Climate Risks in Africa

Photo: Martchan/Shutterstock

KEY MESSAGES

- Climate change acts as a risk multiplier, amplifying the intensity of extreme weather events, increasing unpredictability, and exacerbating vulnerabilities. Both the changing realities of climate in Africa today and modeling of future outcomes show that Africa is one of the most vulnerable regions in the world to climate risk.
- Africa has been substantially impacted by natural disasters, which are set to increase in severity and frequency. Between January 2021 and September 2022, approximately 52 million people (around 4 percent of the African population) were impacted either by drought or floods, deeply affecting African livelihoods.
- African food systems are particularly vulnerable to climate extremes and shifts in weather patterns, as food production is largely dependent on rainfed agriculture and pastoralism. Considerable negative impacts of a changing climate are also expected for marine and inland fisheries.

- Water-dependent sectors across Africa are largely and negatively impacted by extreme variability. Extreme hydrological variability will progressively amplify under all climate change scenarios (relative to the current baseline), depending on the region. Projections of the number of people who will experience water stress by the 2050s vary widely, with potential decreases or increases by hundreds of millions. This requires planning under high uncertainty.

> **"Africa is suffering enormously from the devastating effects of climate change. This is serious in the Horn of Africa, due to the droughts in East Africa. In the past two years, we've barely had rains. This has serious implications for food security, has decimated a lot of livestock, affecting the livelihoods and incomes of pastoralists, and causing displacement of population as they search for water. To say that Africa, which suffers losses of $7 billion to $15 billion per year and could rise to $50 billion per year by 2014, is clearly the most vulnerable region of the world is not in any way an exaggeration."**
>
> **H.E. Sahle-Work Zewde**
> President of Ethiopia

Photo: Curt Carnemark/World Bank

INTRODUCTION

The "Present and Projected Climate Risks for Africa" chapter in the *State and Trends in Adaptation 2021* (STA21) report gave an overview of the observed climate trends and modeled projections of the physical processes that determine changes in the climate system for Africa.[1] It also provided an overview of the climate-related disasters now experienced across the continent and the resulting human and economic losses. It then presented trends in near-surface (2 meters) air temperature and sea levels, followed by a brief overview of projections presented by Working Group I of the Intergovernmental Panel on Climate Change (IPCC) in the Sixth Assessment Report, which were derived from a new modeling effort.[2]

To reprise a key message from STA21, although Africa has historically contributed a very small share of global greenhouse gas emissions, it is highly vulnerable to anthropogenic climate change and is already experiencing widespread losses and damages. Surface temperatures are increasing across all African regions, and the continent is warming faster than the global average over both land and the oceans.[3] Agriculture, which is mostly rainfed and employs a majority of the workforce across Sub-Saharan Africa, mainly as smallholders, is particularly vulnerable to climate variability and to escalating climate change impacts.

With projected increases and intensity of high-warming scenarios of heatwaves, heat stress, droughts, and flooding for some parts of Africa, STA21 emphasized the need and urgency to adapt. Importantly, it highlighted that adaptation is particularly urgent for Africa, as many small changes in weather patterns resulting from climate change can gradually erode food system productivity, causing losses of assets through events too small to attract global or even national attention. Such changes affect people's wellbeing and can counteract efforts to alleviate, or can even push people back into, poverty. Furthermore, STA21 pointed to the vital need for significant additional investment to improve systematic weather and climate observations, as climate-related research in Africa faces severe data constraints.

This chapter provides an update on new climate data published since STA21. This includes, among others, the World Meteorological Organization (WMO)'s State of the Global Climate 2021,[4] the multi-organization synthesis United in Science 2022,[5] the latest data from the Emergency Events Database (EM-DAT),[6] and IPCC Working Group II's contribution to the Sixth Assessment Report, released in February 2022. The latter examines the interactions between the physical changes analyzed by Working Group I and the exposure, vulnerability, and adaptive capacity of social and biophysical systems, with a dedicated chapter for Africa.[7]

This chapter first provides an overview of climate-related disasters experienced in Africa in the last year, followed by a closer look at high-impact events across the continent. It then summarizes temperature and precipitation data for the different regions in Africa. Lastly it outlines the expected impacts of physical changes to the climate system, highlighting the critical interconnection between climate change, society, and nature for climate-resilient development.

NATURAL HAZARDS IN AFRICA

Africa is substantially impacted by natural hazards, which are set to increase in severity and frequency with climate change. The EM-DAT database is a global, comprehensive, and readily accessible record of disasters maintained by the Centre for Research on the Epidemiology of Disasters (CRED).[8] It shows that from January 2021 to September 5, 2022, more than 54 million people were affected by disasters linked to storms, droughts, wildfires, floods, and landslides in Africa (Table 1). Drought-related disasters affected the most people in Africa over that period, followed by floods. Eastern Africa has been hit the hardest by climate-related disasters, with a total of more than 33 million people who were injured, affected, or killed. In North Africa, the greatest impacts were from floods and wildfires.

In the past decade, most disasters triggered by natural hazards globally were caused by extreme weather and climate-related events such as heatwaves, floods, and storms. This number has been increasing since the 1960s and has risen almost 35 percent since the 1990s.[9] As recorded by EM-DAT, in the period 2011 to 2020, the main types of disasters that have affected Africa were droughts and floods. On average, approximately 13 million people in Africa per year were impacted by droughts over that period, and 3.5 million were impacted by floods (Table 2).

Climate change acts as a risk multiplier, amplifying the intensity of extreme weather events, increasing unpredictability, and exacerbating vulnerabilities. To minimize the impacts on livelihoods and make African countries more resilient in the long run, STA21 called for adaptation to climate change to be mainstreamed into policy and strategies.

