a result of sea level rise and groundwater extraction,[38] which has led to an acute shortage of drinking water and loss in agricultural productivity.[39] For example, farmers estimate that rice and maize yields have fallen by as much as two thirds over the past 10 years,[40] which is partially attributed to increased salinity, with higher impacts closer to the coast.[41]

The project was implemented in Dar-es-Salaam and in the coastal districts of Pangani, Rufiji, Bagamoyo, Mkoani and Mijni.[42] The project innovated with green-gray infrastructure measures providing buffer zones that minimize the impacts of sea-level rise by combining construction of seawalls (2.4 km long) with restoring 1,000 ha of mangrove forests and 3,000 m^2 of coral reefs. Seawalls, groynes and dikes were built in seven locations along the coast to stop shoreline erosion and saltwater intrusion and flooding. Improved drainage brought flood protection to about 1,500 households in Dar es Salaam. Water availability under increased climate extremes (both floods and droughts) in Bagamoyo district was improved through the relocation of boreholes to protect local communities from rising seas and adding 15 m^3 of water storage capacity. Rain water harvesting devices and storage were added in two schools.

The project not only delivers benefits for adaptation through improved sea defense system but also contributes to mitigation through mangrove restoration and to reduced environmental degradation through delineation of no-take zones to reduce deforestation. Participatory processes, local capacity building, and institutional integration from the local to national level were implemented to ensure buy-in by key local stakeholders and thus sustainability in the uptake of these measures and generation of co-benefits. The participatory processes were introduced through training events in integrated coastal zone management and climate change vulnerability assessment for local representatives, along with related assessments and awareness workshops.

The project also led to the establishment of climate change community based organizations (CBOs) and water committees that informed national planning processes through reports and policy briefs, workshops with regulators on cost-effectiveness of adaptation and lessons learned, and integration of coastal management plans into regional and district action plans.[43] To this end, project implementation was done in partnership with national ministries dealing with water and public works and local governing bodies as well as a consortium of NGOs. In collaboration with the University of Dar es Salaam, the project has also provided training to more than 100 people in coastal and vulnerability mapping and has supported subsequent research undertaken by 27 master's students on themes related to the project, ensuring the development of local capacities for further scaling actions.

The projects have followed priorities set out by Tanzania's National Adaptation Programme of Action (NAPA), and were designed to execute its goals, which are related to protecting water supplies and coastal regions,[44] on prioritized sites.


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Strengthening Climate Resilient Systems for Water, Sanitation and Hygiene services in Ethiopia

Geography: Ethiopia: Afar, SNNPR, Amhara, Gambella and Somali, Oromiya and Tigray.

Adaptation measures: The project is working to develop climate-resilient WaSH facilities for year-round access to services in targeted drought/flood-prone and water-stressed areas in the most vulnerable states, including during extreme events. The services are delivered by rural village management units and urban utilities through efficient and self-sustained systems.

Key outcomes: The project aims to establish building blocks for transformational change in the delivery of WaSH services. It expects to provide improved access to climate-resilient water and sanitation services and good hygiene practices for 1.2 million people in areas affected by climate extremes.

At the end of 2020, some of the project's achievements include: six climate-resilient water supply schemes were designed and moving into the implementation phase, with capacity to serve 20-30,000 people each; nearly 7,000 ministry and community experts had been trained in climate-resilient WaSH, supporting behavioral change and capacity building; and about 154,000 new and 23,000 rehabilitated latrines had been constructed.

Partners and funding: The five-years program (2019-2024) received £95 million UK funding. Other contributors to the overall program include World Bank, AfDB, UNICEF, Saudi Fund for Development, Finland, South Korea, and Netherlands.

