GLOBAL CENTER ON ADAPTATION

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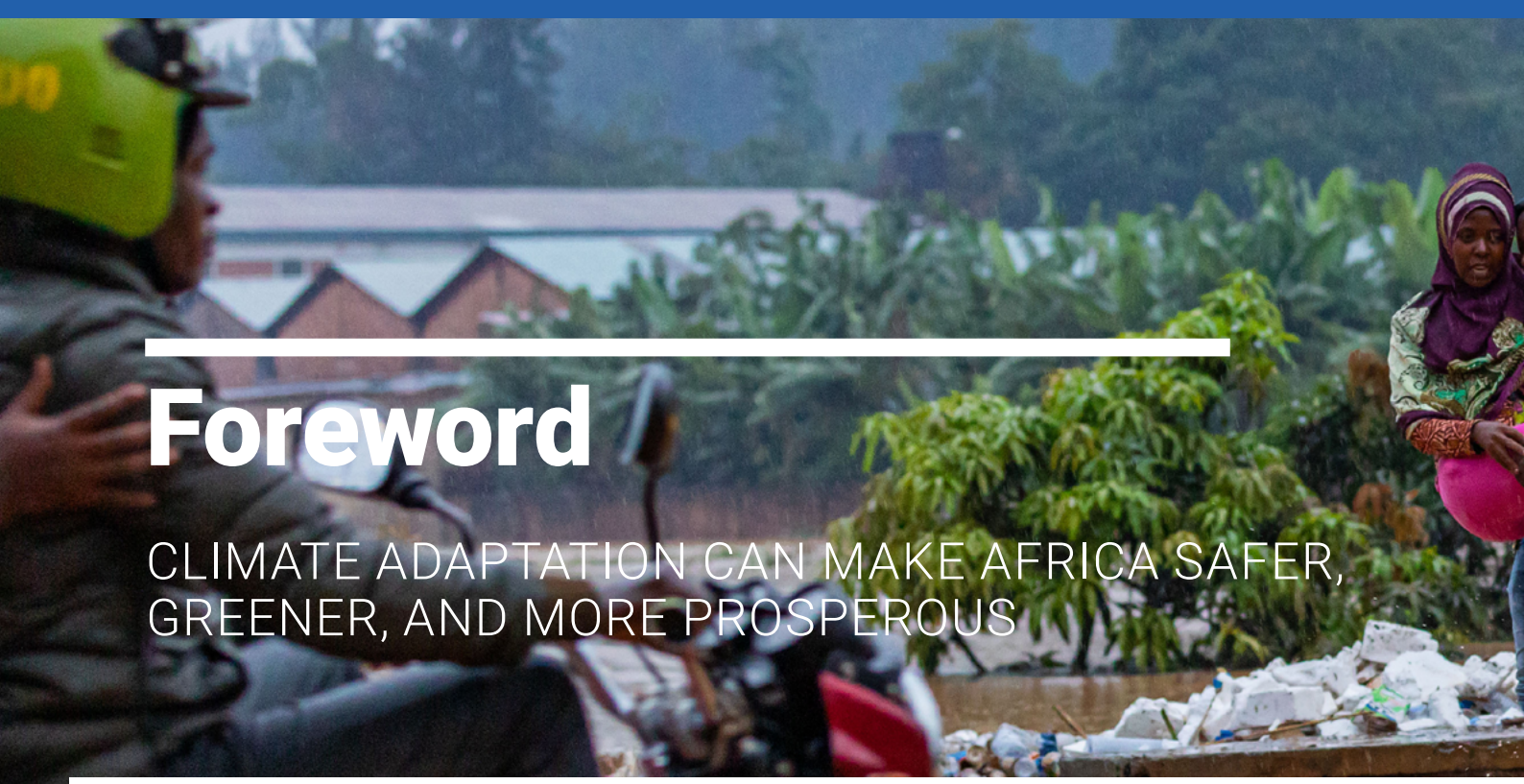

Foreword

CLIMATE ADAPTATION CAN MAKE AFRICA SAFER, GREENER, AND MORE PROSPEROUS

ADAPTATION IS CRUCIAL FOR THE CONTINENT THAT IS THE MOST VULNERABLE TO CLIMATE CHANGE, BUT ADAPTING SUCCESSFULLY WILL BRING ENORMOUS BENEFITS.

The early impacts of climate change are upon us. Scientific assessments detail what millions of people are already seeing with their own eyes. More extreme storms, record floods, searing heatwaves, more powerful cyclones, rising sea levels, and more severe droughts. Accelerated efforts to combat the causes of climate change must be matched by efforts to deal with its consequences, as these impacts will only grow more intense as the planet continues to warm.