Table 1. Summary of Climate-related Hazards and their Impacts per Region in Africa (January 2021 to September 2022)

	Disaster type					
	Storm	Drought	Wildfire	Flood	Landslide	Total impacted
Eastern Africa						
Total deaths	400	2,000	NA	200	NA	3,000
No. injured	600	NA	NA	100	NA	700
No. affected	1,967,000	30,455,000	NA	990,000	NA	33,411,000
Central Africa						
Total deaths	26	NA	NA	108	5	100
No. injured	NA	NA	NA	300	NA	300
No. affected	NA	2,100,000	30,000	820,000	100	2,950,000
Northern Africa						
Total deaths	NA	NA	100	200	NA	289
No. injured	NA	NA	200	500	NA	738
No. affected	16,000	18,000	44,000	1,377,000	NA	1,455,000
Southern Africa						
Total deaths	10	NA	NA	550	NA	600
No. injured	27	NA	NA	4	NA	30
No. affected	14,600	12,000,000	NA	125,000	NA	12,140,000
Western Africa						
Total deaths	17	NA	NA	300	NA	300
No. injured	100	NA	NA	300	NA	400
No. affected	17,000	4,446,000	NA	393,000	NA	4,856,000

Notes: NA, data not available; No., number.

"No. affected" refers to the number of people requiring immediate assistance during a period of emergency, i.e. requiring basic survival needs such as food, water, shelter, sanitation, and medical assistance. Numbers were rounded up or down to the thousands.

Source: EM-DAT data for Africa, January 1, 2021, to September 5, 2022.

Table 2. Climate-related Hazards and their Impacts per Region in Africa (Yearly Average of the Period 2011–2020)

	Disaster type					
	Storm	Drought	Wildfire	Flood	Landslide	Total impacted
Eastern Africa						
Av. total deaths	200	NA	NA	300	100	600
Av. no. injured	1,000	NA	NA	300	17	1,200
Av. no. affected	724,000	6,562,000	NA	1,272,000	17,000	8,574,000
Central Africa						
Av. total deaths	NA	NA	NA	100	30	100
Av. no. injured	7	NA	NA	100	5	100
Av. no. affected	1,500	833,000	5,700	243,000	NA	1,083,000
Northern Africa						
Av. total deaths	13	NA	5	100	2	100
Av. no. injured	14	NA	1	100	NA	100
Av. no. affected	15,000	760,000	200	525,000	NA	1,300,000
Southern Africa						
Av. total deaths	4	NA	1	36	NA	41
Av. no. injured	26	NA	NA	32	NA	58
Av. no. affected	1,400	876,000	NA	88,000	NA	966,000
Western Africa						
Av. total deaths	11	NA	0	200	100	300
Av. no. injured	17	NA	NA	400	11	400
Av. no. affected	4,500	3,896,000	NA	1,342,000	1,200	5,244,000

Notes: Av, average; NA, data not available; no., number.

"Av. no. affected" refers to the average number of people requiring immediate assistance during a period of emergency, i.e. requiring basic survival needs such as food, water, shelter, sanitation, and medical assistance. Numbers were rounded up or down to the thousands.

Source: EM-DAT data for Africa, January 1, 2011, to December 31, 2020.

Several high-impact extreme weather events, such as heavy rain, droughts, heatwaves, and storms, occurred across Africa in 2021 and 2022, leading to flooding, landslides, wildfires, and avalanches. Table 3 presents the most impactful events, as catalogued by the WMO.[10]

