FACTSHEET

WEST AFRICA

THE IPCC'S SIXTH ASSESSMENT REPORT

Impacts, adaptation options and investment areas for a climate-resilient West Africa

Lagos, Nigeria. Lagos is one of many coastal African cities exposed to sea level rise, which is expected to cost the city between US$ 3.7 and 9.4 billion by 2050.

IN THIS FACTSHEET:

CDKN Climate & Development Knowledge Network

ACDI African Climate & Development Initiative

ODI

SOUTH SOUTH NORTH

IPCC confidence ratings and Africa's severe data constraints

The IPCC assigns a degree of confidence (high, medium and low confidence) to each key finding based on (1) the **robustness** (quality and quantity) of the available evidence, and (2) the **degree of agreement** among scientists. **High confidence** means that there is a high level of agreement as well as robust evidence in the literature. **Medium confidence** reflects medium evidence and agreement. **Low confidence indicates** that there is low agreement and/or limited evidence.

Africa faces severe data constraints due to under-investment in weather observation stations, research and data sharing. This hinders the analysis of regional change trends, the development of early warning systems, and climate impact and extreme event attribution studies.[4] From 1990–2019, Africa received just 3.8% of climate-related research funding globally.[5] Of this, only 14.5% went to African institutions, while 78% went to EU and North American institutions to do research on Africa. In Africa, scientific findings may be assigned 'low confidence' because there is relatively little data from a location and more data needs to be collected in order to strengthen the scientific assessment of a climate trend.

Meteorological, agricultural and hydrological drought

There are different types of drought. A **meteorological drought** is when there is an abnormal lack of rainfall. A **hydrological drought** affects water supplies and can take place downstream from where a meteorological drought occurred, and is also influenced by poor water resource management. An **agricultural drought** impacts crop production during an agricultural growing season.[15]

West Africa has already experienced widespread losses and damages from climate change

The climate has warmed at rates "unprecedented in at least 2,000 years" due to human activity,[1] finds the *Sixth Assessment Report* of the Intergovernmental Panel on Climate Change (IPCC).

Most African countries have contributed among the least to global greenhouse gas emissions causing climate change, yet have already experienced widespread losses and damages attributable to human-induced climate change. West Africa is no different and is already facing loss of lives and impacts on human health, reduced economic growth, water shortages, reduced food production, biodiversity loss, and adverse impacts on human settlements and infrastructure as a result of human-induced climate change.[2]

> **Limiting global warming to 1.5°C is expected to substantially reduce damages to West African economies and ecosystems[3]**

Transformative adaptation – which includes climate risk reduction in every sphere of development – will contribute to achieving climate resilience in West Africa.

HOW WEST AFRICA'S CLIMATE IS CHANGING

The Earth's average surface temperature has already warmed by 1.09°C since pre-industrial times (1850–1900).[6] However, West Africa's climate has warmed even more than the global average in the past few decades.

Temperature: West Africa's average annual and seasonal surface temperatures have increased 1–3°C since the mid-1970s, with the highest increases in the Sahara and Sahel.[7]

Heat waves: In the 21st century, heatwaves in West Africa have become hotter and longer compared to the last two decades of the 20th century. Between 1961–2014, the frequency of very hot days (over 35°C) increased by 1–9 days per decade and tropical nights (minimum temperature above 20°C) by 4–13 nights per decade. Cold nights have become less frequent.[8]

Marine heat waves: Climate change has doubled the probability of heatwaves in the ocean around most of Africa (high confidence).[9]

Rainfall: West Africa has been getting wetter since the mid-1990s, accompanied by fewer but more intense rainfall events.[10]

Extreme rainfall and flooding: Extreme rainfall increased from 1981–2010, increasing flows in large Sahelian rivers and catchments, leading to flooding.[11] Between 1981–2014, the Gulf of Guinea and the Sahel experienced more intense rainfall and the frequency of convective storms tripled.[12]

Drought: Meteorological, agricultural and hydrological drought have increased in frequency since the 1950s (medium confidence).[13] Multi-year droughts have become more frequent.[14]

WEST AFRICA'S FUTURE CLIMATE

The Earth's average surface temperature is expected to reach or surpass 1.5°C of warming above pre-industrial times in the near-term (up to 2040).[16]

Future scenarios (Table 1) measure warming as global averages, and warming at local and country level is expected to be higher than these averages. Most African countries are expected to experience high temperatures unprecedented in their recent history earlier this century than generally wealthier countries at higher latitudes (high confidence).[17]

> **Climate change has increased heat waves and drought on land, and doubled the probability of marine heatwaves around most of Africa[18]**

Table 1 Changes in global surface temperature

Global warming scenario according to emissions levels, showing best estimate, °C (very likely range, °C)[19]	Near-term, 2021–2040	Medium-term, 2041–2060	Long-term, 2081–2100
Very low emissions (net zero carbon dioxide emissions by 2050)	1.5°C (1.2–1.7°C)	1.5°C (1.2–2°C)	1.4°C (1.0–1.8°C)
Low emissions	1.5°C (1.2–1.8°C)	1.7°C (1.3–2.2°C)	1.8°C (1.3–2.4°C)
Intermediate emissions	1.5°C (1.2–1.8°C)	2°C (1.6–2.5°C)	2.7°C (2.1–3.5°C)
High emissions	1.5°C (1.2–1.8°C)	2.1°C (1.7–2.6°C)	3.6°C (2.8–4.6°C)
Very high emissions	1.6°C (1.3–1.9°C)	2.4°C (1.9–3.0°C)	4.4°C (3.3–5.7°C)

Note: Changes in global surface temperature are assessed based on multiple lines of evidence, for selected 20-year time periods and the five illustrative emissions scenarios considered. Temperature differences relative to the average global surface temperature of the period 1850–1900 are reported in °C.[20]

Temperature: At 1.5°C, 2°C and 3°C global warming, average annual surface temperatures in West Africa are projected to be higher than the global average.[21]

Extreme heat and heat waves: In West Africa, the number of potentially lethal heat days reaches 50–150 per year at 1.6°C global warming and 100–250 per year at 2.5°C global warming, with the highest increases in coastal regions.[22] Children born in West Africa in 2020 will, under 1.5°C global warming, be exposed to 4–6 times more heatwaves in their lifetimes than those born in 1960.[23] Over tropical West Africa, heat-related mortality risk is 6–9 times higher than the 1950–2005 average at 2°C global warming. Increasing urbanisation means cities are particularly exposed, such as Lagos, Niamey, Kano and Dakar.[24]

Marine heat waves: Increases in frequency, intensity, spatial extent and length of marine heatwaves are projected for all coastal zones of Africa.[25]