Our climate emergency affects us all, but the warning light is flashing most urgently for Africa. Even before the social and economic trauma inflicted by the COVID-19 pandemic, African nations have already faced a long list of challenges from high rates of poverty and rising food insecurity to unplanned rapid urbanization, increasing water scarcity, ecosystem loss and desertification, and a lack of decent jobs to meet a growing population.

Despite contributing the least to global warming, Africa finds itself on the frontline of this climate emergency. Highly dependent on rainfed agriculture, hundreds of millions of smallholder farmers are affected by changes in the monsoons they rely on. Indeed, large portions of Africa—in particular, the drylands areas that cover three-fifths of the continent—are warming at a rate twice the global average, putting half a billion people at risk.

Africa has no choice but to adapt now to the present and future impacts of climate change. Yet while adaptation is a critical need, when done right it also presents major opportunities. With swift and effective action across all sectors, Africa can achieve a larger development agenda and move forward rapidly on a new "green" and resilient pathway to growth, harnessing the powerful synergies between adaptation, growth and development. Given the right conditions, Africa has some special advantages that make this green growth path more achievable, such as a rapidly growing labor force and rich reserves of natural resources.

This new report from the Global Center on Adaptation, *State and Trends in Adaptation 2021*, combines in-depth analyses, case studies, and viewpoints from those on the frontlines of climate change impacts in Africa. It presents a detailed blueprint for action by offering innovative adaptation and resilience ideas, solutions, and policy recommendations. The results are clear and compelling. Adaptation measures can be enormously cost-effective and have the potential to start a positively reinforcing cycle of benefits. As these measures protect people and communities from floods, droughts, and others impacts, they also help lift people out of poverty, reduce hunger and undernourishment, raise incomes and living standards, fight diseases, create jobs, reduce inequality, mitigate the risk of conflicts, and give voice to the most vulnerable. These realizable results, in turn, further increase resilience to climate impacts.

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Of course, successful adaptation will not be easy. It requires major increases in adaptation finance and mainstreaming adaptation into all policies and budgets across the public and private sector. New partnerships will need to be forged to embrace both new technologies and traditional adaptive farming practices, empowering women and youth, and transforming key sectors, including agriculture, transportation, energy, trade, and water management.

Yet as, this report also details, African countries and communities have already taken numerous steps forward to adapt and to build resilience. This leadership shows a more prosperous, more sustainable, and safer future is achievable. We hope that this comprehensive report will be an inspiration and a guide to build upon and accelerate those efforts, bring them to scale, and seize the enormous opportunity that lies within our grasp.

Dr. Patrick Verkooijen

Chief Executive Officer
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THE STATE AND TRENDS IN ADAPTATION ADVISORY COMMITTEE

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Executive Summary

TOWARD A MORE RESILIENT AFRICA

THE URGENT NEED TO ADAPT TO CLIMATE CHANGE

The average global temperature is on track to rise to 1.5°C above pre-industrial levels within the next decade or so and 2°C or more by mid-century. These warmer temperatures are already transforming the planet, causing more extreme storms and floods, rising sea levels, more intense heatwaves, and longer and more severe droughts. As global temperatures continue to climb, those impacts will inevitably intensify.

Africa is particularly vulnerable to these extreme impacts of climate change. It faces exponential collateral damage, posing systemic risks to its economies, infrastructure investments, water and food systems, public health, agriculture, and livelihoods, threatening to undo its hard-fought development and reverse decades of economic progress. Rates of poverty are high, both among the millions of smallholder farmers and the large numbers of people who live in informal settlements with low access to basic services in cities. In addition, large portions of Africa—in particular, the drylands areas that cover three-fifths of the continent—are warming at a rate twice the global average, putting half a billion people at risk.

Projections estimate that climate change will cause a 2 percent to 4 percent annual loss in GDP in the region by 2040. The brunt of the impact will be borne by the poor, women, and currently marginalized or excluded populations. Even if international mitigation efforts keep global warming below 2°C, the continent is expected to face climate change adaptation costs of US$ 50 billion per year by 2050. Meanwhile, the continuing COVID-19 pandemic has been a severe disruption, straining resources in many countries.

Africa thus has no choice but to adapt now to the present and future impacts of climate change. At the same time, rapid and decisive action to cut greenhouse gas emissions and mitigate climate change is crucial for reducing those future impacts; without at least some mitigation, adapting to climate change may be impossible for Africa.

The GCA's *State and Trends in Adaptation 2021* report presents the most comprehensive overview of the present and future prospects for the African continent in the light of climate change. It offers a blueprint for how individuals and institutions in the African and international policy space can finance, design, and implement adaptation plans to best protect the lives and livelihoods of millions of African people from such disruptive change.