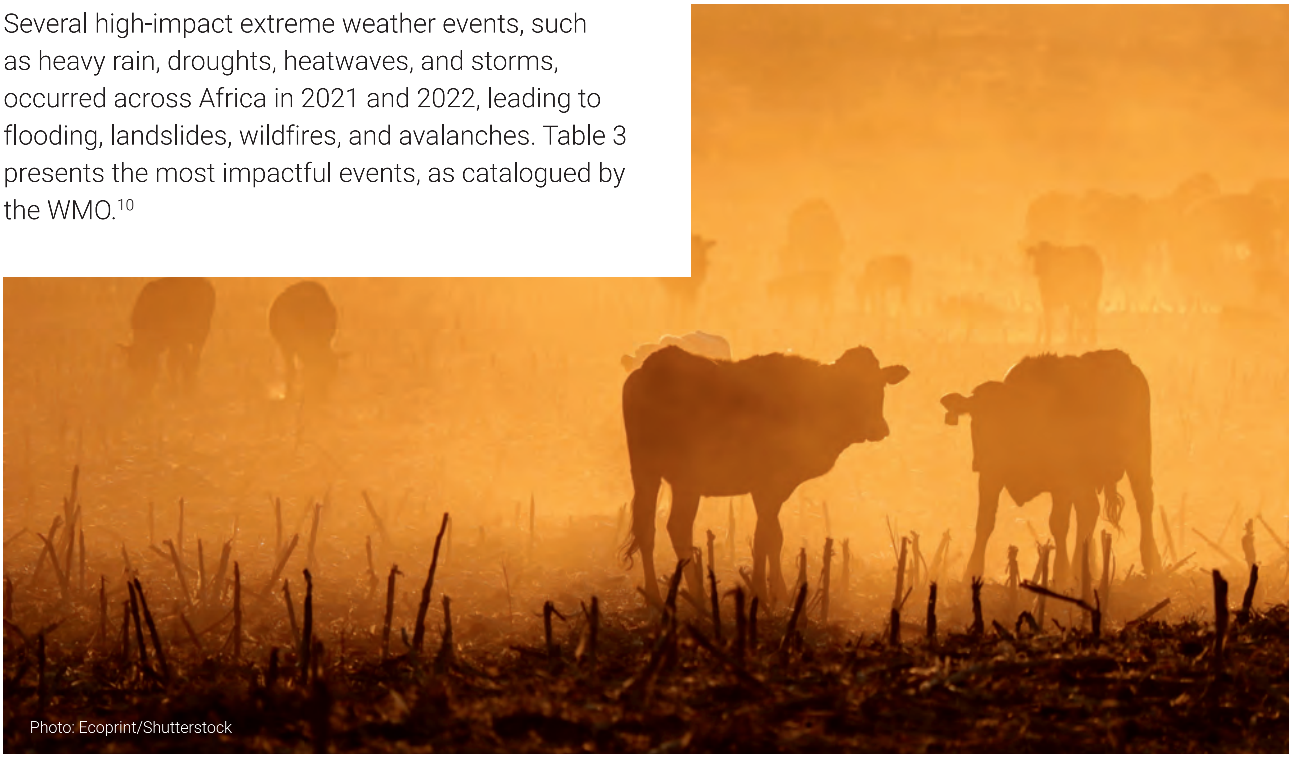


Photo: Ecoprint/Shutterstock

Box 1. Impacts of Wildfires on Vulnerable Populations

Wildfires can affect multiple sectors of the economy through their impact on crops, ecosystems, and human health. According to the data provided by the Global Facility for Disaster Reduction and Recovery (GFDRR) through the platform Think Hazard,[12] large parts of Sub-Saharan Africa and some in North Africa show a high risk of wildfires—meaning a greater than 50 percent chance of encountering weather that could support a significant wildfire. The smoke produced by wildfires increases CO_2 emissions, significantly reduces air quality, and harms human health in multiple ways.[13] For instance, a 2020 study estimated that long-term exposure to particulate matter contributed to about 15 percent of COVID-19 mortality worldwide.[14] There is a need to better understand the specific health impacts of wildfires on the continent and the adaptation measures that can reduce risk and enhance the resilience of vulnerable populations.

Photo: Cathy Withers-Clarke/Shutterstock

Table 3. High-impact Events in 2021 and 2022

Event type	Countries or region affected	Description
Wildfires	Algeria, Morocco, and Tunisia	Major wildfires occurred across many parts of the Middle East and North Africa (MENA) region, with Algeria badly affected. Over 40 deaths occurred in the Algerian fires. Tunisia and Morocco also experienced significant wildfires.
Precipitation variability	Southern Africa, the Greater Horn of Africa region, Madagascar	Large regions with a rainfall deficit included parts of Southern Africa. Both the wet seasons (April to May and October to November) were drier than usual in the Greater Horn of Africa region. It was at least the second year in a row with below-normal rainfall for Madagascar. Across the Horn of Africa heavy precipitation was linked to recent outbreaks of desert locusts, affecting up to 2.5 million people in 2020 and another 1 million in 2021.
Floods	Niger, Sudan, South Sudan, Mali, Burundi, South Africa, and Zimbabwe	Significant flooding was reported, especially in Niger, Sudan, South Sudan, and Mali. In Southern Africa, much of which had been experiencing long-term drought, rainfall during the 2020/2021 rainy season was above average in some regions, including northern South Africa and Zimbabwe, with some flooding reported.
Drought	Greater Horn of Africa region (particularly Ethiopia, Somalia, and Kenya), Madagascar	Drought developed during 2021 into 2022 in the Greater Horn of Africa region, particularly affecting Somalia, Kenya, and parts of Ethiopia, after three successive below-average rainy seasons. The October–December rainy season was especially poor, despite some rains in Kenya late in the season. A severe drought, which has persisted for at least two years, continues to affect southern Madagascar. There were significant food security issues in the area, with 1.14 million people classified by the World Food Programme as needing urgent assistance as of August 2021.
Tropical cyclones	Mozambique, South Africa, Zimbabwe, Eswatini, Madagascar, and Malawi	In 2021, Cyclone Eloise contributed to flooding in Southern Africa, with damage and casualties reported in Mozambique, South Africa, Zimbabwe, Eswatini, and Madagascar. In January 2022, Cyclone Ana brought heavy rain, strong winds and flooding to Madagascar, Mozambique, Malawi and Zimbabwe. It was followed by Batsirai, an even stronger tropical cyclone. As a result of these storms, tens of thousands of people were displaced, infrastructure was destroyed, and flooded farmlands further exacerbated food insecurity.

Source: WMO, 2022.[11]

Photo: fivepointsix/Shutterstock

Temperature and Precipitation Trends and Projections

The El Niño-Southern Oscillation (ENSO), Indian Ocean Dipole (IOD), and Southern Annular Mode (SAM) are the primary large-scale drivers of seasonal and interannual climate variability in Africa. In eastern Africa, ENSO and IOD particularly affect the June–July–August–September and October–November–December (short rains) seasons. El Niño is associated with negative rainfall and positive temperature anomalies in Southern Africa. The opposite is true for La Niña.[15] La Niña is also associated with drier-than-normal conditions in East Africa, especially in Kenya, Ethiopia, and Somalia, which experienced consecutive below-average rainfall seasons in late 2020, early 2021, and late 2021.[16] The SAM influences rainfall in southwestern Africa, with positive SAM modes generally associated with lower levels of seasonal rainfall. There is some indication that extreme ENSO events and extreme IOD phases may increase in frequency due to climate change.[17]

The "Present and Projected Climate Risks in Africa" chapter in STA21 provided an overview of the observed trends and projections of temperatures and precipitation for the continent as a whole. Table 4 presents a summary for each region of Africa.

Table 4. Trends and Projections of Temperatures and Precipitation by Region in Africa

North Africa		
Temperature	Trends	Seasonal and mean annual temperatures have increased at twice the global rate. Since the 1970s, increasing temperature trends have been between 0.2°C per decade and 0.4°C per decade, especially in the summer.
	Projections	At 1.5°C, 2°C and 3°C of global warming above pre-industrial levels, mean annual temperatures are projected to be 0.9°C, 1.5°C and 2.6°C warmer than the 1994–2005 average, respectively. Warming is projected to be higher in summer.
Precipitation	Trends	Mean annual precipitation has decreased over most of the region between 1971 and 2000. Aridity (the ratio of potential evaporation to precipitation) has increased due to decreases in precipitation.
	Projections	At warming levels of 2°C and higher, mean annual precipitation is projected to decrease, with the most pronounced decreases in the northwestern parts of the region.