Rainfall: Rainfall is projected to decrease in the west and increase in the east (medium confidence) in West Africa. A reduction in length of the rainy season is projected over the western Sahel through delayed rainfall onset by 4 to 6 days at global warming levels of 1.5°C and 2°C.[26]

Extreme rainfall: Heavy rainfall events will become more frequent and intense with mid to high emissions, increasing exposure to flooding (high confidence).[27, 28]

Drought: At 2°C global warming, West Africa is projected to experience a drier, more drought-prone and arid climate, especially in the last decades of the 21st century.[29] Above 3°C global warming, meteorological drought frequency will increase, and length will double from approximately 2 months to 4 months in the western Sahel (medium confidence).[30]

CLIMATE CHANGE IMPACTS WE HAVE ALREADY SEEN IN WEST AFRICA

The multiple dimensions of poverty and wellbeing – people's health, nutrition, education, security of food, water and shelter and economic development – are now all affected by climate change. The natural environment is also deeply affected. Addressing climate change effectively depends on viewing climate, people and biodiversity as interlinked systems.[31]

Human life and health

- Climate variability and change already affect the health of tens of millions of people in West Africa and across the continent, by exposing them to high temperatures and extreme weather, and increasing the range and transmission of infectious diseases (high confidence).[32]
- Recorded death rates have been above normal on days with raised temperatures in Burkina Faso and Ghana – most commonly because of cardiovascular disease. Respiratory, stroke and non-communicable diseases have also been linked with heat.[33]
- Studies show an increase in malaria in some parts of West Africa and a decrease in other parts, associated with rises in monthly average temperatures.[34]
- There are already large inequalities in people's health – due to their economic status, social behaviours, and where they live (e.g. rural people have worse access to quality healthcare services). Climate change magnifies these existing health inequalities.
- The health impacts of climate change disproportionately affect people with the lowest incomes and, in some cases, impacts differ by gender and age, too.[35] The most vulnerable are young children (younger than 5 years old), the elderly (over 65 years old), pregnant women, individuals with pre-existing illness, physical labourers and people living in poverty or affected by other socioeconomic determinants of health (high confidence).[36]

> **In Africa, increasing carbon dioxide levels and climate change are destroying marine biodiversity, reducing lake productivity, and changing animal and vegetation distributions (high confidence)[37]**

Ecosystems and biodiversity

- Increased carbon dioxide levels in the atmosphere and climate change are influencing the growth of natural vegetation across African landscapes. Woody plants (trees and shrubs) are expanding their range, particularly into grasslands and savannas – this pattern is widespread in West African savannas.[38] This is a new area of scientific understanding and consensus since the IPCC's *Fifth Assessment Report* in 2014.[39] Reported cases of desertification and vegetation loss, for example, in the Sahel, appear transitory and localised rather than widespread and permanent.[40]
- Human land-use activity (tree clearance or planting) also plays a large role in modifying land-based ecosystems in West Africa.[41, 42]
- Climate conditions that support wildfires have increased in West Africa. However, vegetation fragmentation due to cropland expansion and the spread of trees and shrubs into savannas both reduce fire activity.[43]

- Vegetation changes affect animal species and people's livelihoods. For instance, bird, reptile and mammal species that depend on grassland habitats become rarer, as woody plants spread.[44]

- Small changes in the climate have had a big impact on freshwater ecosystems. Temperatures in West African freshwater bodies rose by 0.1–0.4°C per decade; and by up to 0.6°C in Lake Volta in Ghana.[45] Increases in temperature, changes in rainfall, and reduced wind speed altered the physical and chemical properties of inland water bodies, affecting water quality and productivity of algae, invertebrates and fish (high confidence).[46]

Food systems

- Climate change is reducing crop productivity in West Africa. Maize and wheat yields decreased on average 5.8% and 2.3% respectively across sub-Saharan Africa from 1974–2008, due to climate change.[47] Climate change has slowed the growth of agricultural productivity in Africa by 34% since the 1960s, the highest impact of any region. Two thirds of people across Africa perceive that climate conditions for agricultural production have worsened over the past ten years.[48] Africans are disproportionately employed in climate-exposed sectors: 55–62% of the sub-Saharan workforce employed is in agriculture and 95% of cropland is rainfed.[49]

- Encroachment by woody plants – shrubs and trees – on important grazing lands has reduced the availability of fodder for livestock.[51] Increased livestock mortality and livestock price shocks have been associated with droughts in Africa, as well as being a potential factor in localised conflicts.[52]

> **Over half of surveyed farmers in West Africa perceive increases in crop pests and diseases as a result of climate change, as the range and seasonality of many pests and diseases change under warming[53]**

- Fish are the main source of animal protein and key micronutrients for approximately 200 million people in Africa. However, climate change poses a major threat to marine and freshwater fisheries and aquaculture – leading to changes in the productivity of fisheries, abundance of fish in lakes and rivers, and altered distribution of fish species in the oceans.[54]
- Increased sea-surface temperatures are reducing the abundance of small pelagic fishes and shellfish in West Africa.[55]

Water for people

- Rainfall and river discharge have been extremely variable in West Africa recently, as in the rest of Africa – between 50% above and 50% below historic levels. In West Africa, declines in river flows have been attributed to declining rainfall and increasing temperature, drought frequency and water demand.[56] This has caused deep and mostly negative impacts across water-dependent sectors: from freshwater supply to people and agriculture, to availability of water for hydropower and tourism.[57]

> **Overall, climate change has decreased food total calories across all crops in sub-Saharan Africa by an average 1.4%, compared to if no climate change had occurred since 1970 – with up to a 10% reduction in Ghana[50]**

Economies

- Increasing average temperatures and lower rainfall have reduced economic output and growth in Africa, with larger negative impacts than other regions of the world (high confidence). As such, global warming has increased economic inequality between temperate, Northern Hemisphere countries and those in Africa.[58]
- In one estimate, African countries' GDP per capita was on average 13.6% lower over the period 1991–2010 compared to if human-induced climate change had not occurred (see Figure 1).[59]

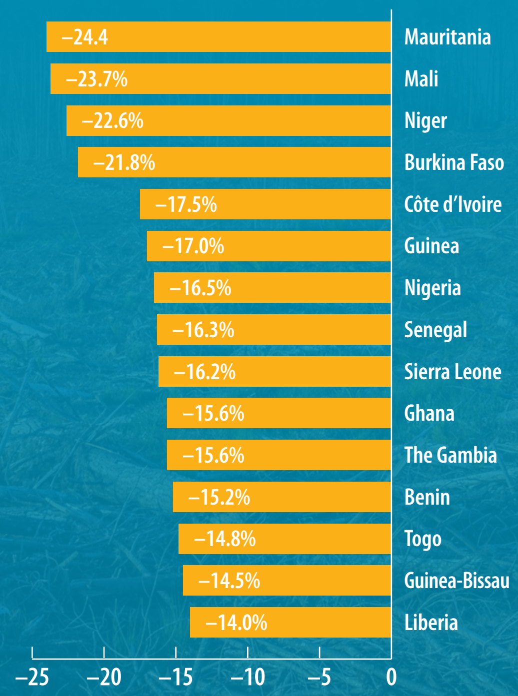


Figure 1 Percentage change in GDP per capita in West African countries due to observed climate change (1991–2010)[60]