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The macroeconomics of adaptation: The potential for large benefits

The analyses in this report document the high costs of climate change impacts in Africa. Because of better hazard reduction measures, improved social safety nets, humanitarian support, and other measures, African nations have significantly reduced the number of deaths from floods, droughts, and other weather events. But the economic toll, which includes reduced crop yields, business losses from disruptions to supply chains and power outages, damage to housing stock and infrastructure, people displaced from their homes and farms, and livelihoods harmed, is enormous—billions of dollars a year. If Africa had not experienced numerous damaging weather events over the last decade, the strong growth rates countries have achieved would have been even higher.

Adaptation measures are essential to decreasing those large economic damages and further decreasing the loss of life. Yet adaptation can accomplish much more than simply preventing future damages; it also presents major opportunities to achieve a larger development agenda and put Africa on a new "green" and resilient pathway to growth. Adaptation and development work hand in hand, creating powerful synergies that can increase the chances of meeting global Sustainable Development Goals and additional goals that African nations have set for improving agricultural productivity. Moreover, Africa has some special advantages that make the green growth path more achievable, such as a rapidly increasing labor force and vast available resources.


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Adaptation measures have the potential to create a virtuous circle. Even as they protect people and communities from the impacts of climate change, they can also help lift people out of poverty, reduce hunger and undernourishment, raise incomes and living standards, fight diseases like cholera and dysentery, create jobs, reduce inequities, reduce the tensions that lead to conflicts, and empower women. Those gains, in turn, will further increase resilience, enabling communities to better cope with future extreme storms, droughts, or other climate change impacts. In addition, many of these actions will help mitigate climate change as well by cutting emissions or pulling carbon from the atmosphere.

The macroeconomic analysis in this report shows that the economic case for adaptation is strong. Adapting now is much more cost-effective that continuing to finance increasingly frequent and severe crisis responses, disaster relief measures, and recovery efforts. Studies focusing on Africa show that the benefits of adaptation measures are almost always more than twice the costs, and often are more than five times higher. In addition, moving quickly to adapt is especially beneficial, with a benefit-cost ratio for early action of at least 12 to 1.

A comprehensive plan of action

This report uses in-depth analyses, case studies, and viewpoints from those on the frontlines of climate change impacts in Africa to present a detailed blueprint for action, offering innovative adaptation and resilience ideas, solutions, and policy recommendations. It calls for a combination of coordinated and supportive bottom-up and top-down solutions. Adaptation is everybody's business.

The report documents and builds upon numerous examples that already exist today in Africa of successful adaptation strategies. An initiative called the Great Green Wall has evolved from the idea of a 7,000 km belt of trees planted across the width of Africa to a comprehensive vision for restoring 100 million hectares of degraded land, demonstrating that African nations can work together to set ambitious targets and make progress. In addition, several countries have released national green growth strategies that include a strong focus on adaptation, such as Ethiopia's Climate-Resilient Green Economy Strategy, Rwanda's Green Growth and Climate Resilience National Strategy for Climate Change and Low Carbon Development, and South Africa's Green Economy Accord. Equally important, these countries have ensured that consideration of adaptation is part of their planning processes and budget allocations.

Other nations are implementing specific adaptation measures, such as the modernized climate information and early warning system in Malawi. That system delivers improved forecasts and weather advisories to farmers, fishers, and disaster response organizations over mobile phones and other platforms, helping people prepare for coming weather events. One study showed that by 2019, the system had directly improved the resilience of 420,000 people and indirectly helped 1.2 million more people.

Many other efforts are growing up from the grassroots, such as farmer-led agroforestry restoration efforts that have increased crop yields in Niger and community-led efforts in urban informal settlements to build stormwater drains and improve access to clean water and electricity, increasing resilience to floods.

These examples, and many more, have laid a strong foundation for a more resilient Africa. But given the size of the climate threat, the pace of adaptation must be dramatically increased. As the report's chapters describe in detail, adaptation must be "mainstreamed" into decision-making at all levels of government, in all economic thinking and planning, and in every ministry, with high level adaptation champions in each country. Adaptation measures also must be implemented in every sector—agriculture, transportation, energy, trade, water resources, and urban development. Particularly important are nature-based solutions, such as restoring mangroves to protect coastal communities or creating urban parks that absorb stormwater and moderate heat waves in cities.

To support these efforts, adaptation finance must be accelerated using a wider variety of finance sources, from commercial banks and venture capital to insurance and foundations, and innovative ideas like debt for climate swaps.

Given the African continent's enormous human and natural resources, Africa has the potential to move forward rapidly in labor-intensive modern industries such as eco-tourism services, climate-smart agriculture, renewable energy, and green building and infrastructure. It thus has an opportunity to adapt to the impacts of climate change while simultaneously reaching sustainable development goals. This report is both a call to action and a comprehensive guide to the climate-adapted and resilient growth path that can move Africa towards a more resilient, healthier, and more prosperous future.