West Africa			
Temperature		Trends	Seasonal and mean annual temperatures have increased by 1–3°C since the mid-1970s, with the highest increases seen in the Sahara and the Sahel. Heatwaves have become hotter and longer in the 21st century compared with the last two decades of the 20th century.
		Projections	At 1.5°C, 2°C, and 3°C of global warming above pre-industrial levels, mean annual temperatures are projected to be 0.6°C, 1.1°C, and 2.1°C warmer than the 1994–2005 average, respectively.
Precipitation		Trends	Extreme heavy precipitation indices show increasing trends from 1981–2010. Increasing high-flow events are seen in large Sahelian rivers and small to mesoscale catchments, leading to flooding. Droughts have increased in frequency since the 1950s.
		Projections	Projections show gradients of decrease in the west and increase in the east, with the magnitude of change increasing with higher warming levels. The duration of meteorological droughts in the western parts of the region is expected to increase from approximately two months (during 1950–2014) to approximately four months (in the period 2050–2100) under the RCP8.5 and SSP5-8.5 scenarios.
Central Africa			
Temperature		Trends	Mean annual temperatures have increased by 0.75°C–1.2°C since 1960. Due to observational uncertainties, there is medium confidence in observed trends of increasing number of heat extremes over the region.
		Projections	At 1.5°C, 2°C and 3°C of global warming above pre-industrial levels, mean annual temperatures are projected to be 0.6°C, 1.1°C and 2.1°C warmer than the 1994–2005 average, respectively.
Precipitation		Trends	Due to a lack of station data over the region, there is large uncertainty in the estimation of observed rainfall trends and low confidence in extreme rainfall changes. There is some evidence of drying since the mid-20th century through increased precipitation deficits, decreased mean rainfall, and increases in drought, especially in the southern and eastern parts of the region.
		Projections	At 1.5°C and 2°C of global warming there is low confidence in projected mean rainfall change. At 3°C and 4.4°C warming, an increased mean annual rainfall of 10–25% is projected, with increasing intensity of extreme precipitation.
East Africa			
Temperature		Trends	Mean temperatures have increased by 0.7°C to 1°C from 1973 to 2013, depending on the season, with the greatest increases seen in northern and central parts of the region.
		Projections	At 1.5°C, 2°C, and 3°C of global warming above pre-industrial levels, mean annual temperatures are projected to be 0.6°C, 1.1°C, and 2.1°C warmer than the 1994–2005 average, respectively.
Precipitation		Trends	The short rains (October–November–December) over equatorial East Africa have shown a long-term wetting trend from the 1960s to present, while the long rainfall season (March–April–May) has shown a long-term drying trend between 1986 and 2007. Since 2005, drought frequency has doubled from one in every six years to one in every three years.
		Projections	At 1.5°C and 2°C global warming, higher mean annual rainfall is projected, particularly in the eastern parts of the region. At 2°C and higher, heavy rainfall events are expected to increase. There is low confidence in projected mean rainfall change during the long rainy season. Drought frequency, intensity and duration are projected to increase in Sudan, South Sudan, Tanzania and Somalia, and to decrease or not change in Uganda, Kenya, and the Ethiopian Highlands.
Southern Africa			
Temperature		Trends	Mean annual temperatures have increased by between 1.04°C and 1.44°C during 1961–2015, depending on the observational dataset.
		Projections	At 1.5°C, 2°C, and 3°C global warming above pre-industrial levels, mean annual temperatures are projected to be 1.2°C, 2.3°C, and 3.3°C warmer than the 1994–2005 average, respectively.
Precipitation		Trends	Mean annual rainfall has increased over parts of Botswana, Namibia, and southern Angola by 128–256 mm during 1980–2015, and decreasing precipitation trends have been detected in parts of South Africa since the 1960s. Extreme precipitation events have increased in number and intensity over the last century.
		Projections	A decrease by 10–20% in mean annual rainfall is projected in the summer rainfall region. At 1.5°C and higher levels of global warming, dryness is expected to increase in the summer rainfall region. At 1.5°C global warming, increases in drought frequency and duration are projected over large parts of the region. At 2°C, unprecedented extreme droughts (compared with the 1981–2010 period) are projected.

Source: Authors' summary of observed and projected temperature and precipitation patterns in Africa from the IPCC Sixth Assessment Report.[18]

WHAT THE PHYSICAL CLIMATE CHANGE DATA MEAN FOR ADAPTATION IN AFRICA

The "Present and Projected Climate Risks in Africa" chapter in STA21 outlined the expected physical changes in the climate system for the continent. Building on that, this section highlights what these physical changes could mean for livelihoods and adaptation in Africa. It synthesizes and summarizes some of the latest climate-related reports since STA21's publication, including the IPCC Working Group II report; the Climate, Land, Agriculture and Biodiversity (CLAB-AFRICA) report (2021) coordinated by the Future Africa Institute;[19] and the WMO-coordinated United in Science report.

For Africa, climate risks are expected to pose significant challenges to food security, biodiversity, poverty eradication, economic growth, and human health. Adaptation measures can reduce present climate risks, but their future effectiveness remains uncertain, pointing to the need for climate-resilient development across the continent.[20] As mentioned in the IPCC report, barriers to climate change adaptation in Africa include a lack of access to climate information, inadequate research opportunities, and a funding gap for adaptation. It is important to strengthen adaptation finance flows to Africa, develop legislative frameworks that facilitate effective design and implementation of adaptation responses, and emphasize good governance for climate-resilient development.[21]

While adaptation cannot prevent all losses and damages, there are a range of options that can be broadly applied across sectors, including disaster risk management, climate services, and risk spreading and sharing. Multi-hazard early-warning systems (MHEWS) are also critical for climate change adaptation and are an important element of disaster risk reduction. MHEWS integrate hazard information and risk analysis to provide early warnings for governments, communities and individuals, resulting in increased understanding of and preparedness for approaching events. When implemented effectively, MHEWS can minimize impacts, reduce losses and damages, and save lives. As of April 2022, however, less than half of all countries globally reported having national MHEWS. Coverage is particularly low in Africa.[22]

Ecosystem-based adaptation can have multiple benefits for society, reducing climate risk while providing social, economic and mitigation benefits. This is particularly the case for Africa, with a large proportion of the population being directly and highly dependent on ecosystem services.[23] Much of this potential, however, depends on how adaptation actions are designed and managed. For example, maintaining indigenous forest ecosystems sees both biodiversity gains and emission reductions, but wrongly targeting ancient grasslands and savannas for reforestation can harm biodiversity and reduce water security. This also points to the importance of cross-sectoral and transboundary planning.[24]

Equity-based and gender-sensitive adaptation measures reduce vulnerability for marginalized groups in Africa, across multiple sectors including food systems, livelihoods, water and health.[25] Integrating climate adaptation into social protection programs such as cash and in-kind transfers, public works programs, microinsurance and healthcare access, can help people in times of crisis and increase resilience to climate change.[26] African Indigenous knowledge and local knowledge systems are also important for strengthening local climate change adaptation.