> Globally, the highest rates of population growth and urbanisation are taking place in Africa's coastal zones (high confidence). Coastal urban populations account for 25–29% of the total population in West, North and southern Africa.[65]

Migration can be an adaptation strategy

Migration is an important and potentially effective climate change adaptation strategy in Africa and must be considered in adaptation planning (high confidence).[74] In drylands, including northern Ghana, Burkina Faso and large parts of the Sahel, migration resulting from unfavourable environmental conditions linked to climate change has often provided opportunities for farmers to earn income (Sustainable Development Goal 1 – End Poverty) and mitigate the effects of climate-related fluctuations in crop and livestock productivity (SDG 2 – Zero Hunger).[75]

Although deteriorating economic conditions caused by climate change can encourage migration, these same economic losses undermine household resources needed to migrate. Migration responses to climate change thus tend to be stronger among relatively wealthier households, as poorer households often lack the finances necessary to migrate.[76] The potential benefits to areas sending and receiving migrants are greater when migrants are able to move voluntarily and have freedom of movement (high agreement, medium evidence).[77]

Human settlements and infrastructure

- West Africa's human settlements are particularly exposed to floods (from rain and river flows), droughts and heat waves. Other climate hazards are sea level rise and storm surges in coastal areas and thunderstorms.[61]
- Economic opportunities, transportation of goods and services, and mobility and access to essential services, including health and education, are greatly hindered by flooding. People's exposure to flood shocks is associated with an increase in extreme poverty.[62]
- The human cost of climate hazards in West African settlements has been very heavy. In Freetown, Sierra Leone in 2017, a landslide killed at least 500 people and more than 600 people were declared missing. It left more than 3 000 people homeless and damaged health facilities and educational buildings, as well as housing. The economic cost was US$ 31.6 million.[63]
- From 2005–2020, flood-induced damage over Africa was estimated at over US$ 4.4 billion, with East and West Africa the most affected regions. Total damages in four West African countries (Benin, Côte d'Ivoire, Senegal and Togo) in 2017 were estimated at US$ 850 million for flooding from rainfall/surface water and US$ 555 million for riverine floods. Floods in Lagos, Nigeria in 2011 are estimated to have caused unprecedented economic losses of some US$ 200 million.[64]

Education

- Low rainfall, warming temperatures or extreme weather events have reduced children's educational attainment. If bad weather reduces income in agriculture-dependent households, adults may withdraw children from school. Poor harvests or interruptions in food supply – due to extreme weather – may also lead to undernourishment in young children, which negatively affects their cognitive development and schooling potential.[66]
- In West Africa, experiencing lower-than-average rainfall during early life is associated with up to 1.8 fewer years of completed schooling.[67]

Migration

- Climate-related displacement is widespread in Africa, with increased migration to urban areas in sub-Saharan Africa linked to decreased rainfall in rural areas, increasing urbanisation and affecting household vulnerability.[68]
- Over 2.6 million and 3.4 million new weather-related displacements occurred in sub-Saharan Africa in 2018 and 2019, with West Africa (798,000) a hotspot in 2018.[69, 70]
- Migrants often move to informal settlements in urban areas located in low-lying coastal areas or alongside rivers, exacerbating existing vulnerabilities.[71]
- In Africa, most climate-related migration is currently within countries or between neighbouring countries, rather than to distant high-income countries (high confidence).[72, 73]

The Great Mud Mosque in Djenné, Mali, where high climate variability has reduced the ability to effectively re-mud traditional buildings – increasing their exposure, but also interrupting traditional knowledge and practices tied to re-mudding performances.

West Africa's heritage at risk

African heritage of immense cultural, historical and natural value is already at risk from climate hazards, including sea level rise and coastal erosion (high confidence).[78] This heritage ranges from loss of traditional cultures and ways of life, to loss of knowledge systems and damage to heritage sites.[79]

In Nigeria, climate change and poor land-use decisions are reducing the flow of the Yobe River, negatively impacting the Bade fishing festival through a decline of fish species. Similarly, Lake Sanké in Mali has been degraded by urban development and poor rainfall, threatening the Sanké mon collective fishing rite.[80]

Sustainable 'green' earthen architecture practised in West Africa and elsewhere in Africa is also at risk because of lost expertise and ceremonies that accompany building and renewing these structures, as well extreme climate variability and change worsening their decay. Key examples in West Africa include Tiébélé in Burkina Faso, Akan in Ghana, Walata in Mauritania, and the Old Towns of Djenné in Mali (a UNESCO World Heritage Site).[81]

Compound risks

- In Africa, including West Africa, risks intersect and cascade across sectors influenced by both climatic and non-climatic factors, such as socioeconomic conditions, resource access and livelihood changes, and vulnerability among different social groups.[82]
- These 'compound risks' are particularly evident in the urban context where people living in coastal or low-lying areas in informal housing are exposed to multiple climate hazards (floods, extreme heat, sea level rise) while also experiencing poverty, unsafe housing, insecure jobs, amongst other drivers of vulnerability.[83]
- Climate change is already challenging the health and wellbeing of African communities, compounding the effects of underlying inequalities (high confidence).[84]

Conflict

- There is growing evidence linking increased temperatures and drought to conflict risk in Africa (high confidence). Agriculturally-dependent and politically-excluded groups are especially vulnerable to drought-associated conflict risk. However, climate is one of many interacting risk factors, and may explain a small share of any changes in conflict.[85]

FUTURE CLIMATE RISKS IN WEST AFRICA

Human life and health

- Above 1.5°C risk of heat-related deaths rises sharply (high confidence), with at least 15 additional deaths per 100,000 annually across large parts of Africa.[86] Heat-related deaths reach 50–180 additional deaths per 100,000 people annually in North, West, and East Africa for 2.5°C global warming, and increase to 200–600 per 100,000 people annually for 4.4°C global warming.[88]
- Very high risk for human health is projected to occur from 2°C global warming (high confidence).[89] Climate change-related illness will strain healthcare systems and economies in West Africa.[90]
- Considering the urban heat island effect, even under relatively low population growth scenarios, the sensitive population (people under 5 years or over 64 years old) exposed to heat waves of at least 15 days over 42°C in African cities is projected to increase from around 27 million in 2010 to 360 million by 2100, for 1.8°C global warming. This increases to 440 million for greater than 4°C global warming. West Africa is the most affected African region.[91]