THE CHALLENGE: THE PRESENT AND FUTURE IMPACTS OF CLIMATE CHANGE

Africa's climate and weather are largely controlled by the El Niño Southern Oscillation (ENSO), a weather system driven by changes in atmospheric and ocean circulation across the equatorial Pacific Ocean, and by two monsoons. The West African monsoon brings rain to the western Sahel from June to September, and the East African monsoon drops precipitation in East and Central Africa from March to May and October to December. In addition, Africa's East Coast is regularly struck by strong cyclones.

Variations in these large-scale climate phenomena have huge implications for the amounts and patterns of rainfall and storms in individual African countries, and have historically caused numerous natural disasters like floods and droughts.

A major challenge in the planning for climate change is the deep uncertainty at small geographical scales (like a city) and over longer timeframes (the decades of useful life of infrastructure assets). This calls for a strong emphasis on no-regret robust solutions able to handle that uncertainty.

Now, however, climate change is increasing the frequency and intensity of those extreme weather events. The number of floods in Africa has jumped five-fold since the 1990s, and many floods are more extreme. Sudan experienced its most severe flood in 60 years in 2020, for example, with more than 500,000 people displaced and 5.5 million areas of farmland destroyed.

In 2019, two of the strongest storms ever recorded hit East Africa. Cyclone Idai destroyed 90 percent of the homes in the city of Beira in Mozambique and damaged 1.4 million hectares of arable land in Zimbabwe. A few weeks later, Cyclone Kenneth struck a little to the north. Together, the storms killed 1300 people and affected 3.5 million more.

Droughts are becoming more intense as well. A 2016-17 drought in Somalia caused US $1.5 billion in losses to agriculture, along with widespread malnutrition, and a 2019 drought lowered water levels behind the Kariba Dam, leading to US $200 million in lost production in Zimbabwe from power shortages.

In addition, the intensification of the Asian monsoon lows, which draw warm dry air from the Arabian Peninsula to North Africa, caused temperatures to rise up to 47°C in Egypt in August 2021, making it unsafe to work outdoors and forcing the Metro in Cairo to close. Such dangerous heatwaves are becoming more frequent.

The increase in extreme climate events is having serious consequences. Productivity growth for the continent's number one staple, maize, has stalled, and the likelihood of conflict has increased. Data for the period 1980-2016 show that one-third of conflicts have been preceded by a natural disaster within seven days. After the 2009 drought in Mali, for example, Al Qaeda militants based in southern Algeria recruited fighters and extended their operations into Mali.

Studies show that each 1°C rise in temperature increases the risk of intergroup conflict by more than 10 percent. That can start a vicious cycle, where higher levels of conflict triggered by climate change further undermine communities' abilities to cope with and adapt to more extreme weather events, making additional conflicts more likely.

These growing climate threats come at a time when Africa already faces significant economic and social challenges. More than one in five people across the continent experience hunger in their daily lives, and 282 million people are undernourished. The numbers of stunted children are rising, exacerbating cycles of poverty that can continue from generation to generation. And 94 percent of the world's cases of malaria—215 million in 2019—occur in Africa, with 386,000 deaths in 2019.

Climate change impacts will become more severe

There are large uncertainties about Africa's climate future. Whether or not certain regions will experience greater rainfall or suffer from more droughts is highly dependent on small changes in ENSO and the monsoons, which today's climate models cannot yet accurately predict.

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But many of the general trends are clear. By mid-century, average temperatures will be 2°C higher, or more, compared to pre-industrial levels. Life-threatening temperatures above 41°C are projected to increase by 50 to 200 additional days, depending on the region and the world's pace of cutting greenhouse gas emissions. For countries like Chad, Burkina Faso, and Togo, more than seven percent of all working hours will be lost because of heat stress.

The climate models do project that parts of North Africa, western Southern Africa, and Central Africa will continue to experience a drying trend—and that almost all regions of the continent will be struck by more frequent and more intense rainstorms, causing greater numbers of potentially devastating floods. At the same time, higher temperatures, enhanced evaporation, and more erratic monsoons are expected to increase the number and severity of droughts.

Meanwhile, sea levels are virtually certain to climb by half a meter by the end of the century and could rise nearly a meter unless greenhouse emissions

are quickly curbed, while cyclones are expected to become more powerful. The combination of higher seas and stronger storms will mean that today's 1-in-100-year coastal flooding events will happen once every 10 to 20 years by mid-century, threatening millions of people in coastal communities.

Failure to curb global greenhouse gas emissions would put the world on a trajectory towards planetary warming of 3°C, which would cause catastrophic disruptions of the whole African food system. Under the 3°C scenario, Africa would lose 30 percent of its current growing areas for maize and banana, and 60 percent for beans, by 2050.