This section offers an overview of the implications of climate risks for several key sectors in Africa: food systems; ecosystems; water; human settlements and infrastructure; health; and economics, education and heritage.

Food Systems

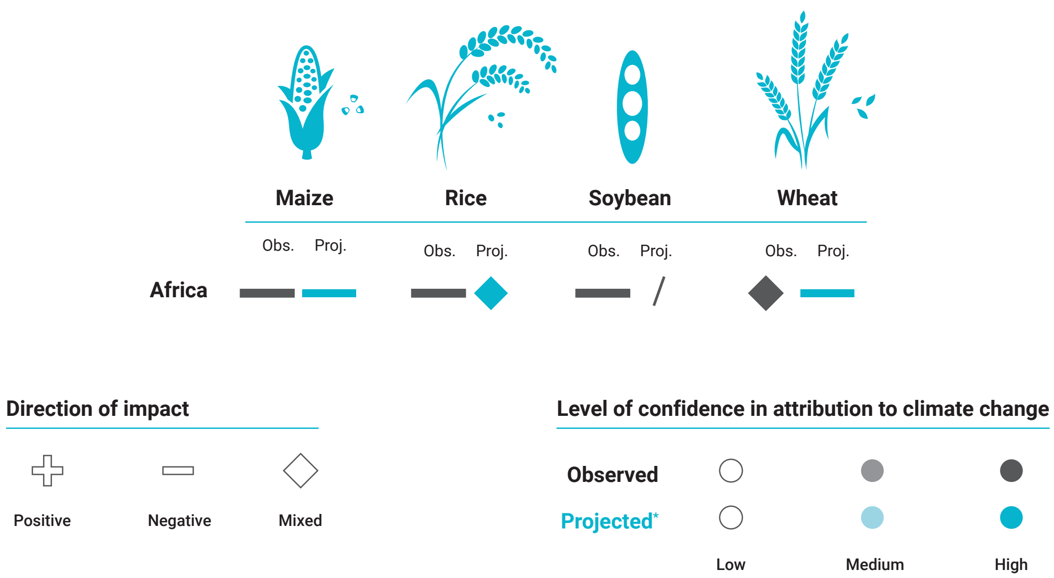
Growth in agricultural productivity in Africa has reduced by 34 percent since 1961 due to climate change, more than in any other region.[27] Global warming is projected to shorten growing seasons and increase water stress across the continent. Ethiopia, Sudan, and South Sudan were among the countries most affected by food crises in 2020, partly due to climate impacts such as drought, changes in pest distribution, and conflict in the region.[28] With 1.5°C of global warming, yields are projected to decline for olives in North Africa and sorghum in West Africa; a decline in suitable areas for coffee and tea is also expected in East Africa.[29] A 2°C temperature rise would result in yield reductions for staple crops across most of Africa, even with adaptation and even after accounting for any potential benefits from increased CO_2 concentrations (Figure 1). Elevated CO_2 concentrations might mitigate some climate-driven losses of staple crops; however, there is considerable uncertainty around crop response to CO_2.

For some cash crops, climate change is projected to have a positive impact on yields, such as for Bambara nuts and sugarcane in Southern Africa, chickpea in Ethiopia, and oil palm in Nigeria.[30] With global warming of 3°C, agricultural labor capacity could be reduced by 30–50 percent in Sub-Saharan Africa,[31] linked to a sharp increase in the number of extremely hot days (temperatures exceeding 40°C) across Africa. The "Present and Projected Climate Risks for Africa" chapter in STA21 provides extreme heat projections for different global warming levels.

Climate change also threatens livestock production across Africa. At 2°C of global warming, rangeland net primary productivity is expected to decline by 42 percent for West Africa by 2050.[32] Increasing warming will heighten the prevalence of vector-borne livestock diseases and the duration of severe heat stress.[33] More variable precipitation and increasing rainfall intensity are also linked to a risk of locust outbreaks in East Africa, which poses a major threat to crops and livestock in the region.[34]

The "Drylands" chapter in STA21 highlights the important opportunity that well-managed small-scale irrigation, particularly if supported by off-grid solar energy and with linkages to grower cooperatives and access to markets—in comparison to large-scale schemes—presents for more productive and resilient food systems and dryland communities in Africa.[35] Farming methods based on crop diversity can add varieties and hybrids, improve soil and water management, and promote sustainable irrigation. Integrating animal health, land use, and markets can help increase production and resilience of livestock pastoral systems. The chapter delves deeper into more adaptation options for food systems in Africa and presents an important vision for climate-adapted African drylands.