- Disruptions in water availability, such as during droughts or infrastructure breakdown, will jeopardise access to safe water and adequate sanitation, undermine hygiene practices and increase contamination of the environment with toxins.[92]
- Climate change is projected to cause 20,000–30,000 additional diarrhoeal deaths in children (younger than 15 years old) by mid-century for 1.5°C to 2°C global warming. West Africa will be especially negatively affected.[93]

- Epidemics of dengue and yellow fever are projected to expand further into the Sahel region of West Africa under future global warming scenarios.[94] Studies estimate that malaria vector hotspots and prevalence are projected to increase in the Sahel under mid- to high-warming scenarios by 2030 and thereafter. However, in other parts of West Africa malaria hotspots are projected to diminish.[95]

> **Above 1.5°C, impacts considered high risk include potentially lethal heat exposure for more than 100 days per year in West Africa[87]**

Disruptions in water availability will jeopardise access to:

- Safe water and adequate sanitation
- Undermine hygiene practices
- Increase contamination of the environment with toxins

Climate change is projected to cause

20 000–30 000

additional diarrhoeal deaths in children (younger than 15 years old) by mid-century for 1.5°C–2°C global warming.

Ecosystems and biodiversity

With every increment of global warming, the risk of biodiversity loss and species extinction increases across Africa, as shown here:

> **Above 2°C, risk of sudden and severe biodiversity losses becomes widespread in West, Central and East Africa[96]**

Table 2 Risk of biodiversity loss across Africa with increasing global warming[97]

Global warming level (relative to 1850–1900)	Biodiversity at risk	% of species at a site at risk of local population collapse	Extent across Africa (% of the land area of Africa)	Areas at risk
1.5°C	Plants, insects, vertebrates	>10%	>90%	Widespread. Hot and/or arid regions especially at risk, including the Sahara and Sahel
>2°C	Plants, insects, vertebrates	>50%	18%	Widespread
>4°C	Plants, insects, vertebrates	>50%	45–73%	Widespread

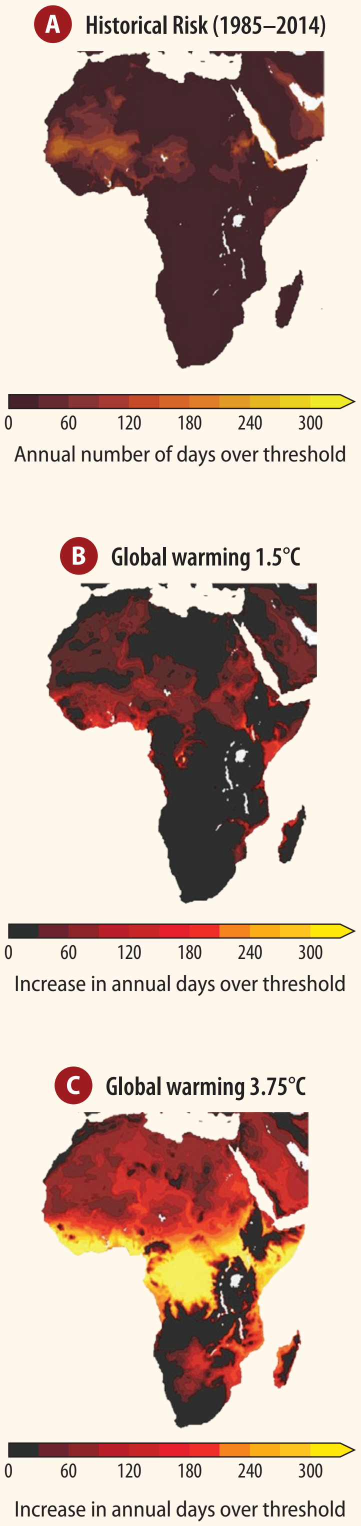
- At 2°C global warming, 36% of African freshwater fish species are vulnerable to local population collapses, and 7–18% of African land-based species assessed are at risk of extinction. Climate change is also projected to change patterns of invasive species spread.[98]

> **Tipping point: A level of change in system properties beyond which a system reorganises, often abruptly, and does not return to the initial state[100]**

- The geographic distribution of major biomes across Africa, including forests, savannas and grasslands, are projected to shift from the greening effect of increases in atmospheric carbon dioxide and also from desertification effects from changes in aridity (high confidence). This will have severe consequences for species that depend on these biomes, such as savanna animals, and for livelihoods, such as pastoralism. There is high uncertainty about how these changes will affect specific locations. However, limiting global warming will reduce the chance of rapid changes from ecosystems reaching irreversible tipping points.[99]

Figure 2 Severe heat stress duration for cattle in Africa with increased global warming[109]

KEY: (A) Number of days per year over heat stress threshold in the historical climate (1985–2014). **(B and C)** Increase in the number of days per year over heat stress threshold for global warming of 1.5°C and 3.75°C above pre-industrial levels (1850–2100). Heat stress is estimated using a high Temperature Humidity Index value (Livestock Weather Safety Index).[110]



Food systems

- Future warming will negatively affect food systems in Africa by shortening growing seasons and increasing water stress (high confidence).[101] At 1.5°C global warming, sorghum yields are projected to decline in West Africa, and a 9% decline in maize yields is expected (if adaptation is only incremental and localised).[102] Research on other regional crops is limited.
- Global warming above 2°C will result in reduced yields of staple crops across most of Africa compared to 2005 yields, even if adaptation options are implemented.[103] Relative to 1986–2005, global warming of 3°C is projected to reduce labour capacity in agriculture by 30–50% in sub-Saharan Africa due to higher temperatures.[104]

- Climate change threatens livestock production in West Africa (high agreement, low evidence).[105] This is through a combination of negative impacts on the availability and quality of animal fodder, availability of drinking water, direct heat stress on animals (see Figure 2), and the prevalence of livestock diseases.[106]
- Over 40% losses in rangeland productivity are projected for western, sub-Saharan Africa at global warming over 2°C (which could occur by 2050 under a mid-to high-warming scenario).[107] By 3.75°C, severe heat stress may be near year-round for cattle across tropical Africa (see Figure 2).
- Multiple countries in West, Central and East Africa are projected to be at risk from simultaneous negative impacts on crops, fisheries and livestock.[108]