Climate tipping points are also possible. If the ocean currents known as the Atlantic Meridional Overturning Circulation collapse, for example, deserts would spread across large areas of Africa south of the Sahara, with calamitous impacts on food production and agricultural livelihoods.

THE PATH FORWARD

Climate change presents a huge threat to Africa's economic development and social progress. Adaptation is thus a necessity, not a choice. But it can put Africa on the path to a more resilient and prosperous future. This report lays out a detailed blueprint for successful adaptation. The key enabling foundations include:

- *Mainstreaming adaptation.* This means creating national adaptation strategies and viewing every decision and every plan through the lens of how those actions can improve long-term resilience. In both government and the private sector, a focus on adaptation would lead to a revolution in the planning, design, financing, and delivery of infrastructure, including a heavy emphasis on renewable energy and nature-based solutions like the restoration of drylands and forests. A number of countries have taken important steps in this direction, such as South Africa, Rwanda, Ethiopia, and Kenya, among others
- *Dramatically increasing financial support for adaptation.* In their Nationally Determined Contributions (NDCs) under the Paris Agreement, 40 African nations have estimated their investment needs for adaptation at roughly $331 billion by 2030. The amount of money available for adaptation actions, however, is far less, leaving a $265 billion gap. There is an urgent need, therefore, to increase support from developed nations, sovereign wealth funds, pension funds, development banks, philanthropies, foundations, non-profits, and other sources, as well as integrating adaptation into national budgets. There are also opportunities for innovative financing models. The African Adaptation Acceleration Program will invest in climate-smart agriculture to increase yields and improve resilience, along with empowering youth through incubator and training programs, for example. The African Conservancies Fund offers loans to boost sustainable agriculture and eco-tourism in the Maasai Mara in Kenya. And some of the Seychelles national debt was acquired by the Nature Conservancy in return for creating the Seychelles Conservation and Climate Adaptation Trust, which has used $1.5 million in funding for such projects as restoring mangroves

and employing disadvantaged women to harvest seaweed for fertilizer. A related crucial step is requiring disclosure of climate risks. Combined with measures like *"green"* and resilient building codes and other regulations that support adaptation, that will steer both public and private investment dollars towards projects, products, and services that build resilience to floods, droughts, and other climate change impacts.

- *Harnessing the power of the private sector.* Ninety percent of the jobs in Africa and 75 percent of the continent's economic output come from the private sector. Adaptation is thus crucial for the private sector to survive and thrive. At the same time, a strong effort to adapt will create important new business opportunities. In one example, the OCP Group, a global fertilizer producer based in Morocco, has worked with public authorities to build desalination and wastewater recycling plants to reduce water shortages, and has also partnered with research centers to introduce new higher-yielding varieties of quinoa to farmers, helping to reduce food insecurities.
- *Improving hydrological and meteorological (hydromet) services.* Reducing the human and economic toll from disasters like floods or droughts is impossible without high-quality data on weather, climate, and key parameters like river flows and soil moisture—or without a system for warning those in danger. Just 24 hours of advanced notice of a coming storm or heatwave can cut damages by 30 percent, and accurate longer-range weather and climate forecasts can enable herders to move their livestock or farmers to change what and when they plant to maximize productivity. The World Bank estimates that deaths could be cut in half and $2 billion annual losses could be avoided if early warning systems in Africa were upgraded to European standards. In implementing such early warning systems, it's essential to engage local communities, taking advantage of their knowledge about vulnerable crops and livestock, the strength of the housing stock, the locations of shelters, and other key characteristics. It's also vital to devise methods for reaching people with forecasts and warnings. In one example, the national meteorological service in Senegal works with 83 community-based radio stations,

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plus text message servers, to reach 740,000 rural households with seasonal forecasts that can guide planting choices and other decisions.

- *Creating more opportunities for young people.* With 43 percent of its population under the age of 15, Africa has the largest youth population in the world. Young people are particularly vulnerable to the impacts of climate change, with most employment being informal on farms or in urban households. They are also not yet significantly engaged with the climate crisis, and are often excluded from community-level political activities and leadership roles on a continent where countries are governed by the world's oldest leadership. But the youth "bulge" also offers important opportunities. Africa's young people today have more education than their parents do. With policies and investments aimed specially at accelerating "green" and resilient growth, therefore, youth can provide the workforce needed to expand the manufacturing sector, to improve agricultural productivity through climate-smart practices, and to increase formal employment in cities.
- *Empowering women.* Women also are especially vulnerable to climate change. Because they typically lack property and land tenure rights, they are often forced to work on the least productive land, while also taking on laborious tasks like collecting water and fuelwood. They are much less likely than men to use fertilizers and improved seeds or to make use of mechanical tools and equipment. And they are usually excluded from