PROJECT SUMMARY

Extreme climate-related disasters have been common across Ethiopia for decades and are expected to increase. At least 15 major droughts and five major floods in the last 50 years have had devastating consequences. More than 80 million people have been affected by these droughts,[45,46] which have particularly impacted the poorest and most vulnerable communities, and climate projections indicate worsening trends. For example, an already high variability in year-to-year precipitation (with differences between 28 and 62 percent in annual mean rainfall between dry and wet years)[47] is projected to be combined with an increased share of total rainfall during "heavy" events (up to 18 percent) by 2050.[48] Furthermore, the number of poor people exposed to floods will increase nationwide by 12 percent by 2050 (this figure masks expected regional differences).[49]

The SCRS-WASH project is responding to climate threats with new and rehabilitated climate-resilient WaSH services for year-round access, such as at the household, community and institutional levels, including WaSH for households, schools and health facilities in drought-affected and remote areas (Afar, SNNPR, Amhara, Gambella and Somali States).[50]

Measures such as deeper boreholes and piped networks will ensure service provision under scenarios of increased climate variability, protect the water resource base and mitigate costs for relief operations. Where possible, WaSH services have been set up to depend on groundwater sources, which are better able than surface sources to secure the supply under climate extremes. When surface water supply is the only available option, services can be complemented with water treatment plants to address high-fluoride and salinity issues. The sustainability of the system will be supported by developing local maintenance providers, providing technical support, and addressing institutional capacity gaps.

WaSH investments are key to supporting the most vulnerable in Ethiopia. Diarrheal disease causes 15 percent of post-neonatal deaths and 13 percent of deaths among children aged 1-4 years in the country. Climate change threatens to further increase this child mortality, as diarrheal disease outbreaks are exacerbated during periods of flooding.[51] Furthermore, carrying water, especially by children, causes musculoskeletal strain and can lead to debilitating pain and disability.[52]

The project contributed to the outcomes achievement of the Government of Ethiopia's flagship One WaSH National Program (OWNP). Climate Resilient WaSH is one of the program's five pillars. The project brings together government ministries, research and academia, development partners and civil society; and its implementation has provided lessons that can be applied at a larger scale. For example, lessons from early project actions for water provision led to a plan for a groundwater mapping assessment to identify potential groundwater source areas, since they are more resilient to climate extremes than areas supplied by surface sources.

The project puts an emphasis on groups that are disproportionately vulnerable to poor WaSH. For example, women and youth groups were empowered to engage in spare part supply and service maintenance to support the service delivery systems. They were also engaged in producing locally manufactured reusable menstrual hygiene products and building inclusive WaSH facilities. Future climate-resilient WaSH investments are expected to result in more inclusive job creation and increased labor productivity and domestic manufacturing.

Viewpoint: **Greening slums with vertical farms**

Federal University of Technology, Akure, Nigeria

Over 50 percent of Africa's urban poor live in dense slums and informal settlements, without access to basic services and infrastructure, and are especially vulnerable to the impacts of climate change. They usually lack space to grow their own food, and even if land is available, the soil is often polluted or unfit for agriculture. In such circumstances, vertical greening systems – plants grown on vertical surfaces – can not only contribute to food security, but also supplement livelihoods, provide micro-climate control, and contribute to a circular economy by promoting the reuse of waste material.

An adaptation research project hosted at the Federal University of Technology Akure, Nigeria developed two vertical farm prototypes: one using polyethylene terephthalate (PET) bottles, readily available from urban waste; and the second using high-density polyethylene (HDPE) pipes, a common building material. These prototypes were piloted in urban informal settlements in Lagos and Akure in Nigeria, and in Dar es Salaam, Tanzania.

Implementation of vertical greening in slums

The vertical farms yielded up to three kilograms of vegetables every six weeks or so, in a one-bedroom dwelling. They contributed to micro-climate control, reducing wall temperature by as much as 5°C and indoor air temperature by as much as 2°C. This compares well with previous comparable work on shade trees in a non-slum setting, where indoor air temperature is reduced by up to 3°C. Cooling from the trees can result in estimated annual cooling energy cost savings of about US$ 218.

Feedback received through phone calls, reports from neighbors, and post-implementation interviews shows that the pilots were generally well received, particularly for their potential to produce vegetables. Before the pilots can be scaled up, however, a few challenges must be overcome, such as high maintenance (mostly labour) requirements; few available vertical services; and misgivings about growing vegetables on walls.

Efforts to build urban parks and green spaces usually focus on formal and affluent neighborhoods. Policy initiatives and programs that promote citizen-led, community-based vertical farming in low-income urban informal areas are also necessary. A strong push, along with incentives, is needed to promote vertical greening systems in slum areas, to improve food and livelihood security, control micro-climate, and for aesthetic reasons.

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