- Ocean warming, acidification and de-oxygenation are projected to affect the early life of several marine food species, including fish and crustaceans.[111]
- The risk for West African fisheries becomes very high at 2°C of global warming, when marine fisheries catch potential is projected to decline by more than 30%. There is a risk of even greater declines at higher levels of warming.[112]
- Under 1.7°C global warming by 2050, reduced fish harvests could leave up to 70 million people in Africa vulnerable to iron deficiencies, up to 188 million at risk for vitamin A deficiencies, and 285 million for vitamin B12 and omega-3 fatty acids, with multiple countries in West Africa especially at risk.[113]
- Countries whose people depend heavily on fish for nutrition and whose fisheries are at high climate risk are Benin, Ghana, Guinea, Nigeria and Senegal (under a low-warming scenario) and also Mauritania (under a high-warming scenario).[114]
- For freshwater fisheries, beyond 2°C of global warming, over 50% of commercially-important freshwater fish species across Africa are projected to be vulnerable to extinction.[115] Regions reliant on rivers and floodplains – as in the Niger River Basin – are likely to see reduced fish catches, as climate change alters the flow of water.[116]

- Production will not be the only aspect of food security that is impacted by climate change. Processing, storage, distribution and consumption will also be affected.[117]

Economies

- Future climate change is projected to have a very large negative effect on African countries' economic output levels, but this effect is much lower at lower levels of global warming – as shown in Figure 3. Severe risks are more likely in hotter developing countries, such as in much of Africa. For Africa, damages to GDP are projected across most future-warming scenarios.[118]
- The map shows the increase in GDP per capita for African countries if global warming is limited to 1.5°C versus 2°C above pre-industrial temperatures. Across nearly all African countries, GDP per capita is projected to be at least 5% higher by 2050 and 10–20% higher by 2100 if global warming is held to 1.5°C versus 2°C.[120]
- It is important to note that informal sector impacts are omitted from these GDP-based impacts projections. Informal sector activity and small to medium-sized enterprises can be highly exposed to climate extremes.[121]

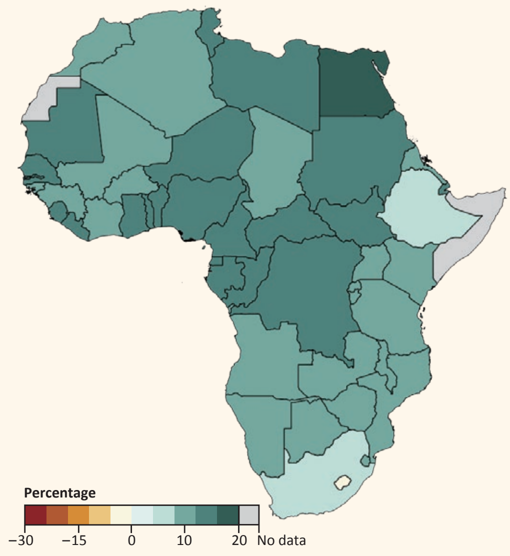


Figure 3 Differences in GDP per capita for African countries for the period 2081–2100, if global warming is limited to 1.5°C versus 2°C above pre-industrial temperatures.

For example, the map shows that Mauritania's GDP per capita would be around 15% higher at 1.5°C global warming, than it would be at 2°C global warming.[119]

Human settlements and infrastructure

- Exposure of people, assets and infrastructure to climate hazards is increasing in Africa due to rapid urbanisation and growing population in informal settlements (high confidence).[122]
- Africa as a whole is the most rapidly-urbanising region in the world – with much of the urban expansion happening in small towns and intermediary cities. Sixty percent of Africans are expected to live in cities by 2050. Approximately 59% of urban dwellers live in informal settlements and this number is expected to increase.[123]
- These trends will increase the number of people exposed to climate hazards, including floods, droughts and heatwaves – and especially to sea level rise in low-lying coastal towns and cities in West Africa (high confidence).[124]
- Towns and cities are growing so rapidly in West, Central and East Africa that the area of urban land exposed to arid climate conditions will increase 700% between 2000–2030, even without further climate change. The urban area exposed to high-frequency flooding will increase by 2,600% in the same period.[125]
- Nigeria, Senegal, Benin and Côte d'Ivoire are among the countries globally with the largest projected population at risk from sea level rise. By 2030, 47 million people are projected to be exposed to sea level rise in West Africa, increasing to 111 to 122 million by 2060.[126]
- Expected aggregate damages from sea level rise in Lagos are projected to be US$ 3.7 to 9.4 billion and in Abidjan US$ 14.3 to 49.6 billion by 2050, with the higher estimates for higher-emissions scenarios.[127]
- The total increase in energy costs for cooling to prevent heat stress are projected to be unaffordable for many African countries at US$ 51 billion by 2°C global warming and US$ 487 billion by 4°C global warming. The greatest increase in cooling demand is projected to be in densely-populated countries such as Nigeria.

- Populations at risk from storm surge and/or sea level rise coincide with areas of high coastal ecosystem-based adaptation potential on the coastlines of the Gulf of Guinea, Gambia, Guinea-Bissau and Sierra Leone.[128]

Exposure to climate hazards in Lagos (Nigeria), and Cotonou and Porto-Novo (Benin)

Lagos is one of many coastal African cities exposed to sea level rise. In the figure, orange shows the built-up area in 2014. Shades of blue show permanent flooding due to sea level rise by 2050 and 2100 under low, medium and high global warming scenarios.[129] Darker colours for higher-emissions scenarios show areas projected to be flooded in addition to those for lower emissions scenarios – assuming the absence or failure of coastal defences. Lagos does not have sea defences yet, so these would need to be built.[130] In the absence of any adaptation action, Nigeria is projected to be one of three countries in Africa worst affected by sea level rise in terms of the number of people at risk of flooding annually in a 4°C warming scenario.[131]