decision-making. As a result, African countries are failing to take advantage of the unique knowledge, skills, and perspectives that women have—such as local knowledge about sowing seasons, traditional multi-cropping practices, wild edible plants, and livestock management. They also play major roles in disaster recovery and resilience. As a result, there is a critical need to develop gender-responsive policies that both remove barriers to women's advancement and utilize their unique skills. One promising path to those policies is giving more power to women's associations. In the Kenitra province of Morocco, for example, the Soulaliyat women started an initiative to claim land access rights. The Ministry of the Interior responded by urging provincial authorities to ensure that the principles of gender equality are upheld in the transfer of communal land.

The steps described above lay the crucial groundwork for successful adaptation. It is then essential to build on those foundations by targeting adaptation efforts in key sectors. This report examines six sectors that are important for Africa's future, offering in-depth analyses and recommendations for effective action.

Agriculture

Given the huge role of the agricultural sector in the African economy, the millions of smallholder farmers whose livelihoods depend on it, and the growing challenges of hunger and food insecurity, agriculture needs serious and urgent attention—and the economic case for adaptation is particularly strong. The cost of taking effective action (particularly in priority areas like research and extension, water management, infrastructure, land restoration, and climate information services) is estimated at US $15 billion per year, less than a tenth of the estimated US $201 billion annual cost of inaction, which includes paying for disaster relief and recovery after floods and droughts.

Numerous proven strategies can make African agriculture more resilient. Some involve providing farmers and herders with more information and resources, such as early disaster warnings, weather advisories, remote sensing of vegetation to pinpoint the best grazing areas, and innovative insurance products, such as payouts pegged to insufficient rainfall. In the Sahel, for example, such payouts have assisted 1.3 million drought-affected people. Expanding mobile internet coverage, which now reaches only 24 percent of the population, is important for both delivering information and enabling farmers to connect with buyers and access new markets.

Other approaches, especially those led by local farmers and communities, can boost yields and incomes. In Niger, smallholder farmers have allowed versatile nitrogen-fixing Faidherbia albida acacia trees and other valuable species to naturally regenerate from seeds and rootstocks. The new trees have "regreened" more than five million hectares of degraded drylands, improving the soil, suppling food and fuel, and recreating a traditional form of resilient agroforestry that has dramatically raised yields and incomes. Local knowledge can also be tapped to grow and market neglected local species that are climate tolerant, such as cassava bread in West Africa, teff in Ethiopian cuisine, rooibos tea in southern Africa, or the faba bean in northern Morocco.

More gains can come from better water management, such as more efficient irrigation and water storage in small farm ponds. Cold storage for fresh produce like fruit, eggs, dairy, meat, and fish, along with better storage for grains, could significantly reduce food spoilage, which now wastes 36 percent of all the food produced in Africa. And pastoralists can switch from cattle to sheep and goats, which require less feed during droughts, or to livestock bred to be more drought- or disease-resistant.

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Adapting the agricultural sector to climate change bring benefits beyond higher crop yields and increased farm incomes. Those benefits include greater resilience to pandemics, lower inequities, more opportunities for women and youth, greater political stability, and billions of dollars' worth of ecosystem services like cleaner water as landscapes are restored.

Trade

When climate events destroy crops and cause food shortages, trade can cushion the volatility of food markets and reduce the harm to people and communities, while also creating jobs and raising incomes. The classic historical example is the arrival of the railroad in colonial India in the early 1900s. The resulting ability to transport food and supplies almost completely ended large numbers of deaths from regional droughts and food shortages. More recently, South Africa lowered barriers to imports of maize and other foods in response to a 2015-2016 drought, limiting shortages and price spikes.

Africa now should take greater advantage of the opportunities trade offers to open up markets, boost productivity, and improve resilience. Studies show that simply phasing out agricultural tariffs could cut undernourishment caused by the impacts of climate change by 64 percent, with 35 million fewer people suffering from hunger.

This report recommends that governments reduce trade barriers, especially for food, goods, and services that can directly increase resilience. Those can include new stress-tolerant varieties of crops, technology for early warning systems, renewable off-grid electricity generation, and innovative irrigation systems. Countries should also improve transportation networks throughout the continent, reducing their vulnerability to floods and other impacts, and ensuring that natural disasters don't curtail trade.

Drylands

Two-thirds of the total area of Africa is comprised of arid and semi-arid regions defined by a scarcity of water. These so-called drylands are home to two-fifths of the continent's population and contain three-fifths of the total farming land. In addition to cropland, they range from woodlands and savannas to Mediterranean shrublands and the hyper-arid

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Sahara. Unfortunately, many of these dryland areas have suffered from decades of land degradation. Now, the drylands are warming at a rate twice the global average, putting half a billion people at risk.