Figure 1. Observed and Projected Impacts from Climate Change to Crop Yield Productivity in Africa

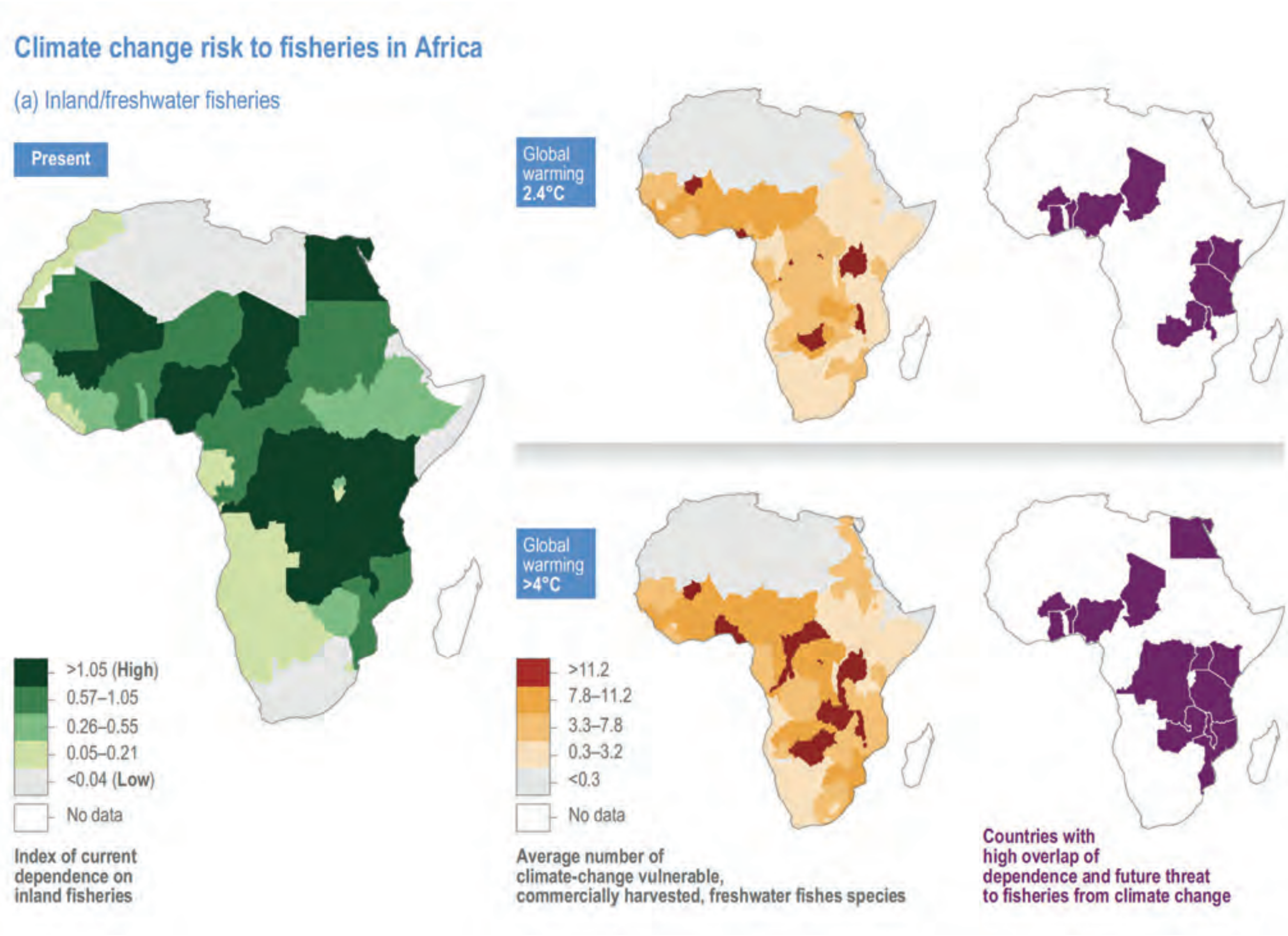


Source: Adapted from a section of IPCC (2022) Figure AI.17[36]

Notes: / not observed or insufficient evidence; * mid-century at RCP4.5 (about 2°C global warming level).

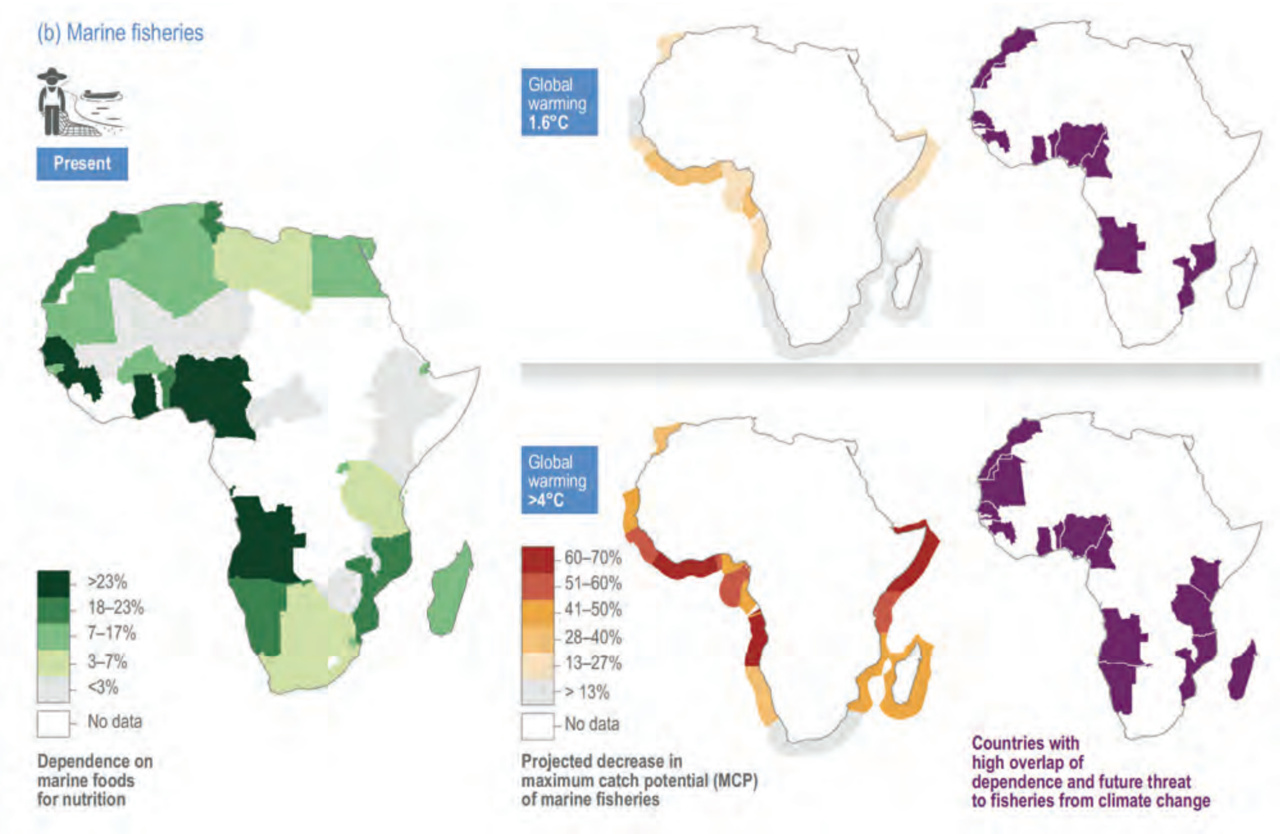
At 1.7°C of global warming, one study found that reduced fish harvests could render 1.2 million to 70 million people in Africa vulnerable to iron deficiencies, up to 188 million people to vitamin A deficiencies, and 285 million to vitamin B12 and omega-3 fatty acid deficiencies by mid-century.[37] By the end of the century (2071–2100), with 2.5°C of global warming, 55–68 percent of commercially harvested fish species in inland fisheries would be vulnerable to extinction (Figure 2a).[38] Also by mid-century, with 2°C of global warming, the catch potential for marine fisheries on the western coast of Africa and in the Horn of Africa could decline by 10 percent to more than 30 percent (Figure 2b).[39] Considering that in Africa, agriculture provides employment for approximately 60 percent of the population, and accounts for roughly 25 percent of GDP,[40] it is critical to keep enhancing the resilience of the sector in Africa by mainstreaming adaptation into policies, plans, strategies, and actions.