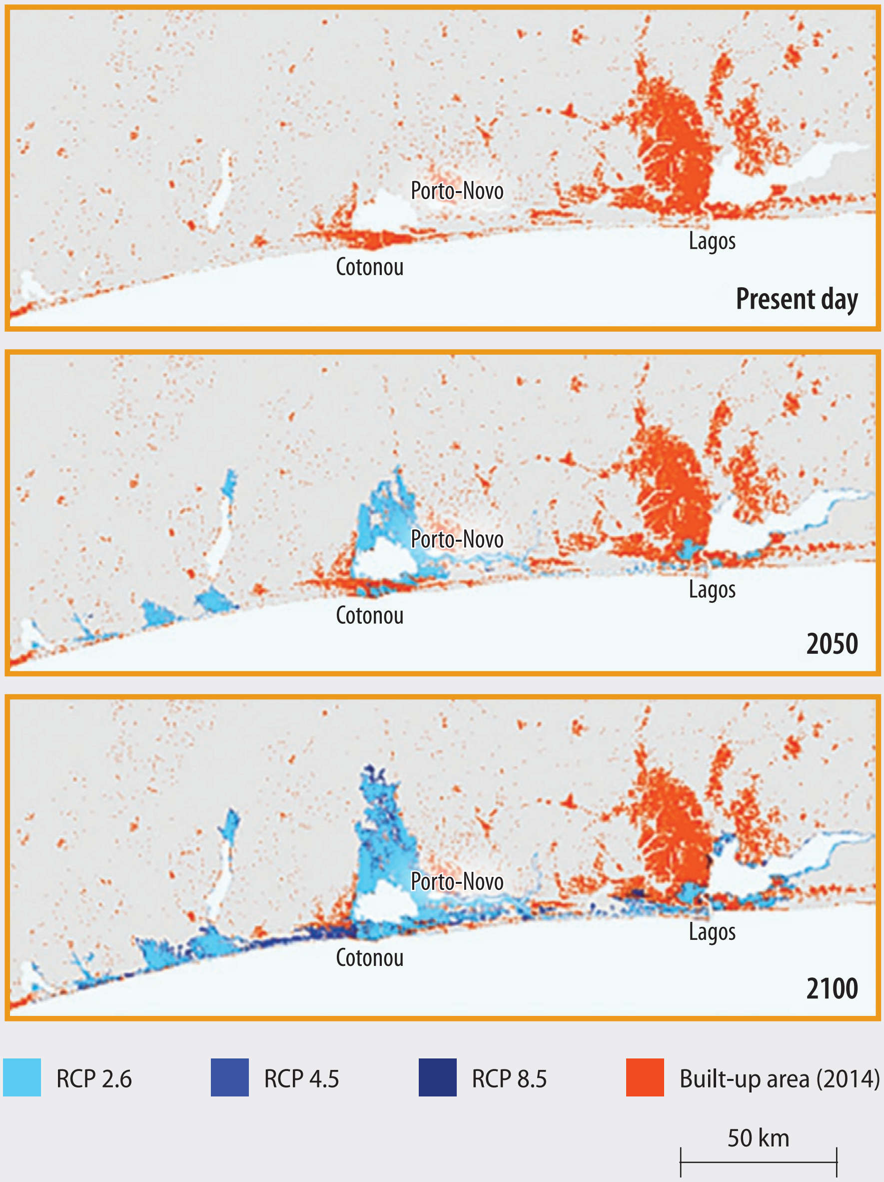


Figure 4 Lagos, Cotonou and Porto-Novo exposure to sea level rise[132]

Migration

- Tens of millions of Africans are expected to migrate in response to water stress, reduced crop productivity and sea level rise associated with climate change. The majority will be in West Africa, and many will be internal migrants, moving from rural to urban areas.[133]
- West Africa has the highest levels of projected climate-related internal migrants (moving within countries), potentially reaching more than 50 million by 2050 for 2.5°C global warming.[134] This suggests that climate impacts will have a particularly pronounced impact on future migration in the region.

Education

- Future climate risks to children's and adolescents' educational attainment and life prospects need to be further researched. However, recognising that climate hazards can trap poorer households in a cycle of poverty, adaptation actions can be designed in ways that actively work to target the most climate-affected and reduce social inequality, whether it is inequality on the basis of gender, income, employment, education or otherwise.[135]

Water for people

- There is increasing demand for water for agricultural and energy production in West Africa.[136] Governments are responding with ambitious plans to expand irrigation and hydropower infrastructure – especially in the Niger and Senegal river basins. Climate change introduces significant risks to these plans: future levels of rainfall, evaporation and runoff will have a substantial impact. However, climate models disagree on whether climates will become wetter or dryer in each river basin.[137]
- The combination of increasing societal demands on limited water resources and future climate change is expected to intensify water-energy-food competition and trade-offs (high confidence).[138]

Heritage

- Most African heritage sites are neither prepared for, nor adapted to, future climate change (high confidence).[139] Climate risk to African heritage has not been properly quantified, but preliminary studies have identified 10 cultural sites (including the Island of Saint Louis in Senegal) and 15 natural coastal heritage sites physically exposed to sea level rise by 2100 under the highest-warming scenario.[140, 141, 142]
- Eight exposed natural sites in West Africa include: Songor Biosphere Reserve in Ghana; the Mangroves de Fleuve Cacheu National Park in Guinea-Bissau; Diawling National Park in Mauritania; the Somone Ramsar Site, Kalissaye Ramsar Site and Delta du Saloum National Park in Senegal; and Bao Bolong Wetland Reserve and Tanbi Wetland National Park in The Gambia.[143]

Compound risks

- Multiple African countries are projected to face compounding risks from: reduced food production across crops, livestock and fisheries; increasing heat-related mortality; heat-related loss of labour productivity; and flooding from sea level rise, especially in West Africa (high confidence).[144]
- The African population exposed to multiple, overlapping extreme events, such as concurrent heat waves and droughts or drought followed immediately by extreme rainfall, is projected to increase 12-fold by 2070–2099 (compared to 1981–2010), for a scenario of low population growth and 1.6°C global warming. Projections rise to 47-fold with high population growth and 4°C global warming. West, Central-East, northeastern and southeastern Africa will be especially exposed.[145]

A woman refills her bucket from a well in Natriguel, Mauritania. Clean water was scarce as a result of drought drying up wells, leading to children at risk of diarrhoea and increased malnutrition. Reduced rainfall, poor harvests, a lack of pasture and rising food prices were also driving a food crisis in the region. © Pablo Tosco/Oxfam

Compounding risks to multiple African countries

- Reduced food production across crops, livestock and fisheries
- Increased heat-related mortality
- Heat-related loss of labour productivity
- Flooding from sea level rise

WEST AFRICA'S POTENTIAL TO ADAPT

As described here, climate change is already affecting all walks of life and aspects of the natural and built environment in West Africa. Impacts are projected to become more widespread and severe, further threatening people's lives and livelihoods, and damaging the region's economy and ecosystems.[146] West Africa's foremost options for adapting to climate change include:

- **Ecosystem-based adaptation** uses biodiversity and ecosystem services to assist people to adapt to climate change. Sometimes it is also described as 'nature-based solutions to climate change'. These solutions can reduce climate impacts and there is high agreement that they can be more cost-effective than traditional 'grey' infrastructure when a range of economic, social and environmental benefits are also accounted for.[147]

- **Investing in nature** (as described above) can provide many diverse benefits to society, far beyond climate benefits – but much of this potential depends on how nature-based adaptation is designed and managed.[148] Gender-sensitive and equity-based adaptation approaches reduce vulnerability for marginalised groups across multiple sectors in Africa, including water, health, food systems and livelihoods (high confidence).[149] Maintaining indigenous forest ecosystems has benefits for both biodiversity and emissions reduction. However, wrongly targeting ancient grasslands and savannas for afforestation harms water security and biodiversity, and can increase emissions from fire and drought.[150]