There is an urgent need therefore to restore degraded drylands, to build greater resilience to future climate impacts, and to scale up climate-adapted development.

In the past, top-down interventions by government agencies, such as national efforts to plant millions of trees, have often been ineffective. In contrast, however, many community-led efforts that draw on local knowledge have been successful. In Burkina Faso, a farmer named Yacouba Sawadogo revived an ancient technique called zaï, in which people dig deep planting pits and stuff them with manure and other organic matter to trap water, making it possible to grow crops again and restore the tree canopy—and Sawadogo became known as "the man who stopped the desert."

On a much larger scale, the Great Green Wall Initiative aims to use zaï and other techniques like stone bunds (embankments to minimize erosion) and farmer-managed natural regeneration to regreen scores of millions of hectares. These approaches are already improving productivity and livelihoods and restoring ecosystems in countries like Mali, Niger, and Senegal, and can be encouraged by institutional, regulatory and land tenure reforms that give local communities more control over their resources.

The drylands also offer great potential for diversifying well beyond smallholder farming. With abundant solar resources, minerals, and biodiversity, and with spectacular landscapes and amazing cultures, they can support or expand many other forms of economic and social development. Cheap, renewable solar electricity can power value-added grain mills and cold storage for farmers, new factories, hotels, and other small business, or rural health clinics. Restored forests and thriving tribal communities can make it possible to expand eco- and cultural tourism, while also generating new revenues from increased carbon storage capacity.

This report encourages African nations to embrace a vision for the large-scale transformation of the drylands, simultaneously meeting the existing challenges of poverty, undernourishment, and lack of opportunity while creating more economic opportunities in these important regions as the climate changes. In regions facing the worst impacts of climate change, the emphasis should be on people-based policies (like health, education and social protection) and not only on place-based policies (like infrastructure and urban development).

Urban development

Africa has the highest rates of urbanization in the world. About half of Africans now live in cities, and the urban population is expected to nearly triple by 2050, driven by high population growth rates and increasing migration from rural areas to cities.

Africa already is home to seven "mega-cities" (those with populations over 10 million people), including Lagos, Johannesburg-Pretoria, and Nairobi, with others soon to cross the threshold. Many of these cities have large and expanding footprints, with the increase in urban area growing faster than population.


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Like many other urban environments around the world, Africa's cities face a long list of challenges: lack of basic housing and infrastructure, overcrowding, congestion, unemployment, large inequities, disease, crime and violence, and low standards of living. Some of the challenges are especially acute in Africa, including inadequate transportation, insufficient urban planning, and lack of employment—with 90 percent of urban jobs being informal. And in sub-Saharan Africa, an estimated 60 percent of the population lives in informal settlements that typically spring up without planning or basic services. With little air conditioning and vulnerable power grids, heatwaves threaten lives and cripple businesses. And because many informal settlements are located on floodplains or hillsides, they are especially vulnerable to floodwaters or landslides. After three days of intense rainfall in 2017 in Sierra Leone, for instance, a massive landslide in the Babadorie River Valley resulted in more than 1000 people being dead or missing.

Solving these problems and building resilience is a difficult and complex challenge, requiring actions at many levels. But African cities do have unique opportunities to adapt to climate impacts, given their relatively low current population density and the fact that many cities are still in the early stages of urbanization. This report's recommendations include strengthening early warning systems, providing affordable safe housing, creating urban parks and better drainage systems to soak up stormwater and reduce urban heat, promoting innovative urban agriculture (such as vertical farms on the walls of homes), strengthening and decarbonizing power grids, generating energy from wastes, moving communities from vulnerable floodplains and hillsides, and restoring natural features like riverbank mangroves and wetlands. In coastal Beira in Mozambique, one of the cities most threatened by climate change, restoring the natural drainage capacity of the Chiveve River and creating urban parks along the riverbanks has reduced the risk of future flooding. In other cases, local communities can lead the way. In Murkuru, a

large slum in east Nairobi, local people have led an effort to build roads, add stormwater drains, and connect each household with electricity, clean water, and sewers, reducing flooding and the incidence of waterborne diseases.

Transport and energy

Many of the roads, bridges, power grids, and other key infrastructure elements in Africa are decades old and are unable to withstand the impacts of climate change. In Tanzania, businesses lose millions of dollars a year because of power outages and transport disruptions caused by flooding. In Mozambique, a 2000 flood destroyed road links between the capital of Maputo and the rest of the country, as well as the rail line to Zimbabwe, for almost a year, leading to the lowest level of economic growth in two decades.

The combination of vulnerable infrastructure and increasing climate shocks can create an "infrastructure trap" in which governments spend most of their limited funds repeatedly rebuilding the same failed structures and systems, leaving few resources to make progress towards a more resilient future.