Figure 2a. Climate Change Risks to Inland/Freshwater Fisheries in Africa



Source: Reproduced from Trisos et al. (2022) Figure 9.26.[41]

Figure 2b. Climate Change Risks to Marine Fisheries in Africa



Source: Reproduced from Trisos et al. (2022) Figure 9.25.[42]

Ecosystems

With every 0.5°C increment above present-day global warming, biodiversity loss and species extinction are expected to escalate across Africa.[43] Above 1.5°C, half of assessed species are projected to lose over 30 percent of their population or suitable habitat area. At 2°C of global warming, 7–18 percent of African land-based species assessed would be at risk of extinction,[44] and 36 percent of freshwater fish species would be vulnerable to local extinction.[45] Also at 2°C, bleaching is projected to severely degrade over 90 percent of east African coral reefs.[46] Above 2°C, the risk of sudden and severe biodiversity losses becomes substantial in East Africa, West Africa, and Central Africa. Changing patterns of invasive species spread are also expected due to climate change.[47]

Some plant species are able to use water more efficiently under increased CO_2 conditions, possibly counteracting the effects of increasing aridity. There is some evidence of increased woody plant cover as a result of these interacting processes. The outcome is highly uncertain, but it could have significant effects on carbon sequestration and grazing systems.[48] The "Present and Projected Climate Risks in Africa" chapter in STA21 has a fuller account of expected changes in aridity across Africa.

Water

Water-dependent sectors across Africa are significantly, and negatively, impacted by extreme variability in rainfall and river discharge.[49] Extreme hydrological variability will rise progressively under all climate change scenarios (relative to the current baseline), depending on the region. However, there is significant uncertainty about future precipitation; a systematic literature review found that the number of people exposed to climate change-related water stress in Sub-Saharan Africa by 2050 was projected to rise by as much as 921 million, or drop by as much as 459 million.[50]

Projected changes entail heightened cross-cutting risks to water-dependent sectors and require planning under high uncertainty for the wide range of extremes expected (Figure 3).[51] Future climate change combined with increasing societal demands on limited water resources is anticipated to intensify water–energy–food competition and tradeoffs. For example, energy is needed for processing and distributing water. Greater rainfall variability, with periods of low rainfall and river flow, may impede hydropower generation with concurrent reductions in electricity production. Water and energy, in turn, are central to food production.

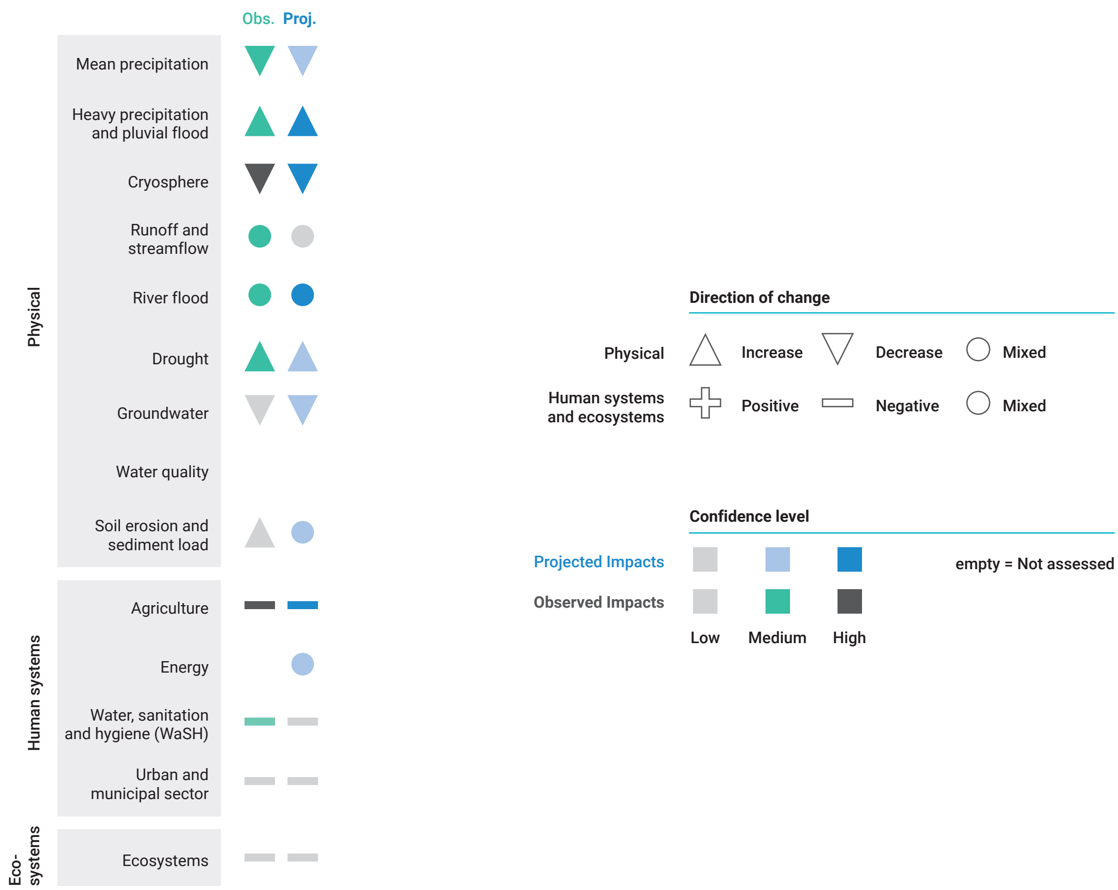
The inter-relationship between water, energy and land use calls for an integrated approach incorporating transdisciplinary teams. It is also important that a coordinated land and water governance approach addresses social inequities and gender imbalances in the socioeconomic value chain of these resources.

