FACTSHEET

CENTRAL AFRICA

Climate & Development Knowledge Network

African Climate & Development Initiative

THE IPCC'S SIXTH ASSESSMENT REPORT

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

A woman carrying a solar panel near Yangambi, Democratic Republic of Congo.
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1. How Central Africa's climate is already changing
2. Central Africa's future climate
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4. Future climate risks in Central Africa
5. Central Africa's potential to adapt
6. Key investment areas for a climate-resilient Central Africa

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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.[5] From 1990–2019, Africa received just 3.8% of climate-related research funding globally.[6] 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 ecological

There are different types of drought. A **meteorological drought** is when there is an abnormal lack of rainfall. An **agricultural drought** impacts crop production during an agricultural growing season, while an **ecological drought** affects natural systems.[14]

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

The climate has changed 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.[2] Central 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.[3]

> **Limiting global warming to 1.5°C is expected to substantially reduce damages to African economies and ecosystems[4]**

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

HOW CENTRAL AFRICA'S CLIMATE IS CHANGING

The Earth's average surface temperature has already warmed by 1.09°C since pre-industrial times (1850–1900).[7] However, Central Africa's climate has warmed even more than the global average in the past few decades:

Temperature: Central Africa's average annual surface temperatures have increased by between 0.75°C and 1.2°C since 1960.[8]

Extreme heat and heat waves: The number of hot days, heatwaves and heatwave days increased between 1979–2016 and cold extremes have decreased. Poor ground-based observation networks in Central Africa result in medium confidence in the increase in the number of heat extremes.[9]

Marine heat waves: Climate change has doubled the probability of heatwaves in the ocean around most of Africa (high confidence).[10]

Rainfall and extreme rainfall: The severe lack of station data leads to large uncertainty in estimating observed rainfall trends and low confidence in extreme rainfall changes.[11]

Drought: There is some evidence of drying since the mid-20th century through decreased average rainfall, as well as increases in meteorological, agricultural and ecological drought (medium confidence).[12] Southern and eastern Central Africa were identified as drought hotspots between 1991–2010.[13]

CENTRAL 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 (1850–1900) in the near-term (up to 2040).[15]

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).[16]

> Climate change has increased heat waves and drought on land, and doubled the probability of marine heatwaves around most of Africa[17]

Table 1 Changes in global surface temperature

Global warming scenario according to emissions levels, showing best estimate, °C (very likely range, °C)[18]	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.[19]

Temperature: At 1.5°C, 2°C and 3°C global warming, average annual surface temperatures in Central Africa are projected to be higher than the global average.[20]

Extreme heat and heat waves:
The average number of days per year with maximum temperature exceeding 35°C will increase by 14–27 days at 2°C global warming and 33–59 days at 3°C global warming (from 61–63 days during the 1995–2014 period) (high confidence).[21]

The annual number of days above potentially lethal heat thresholds reaches 100–150 in Central Africa at 2.5°C. Extreme heatwave events may last longer than 180 days at 4.1°C global warming.[22] Children born in Central Africa in 2020 will, under 1.5°C global warming, be exposed to 6–8 times more heatwaves in their lifetimes than those born in 1960.[23]

Marine heat waves: Increases in frequency, intensity, spatial extent and length of marine heatwaves are projected for all of Africa's coastal zones.[24]

Rainfall and extreme rainfall: At global warming of 1.5°C and 2°C, there is low confidence in projected changes in average rainfall over Central Africa.[25] At 3°C and 4.4°C, average annual rainfall is projected to increase by 10–25% and the intensity of extreme rainfall will increase (high confidence).[26] Extreme rainfall is projected to increase the likelihood of widespread flooding before, during and after the mature monsoon season.[27]

Drought: There is low confidence in changes of drought frequency over Central Africa.[28]

CLIMATE CHANGE IMPACTS WE HAVE ALREADY SEEN IN CENTRAL AFRICA


Forest monitoring in Yangambi, Democratic Republic of Congo. © Axel Fassio/CIFOR via Flickr

> In Africa, increasing carbon dioxide levels and climate change are destroying marine biodiversity, reducing lake productivity, and changing animal and vegetation distributions (high confidence)[34]

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.[29]

Human life and health

- Climate variability and change already affect the health of tens of millions of people in Central 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).[30] Current climate suitability for endemic malaria transmission is concentrated in the Central African region.[31]
- 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.[32]
- 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).[33]

Ecosystems and biodiversity

- Increased carbon dioxide levels in the atmosphere and climate change are influencing the growth of natural vegetation across African landscapes.[35] Woody plants (trees and shrubs) are expanding their range, particularly into grasslands and savannas – and including forest expansion into Central African savannas.[36] This is a new area of scientific understanding and consensus since the IPCC's *Fifth Assessment Report* in 2014.[37] Reported cases of desertification and vegetation loss – for example, in the Sahel – appear transitory and localised rather than widespread and permanent.[38]
- The increasing shifts in rainfall patterns and aridity over central Africa threatens the massive carbon store in the Congo Basin's Cuvette Centrale peatlands, estimated at 30.6 billion tonnes of carbon.[39] If peatland dries out, it releases greenhouse gases rather than locking them up.
- Human land-use activity (tree clearance or planting) also plays a large role in modifying land-based ecosystems in Central Africa.[40,41]