  Beyond 1.5ºC of global warming, certain ecosystems – such as coral reefs – will be irreversibly damaged and thus will contribute less to nature-based adaptation solutions.[151]

- In agriculture, there is potential to **boost farmers' and pastoralists' resilience to climate shocks and stresses**; for example, through the introduction of drought- and pest-tolerant crop and livestock varieties. Often farmers with the lowest incomes cannot afford these without assistance.[152]

However, **adaptation limits for crops in Africa will increasingly be reached for global warming of 2°C** (high confidence), and in tropical Africa may already be reached at current levels of global warming (low confidence). The risk of no available genetic varieties of maize for adaptation is higher for East Africa and southern Africa than for Central or West Africa.[153]

- **There is a need to manage the competition among different water uses** – for example, among household users, farmers and energy producers (the 'water-energy-food nexus'). Effective approaches include working at river basin level to research and quantify the future sensitivity of crops and dams to changing rainfall, runoff, evaporation and drought. Integrating these perspectives and identifying cross-cutting adaptation options work better when decision-making involves a wide range of actors affected by decisions.[154]

- People already make abundant use of their **local and indigenous knowledge** to cope with climate variability. This knowledge is very important for strengthening local climate change adaptation.[155]

- Even social protection that is not climate-specific can improve resilience; however, **integrating climate adaptation into social protection programmes** – such as cash and in-kind transfers, public works programmes, microinsurance and healthcare access to help households and individuals cope in times of crisis – can go even further to increase people's resilience to climate change.[156]

> **Integrated water management measures including sub-national financing, demand management through subsidies, rates and taxes, and sustainable water technologies can reduce water insecurity caused by either drought or floods (medium confidence)**[157]

- **Effective adaptation in human settlements relies on addressing climate risks throughout planning and infrastructure development** and can provide net financial savings. This needs to be done in an integrated, cross-cutting way.[158] There is scope for governments to better harness the role of the informal sector in mitigation and adaptation – through multi-level governance. This could include, for example, service providers, such as informal water and sanitation networks.[159]

- **Early warning systems**, targeting weather and climate information to specific users and sectors, can be effective for disaster risk reduction, social protection programmes, and managing risks to health and food systems (such as vector-borne disease and crops).[160]

- The ability of West African communities and sectors to pursue effective adaptation options to the full is **constrained by lack of finance.**[161]

> **The greatest gains in wellbeing can be achieved by prioritising finance to reduce climate risk for low-income and marginalised residents, including people living in informal settlements (high confidence)**[162]

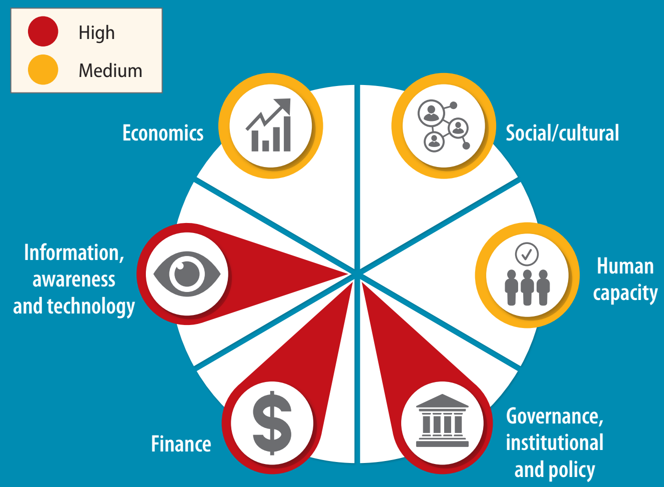


Figure 5 Constraints for the African continent that make it more difficult to plan and implement adaptation[163]

A rural women's cooperative in Guinea harvests vitamin-rich Moringa trees, which support biodiversity and prevent soil erosion.
© UN Women/Joe Saade

Adaptation for the long term – and avoiding maladaptation

Designing adaptation policy under conditions of scarcity, common to many African countries, can inadvertently lead to trade-offs between adaptation options, as well as between adaptation and mitigation options. This can reinforce inequality and fail to address underlying social vulnerabilities.[164] Access to adequate financial resources is crucial so that adaptation actions are well designed and do not create new vulnerabilities (see page 16 below).[165]

What is more, the long-term view is critical. Actions that focus on single sectors or single risks and prioritise short-term gains often lead to maladaptation for ecosystems and people, if long-term impacts of the adaptation option are ignored (high confidence).[166] These include infrastructure and institutions that are inflexible and costly, and increase risk and impacts (high confidence).[167]

Adaptation options that deliver strong development benefits and positive outcomes include: improving access to climate information, developing agroforestry systems and conservation agriculture, agricultural diversification and growing of drought-resistant crop varieties (when low-income farmers can access seeds). Climate-smart agriculture techniques such as drip irrigation, planting pits and erosion control techniques can all improve soil fertility, increase yield and household food security, while increasing farmers' resilience to changing rainfall and temperature patterns.

Examples of negative outcomes, also known as 'maladaptation', are when producing biomass for bioenergy displaces subsistence farming and food crops, and so threatens food security; or displaces biodiversity-rich areas that provide valuable ecosystem services, such as freshwater flows. Overuse of fertilisers leading to environmental degradation is another form of maladaptation that undermines resilience.[168]

KEY INVESTMENT AREAS FOR A CLIMATE-RESILIENT WEST AFRICA

The IPCC's *Sixth Assessment Report* identifies key areas for enabling climate-resilient development in Africa, where investment would have a catalytic effect on the continent's resilience to current and future climate change.[169]

> **Climate-resilient development is a process of implementing greenhouse gas mitigation and climate change adaptation measures to support sustainable development for all**[170]

Finance

Increasing public and private finance flows by billions of dollars per year, enhancing direct access to multilateral funds, strengthening project pipelines, and shifting more finance to implementation would help realise transformative adaptation in Africa.[171]

Annual finance flows targeting adaptation for Africa are billions of dollars less than the lowest adaptation cost estimates for near-term climate change, and adaptation costs will rise rapidly with global warming (high confidence).[172] Developed countries have fallen short of their Copenhagen target to leverage US$ 100 billion per year in climate finance for developing countries for mitigation and adaptation by 2020.[173]

Many African countries, particularly Least Developed Countries (LDCs), express a stronger demand for adaptation than mitigation finance. Compared to developed countries the costs of adaptation are much higher for developing countries as a proportion of national income, making self-financing adaptation more difficult (high confidence). Concessional finance will be required for adaptation in low-income settings (high confidence). However, from 2014–2018 a larger total of climate finance commitments for Africa were debts than grants and – excluding multilateral development banks – only 46% of commitments were actually disbursed.[174]

Aligning sovereign debt relief with climate goals could increase finance by redirecting debt-servicing payments to climate resilience.[175]

Climate services, literacy and research

Investing in climate information services that are demand-driven and context-specific, combined with climate change literacy, can enable informed adaptation responses.[176] Climate services are most effective when they offer geographic- and/or sector-relevant information (such as for agriculture or health) and information users understand the causes and consequences of climate change (known as 'climate literacy').[177,178] However, this is hindered by low climate literacy rates ranging from only 25% to 49% (average 37%) in West Africa,[179] and limited weather and climate data.