Important options for targeting agricultural water shortages include small-scale irrigation during dry spells and drip irrigation for trees and horticulture.[52]

Human Settlements and Infrastructure

By 2030, urbanization is projected to increase the extent of urban land exposed to arid conditions by around 700 percent (relative to 2000), and exposure to high-frequency flooding by 2,600 percent across West, Central, and East Africa.[54] At 1.7°C global warming and low population growth, exposure to extreme heat for urban populations is expected to increase from 2 billion person-days per year in 1985–2005 to 45 billion person-days by the 2060s, and at 2.8°C global warming and medium-high population growth, this is projected to increase to 95 billion person-days, with the greatest exposure projected in West Africa.

Figure 3. Regional Synthesis of Assessed Changes in Water and Consequent Impacts



Source: Excerpt from Figure AI.35 in IPCC (2022)[53]

One study estimated cumulative costs to 2100 to repair and maintain existing road networks damaged from climate change–related precipitation and temperature changes at US$183.6 billion (with adaptation) to US$248.3 billion (without adaptation).[55] Increased rainfall variability is also likely to affect electricity prices in countries with a high dependency on hydropower.[56]

By 2030, between 108 million and 116 million African people are projected to be exposed to sea-level rise (compared with 54 million in 2000), with this number increasing to 190–245 million by 2060.[57] This will be driven mainly by rapid population growth and urbanization in low-elevation coastal zones, and these trends will also increase the number of people exposed to other climate hazards, such as floods, droughts, and heatwaves.[58] A more in-depth overview of sea-level rise trends across Africa can be found in the "Present and Projected Climate Risks for Africa" chapter in STA21.

Impacts of sea-level rise will also be compounded by more pronounced storm surges, increasing the risks to coastal populations and infrastructure.[59] Under medium- and high-emissions scenarios, without adaptation, damages from sea-level rise and coastal extremes to 12 major African coastal cities could average US$65 billion and US$86.5 billion by 2050, respectively.[60]

Health

Further global warming will escalate mortality and morbidity, in turn placing additional strain on health systems. With global warming above 1.5°C, a sharp increase in the risk of heat-related deaths is projected, with at least 15 additional deaths per 100,000 residents annually across large areas of the continent.[61] This number increases to 50–180 additional deaths per 100,000 people annually in North Africa, West Africa, and East Africa at 2.5°C global warming, and to 200–600 per 100,000 people annually at 4.4°C. Above 2°C of global warming, seasonal transmission and distribution of vector-borne diseases are projected to increase, increasing exposure to tens of millions more people, mostly in West Africa, East Africa, and Southern Africa. Large numbers of additional cases of diarrheal disease are projected under 2°C, mainly in West Africa, Central Africa, and East Africa.

Children born in North Africa and West Africa in 2020, under a 1.5°C warming scenario, will be exposed to 4–6 times more heatwaves in their lifetimes compared to people born in 1960.[62] For Central Africa, children born in 2020 are expected to be exposed to 6–8 times more heatwaves. In East Africa and Southern Africa, increase in exposure is expected to be 3–4 times, except in Angola where it is expected to be 7–8 times. At 2.4°C global warming, numbers increase across the continent to between 4–10 times.[63]

The impact of climate change on water quality significantly affects health in Africa, with strong linkages between flooding, poor sanitation, and water contamination in locations where water sources are poorly built and sanitation is rudimentary or non-existent. This is because floods can destroy latrines and cause widespread contamination of the surface environment, soils, and water resources.[64]

Economic Growth, Education, and Heritage

Economic growth across Africa has already been reduced by climate change. Impacts manifest largely through losses in agriculture, as well as in tourism, infrastructure, and manufacturing. Across nearly all African countries, if global warming is held to 1.5°C rather than allowed to rise to 2°C, GDP per capita is projected to be at least 5 percent higher by 2050 and 10–20 percent higher by 2100.[65] Inequalities between African countries are projected to widen with increased warming. The informal sector and small to medium-sized enterprises can have high exposure to climate extremes. However, importantly, informal sector impacts are omitted from GDP-based impact projections.[66]

Climate change and variability can undermine educational attainment. Low rainfall, high temperatures, and flooding, especially during the growing season, may mean children are removed from school to help generate income. Undernutrition associated with weather-related food supply interruptions or poor harvests can hinder cognitive development in early life.[67] African cultural heritage is also at risk from climate hazards, including sea-level rise and coastal erosion, though the potential losses have not yet been quantified on a large scale.[68] Most African heritage sites are neither prepared for nor adapted to future climate change.[69]