The way out of this trap is switching from reacting only after disasters strike to "proactive" adaptation: considering climate risks at the beginning of every project, and incorporating resilience in planning, design, construction, operation, and maintenance. The upfront costs of building in resilience from the start are estimated to be only about three percent higher than normal construction, but the payoff is much larger—at least four times the additional investment in reduced rebuilding and maintenance costs. There are many other benefits as well. More resilient solar power plants not only provide electricity when droughts curtail hydropower, for instance, they also mitigate climate change, reduce air pollution, and lower fuel costs compared to alternative diesel generators.

Another part of the solution is making better use of natural systems. Green roofs, urban parks, wetlands, forests, and other nature-based approaches can significantly improve stormwater management and reduce flooding, while also reducing the costs of engineered solutions like more massive stormwater drains. Similarly, restoring salt marshes, coral reefs, and mangrove forests to protect coastal roads, rail lines, ports, and airports is highly cost-effective.

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There are also countless opportunities for clever ideas. In Ghana, the Bamboo Bike Initiative trains rural women and youth to build bicycles for those who can't afford commercial ones. Farmers report that the bicycles enable them to spend more time growing crops, and students who used to walk up to 10 km to classes say their school performance is improving because they can arrive earlier and more quickly.

Water resources, floods, and disaster risk management

A key principle of adaptation is that you cannot prepare for future climate disasters if you are not ready for current disasters. That's why it is encouraging that all 55 countries in Africa have signed onto the Sendai Framework for Disaster Risk Reduction, which sets ambitious goals for reducing

the number of people killed or affected by disasters, along with economic losses, damage to infrastructure, and disruptions of basic services. In addition, 18 countries have strategies or policies in place to work towards those goals, and seven more are developing such policies.

This is just a beginning, though. This executive summary has already offered many recommendations, from improving early warning systems to harnessing nature-based solutions like ecosystem restoration, for reducing the toll from floods, droughts, and storms.

Additional recommendations include boosting the financial resources for disaster relief and recovery—and using those resources to provide nearly instantaneous relief support. A case study in Malawi shows that a four-month delay in disaster support can increase the cost per household from a few dollars to US $50. And a nine-month delay sends costs soaring to US $1,300 household, primarily because people are forced to sell assets like livestock at distressed prices and children's development is set back.

Given that most disasters are caused by too much or too little water, better water management is also crucial. That means integrating policies across a range of sectors and activities—forestry, agriculture, municipal water supplies, hydropower and river management, to name a few. It also requires more international coordination, since many large watersheds cross borders. A good example of such basin-wide collaboration is the Niger Basin Agreement, in which nine countries have come together to develop both a sustainable development action plan and a climate resilience investment plan.

CONCLUSION: TURNING THE BLUEPRINT INTO ACTION

A consistent theme runs through the sections of this report: Adaptation is not just a vital imperative; it also represents a major opportunity to solve previously intractable problems and put Africa on a more resilient path.

The same adaptation measures that can prevent devastating floods will reduce outbreaks of waterborne diseases like diarrhea, now the leading cause of death in Africa in children under five. Regreening the drylands and boosting crop yields will help stamp out malnutrition and child stunting, beginning a positive cycle that can improve families' prospects and well-being over generations.

Or consider the challenges of gender equity. Women in Africa now have less access to productive land than men do. They get only seven percent of all agriculture extension services and less than 10 percent of the credit offered to smallholder farmers. They are less likely to have mobile phones to connect them to markets or warn of threatening weather events, and they tend to shoulder laborious tasks like fetching water and collecting fuelwood.

Adaptation done right not only corrects these inequalities, it also offers benefits from tapping into the often unique and invaluable knowledge and expertise of women in such areas as traditional crops, agricultural practices, and edible wild plants. This report thus strongly recommends giving women greater roles in politics and decision making.

Adaptation is not easy. The pursuit of other important objectives, like the 169 targets in the Sustainable Development Goals, can even result in actions that are maladaptive. For example, efforts to reduce hunger by increasing irrigation could end up depleting aquifers, with severe long-term consequences. It is encouraging, therefore, that this particular risk was recognized in the Sebou-Saïss basin in northern Morocco, and the Saïss Water Conservation Project was launched to both cut hunger through more efficient irrigation and boost long-term resilience by preserving the aquifer.

Successful adaptation will take countless efforts like this one—and a resolve and commitment that most countries have yet to fully embrace. Africa needs more international cooperation and South-South exchanges of practical adaptation solutions with demonstrated results at scale. The hope is this comprehensive blueprint report can help African countries make that commitment and provide a guide to the way forward, helping to put Africa on the path to a more resilient future.