Increased funding for African partners, and direct control of research design and resources can provide more actionable insights on adaptation in Africa.[180]

Climate-related research in Africa faces severe data constraints, as well as inequities in funding and research leadership that reduce adaptive capacity. From 1990–2019, Africa received just 3.8% of climate-related research funding globally. Of this, only 14.5% went to African institutions, while 78% went to EU and North American institutions to do research on Africa.[181]

> **From 1990–2019, research on Africa received just 3.8% of climate-related research funding globally**[182]

Governance

Governance for climate-resilient development includes integrating climate resilience into long-term planning and investment decisions, all-of-government approaches, transboundary cooperation and benefit-sharing, development pathways that increase adaptation and mitigation and reduce inequality, and implementing Nationally Determined Contributions (NDCs).[183] Making space for marginalised and diverse groups in policy processes, including women and indigenous communities, can catalyse inclusive action and transformational responses to climate change.[184]

There are multiple possible pathways by which communities, nations and the world can pursue climate-resilient development. Moving toward different pathways involves confronting complex synergies and trade-offs between development pathways, and the options, contested values, and interests that underpin climate mitigation and adaptation choices (very high confidence).[185]

Robust legislative frameworks that develop or amend laws are an important basis for mainstreaming climate change across government and society. Benin is one of two countries in Africa that has enacted a climate change law (the other is Kenya). Nigeria also has a draft climate change bill in place, and discussions are underway for a draft bill in Ghana. A number of West African countries have integrated climate change considerations into existing law, including Côte d'Ivoire, Ghana, Guinea, Guinea Bassou, Liberia, Mali, Niger and Togo.[186]

Working across sectors and at transboundary levels can ensure that adaptation and mitigation actions in one sector don't exacerbate risks in other sectors, and cause maladaptation.[187] Cross-sectoral approaches provide significant opportunities for large co-benefits and/or avoided damages. Examples of co-benefits include climate change adaptation supporting Covid-19 pandemic preparedness and 'One Health' approaches benefiting human and ecosystem health.[188] The close dependency of many Africans on their livestock and surrounding ecosystems demonstrates how integrated human and ecosystem health approaches are especially critical for addressing climate change risks to health.[189]


Farmers in Guinea use an aerial map to plot agroforestry in the Nialama Classified Forest. © USAID

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26. 9.5.3.2.
27. 9.5.3.2.
28. Chapter 9, Executive Summary; 9.5.3–7, 9.7.
29. 9.5.3.2.
30. Chapter 9, Executive Summary; 9.5.2, 9.5.3, 9.5.6.
31. Figure Box 9.7.1; 9.1.3.
32. Chapter 9, Executive Summary; 9.10.1.
33. 9.10.2.3.1.
34. 9.10.2.1.1.
35. 9.10.1.
36. 9.10.
37. Chapter 9, Executive Summary, 9.6.1.
38. 9.6.1.1.
39. 9.6.1.1.
40. 9.6.1.1.
41. 9.6.1.1.
42. Figure 9.17.
43. 9.6.1.1.
44. 9.6.1.1.
45. Figure 9.17.
46. 9.6.1.3.
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50. 9.8.2.1.
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52. 9.8.2.4.
53. 9.8.2.1.
54. 9.8.5.1.
55. 9.8.5.2.
56. 9.7.1.
57. Box 9.4.
58. Chapter 9, Executive Summary; 9.6.3, 9.11.1.
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60. Figure 9.37.
61. 9.9.1.
62. 9.9.2.
63. Table 9.7.
64. 9.9.2.
65. 9.9.1.
66. 9.11.1.2.
67. 9.11.1.2.
68. 9.9.1.
69. Chapter 9, Executive Summary.
70. Box 9.8.
71. 9.9.1.
72. Chapter 9, Executive Summary.
73. Table Box 9.8.2.
74. Box 9.8.
75. 9.3.2.
76. Box 9.8.
77. 9.3.2.
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79. Table 9.1.
80. 9.12.1.
81. 9.12.1.
82. Figure Box 9.1.1.
83. Table 9.2.
84. 9.10.2.3.1.
85. Chapter 9, Executive Summary; Box 9.9.
86. Chapter 9, Executive Summary; 9.10.2.
87. 9.2.
88. 9.10.2.3.1.
89. Figure 9.26.
90. Chapter 9, Executive Summary; 9.10.2.
91. 9.9.4.1.
92. 9.10.2.2.
93. 9.10.2.2.
94. 9.10.2.1.2.

95. 9.10.2.1.1.
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108. 9.2.
109. Figure 9.24.
110. 9.8.2.4.
111. 9.8.5.2.
112. 9.2, 9.8.2.
113. Chapter 9, Executive Summary; 9.8.5.
114. Figure 9.25.
115. 9.2; Figure 9.26.
116. 9.8.5.2.
117. 9.8.
118. 9.11.
119. Figure 9.37.
120. Chapter 9, Executive Summary; 9.11.
121. Figure 9.37.
122. 9.9.1.
123. 9.9.1.
124. 9.9.4.1.
125. Chapter 9, Executive Summary; 9.9.1, 9.9.2, 9.9.4; Box 9.8.
126. Figure 9.28.
127. Table 9.8.
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134. Table Box 9.8.2.
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About this factsheet

This factsheet is a guide to Working Group II's contribution to the IPCC's *Sixth Assessment Report* (AR6) for decision-makers and climate change communicators in southern Africa. It has been prepared by the Climate and Development Knowledge Network (CDKN), African Climate and Development Initiative (ACDI), SouthSouthNorth (SSN) and ODI. The IPCC *Sixth Assessment Report* provides the strongest-ever assessment of evidence on how climate change is impacting the African continent and its sub-regions. This factsheet distils data, trends and analysis most relevant to southern Africa from the Africa Chapter of the *Sixth Assessment Report*. In doing so, we hope to make the IPCC's important material more accessible and usable to southern African audiences.

The team, comprising CDKN researchers and communicators as well as IPCC Coordinating Lead Authors and Lead Authors of the Africa Chapter, has extracted the southern Africa-specific information directly and solely from the *Sixth Assessment Report*.

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Our publication is part of a suite of materials sharing IPCC AR6 evidence for Africa's five sub-regions: Central Africa, East Africa, North Africa, southern Africa and West Africa.

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