Forests' resilience and risks

African tropical forests remained a carbon sink through the record drought and temperature experienced in the 2015–2016 El Nino, indicating resilience in the face of extreme environmental conditions.[42] This resilience indicates that there is the capacity to recover from disturbances and short-term change. But resilience has limits. Change can lead to irreversible shifts, whereby ecosystems' character changes completely, e.g. at a certain point, increasing aridity could lead to widespread die-offs of trees in tropical forests.[43]

Ecosystems and biodiversity *Continued*

- 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 large impact on freshwater ecosystems. Temperatures in Central African freshwater bodies rose by 0.1–0.4°C in a decade; and by up to 0.6°C in Lake Chad.[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 Central 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.[48]
- Two-thirds of people in Africa perceive that climate conditions for agricultural production have worsened over the past ten years.[49] 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.[50]

- 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]

- 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, in abundance of fish in lakes and rivers, and altered distribution of fish species in the oceans.[53]

Water for people

- Rainfall and river discharge have been extremely variable in Central Africa recently, as in the rest of Africa – between 50% above and below historic levels. 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.[54]

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.[55]
- 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).[56]

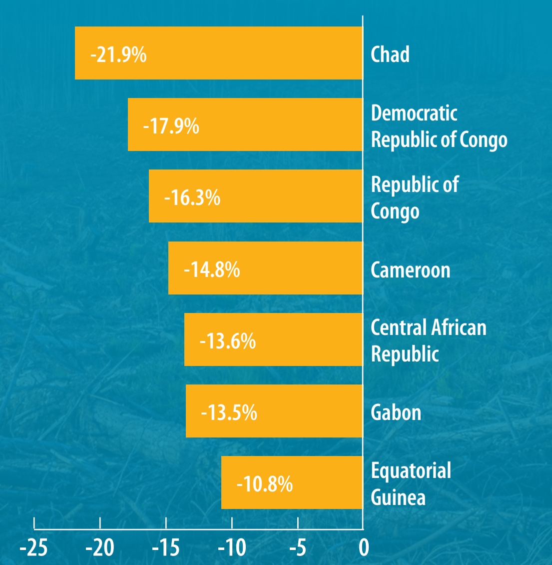


Figure 1 Percentage change in GDP per capita in Central African countries due to observed climate change (1991–2010)[57]

Human settlements and infrastructure

- Africa's human settlements, including those in Central Africa, are particularly exposed to floods (from rain and river flows), droughts and heat waves.[58]
- 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.[59]

- Floods affect transport infrastructure, with potentially severe consequences for food security, communication and the economy of affected regions (high confidence).[60] Eight of the twenty countries with the highest expected annual damages to road and rail assets, relative to the country's GDP, are located in East, West and Central Africa.[61]

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.[62]
- In Central Africa, experiencing lower-than-average rainfall during early life is associated with up to 1.8 fewer years of completed schooling. In Cameroon, warming temperatures have negatively affected plantain yields, which in turn is linked to lower educational attainment.[63]

Heritage

- African heritage is already at risk from climate hazards, including sea-level rise and coastal erosion (high confidence).[64] This risk ranges from loss of traditional cultures and ways of life, to loss of knowledge systems and damage to heritage sites.[65]

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.[66]
- Over 2.6 million and 3.4 million new weather-related displacements occurred in sub-Saharan Africa in 2018 and 2019.[67, 68]
- Migrants often move to informal settlements in urban areas located in low-lying coastal areas or alongside rivers, exacerbating existing vulnerabilities.[69]
- Most climate-related migration is currently within countries or between neighbouring countries, rather than to distant high-income countries (high confidence).[70]

Conflict

- There is growing evidence linking increased temperatures and drought to conflict risk in Africa (high confidence).[71] 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.[72]
- Conflict-inducing impacts of drought have been uncovered in the Democratic Republic of Congo.[73]

Compound risks

- In Africa, including Central 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.[74]
- 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 (such as floods, extreme heat and sea level rise) while also experiencing poverty, unsafe housing, insecure jobs, amongst other drivers of vulnerability.[75]

> **Climate change is already challenging the health and wellbeing of African communities, compounding the effects of underlying inequalities (high confidence)[76]**

FUTURE CLIMATE RISKS IN CENTRAL 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.[78]
- Very high risk for human health is projected above 2°C global warming (high confidence).[79] Climate change-related illness will strain healthcare systems and economies in Central Africa.[80]
- The difference between an intermediate global warming scenario of 2.5°C and a very high global warming scenario of over 4°C is projected to be tens of thousands of African lives saved each year from heat-related illness – especially in North, West, Central and parts of East Africa.[81]
- Considering the urban heat island effect, the more vulnerable populations (under 5 and over 64 years old) exposed to heat waves of at least 15 days over 42°C in African cities are projected to increase from 27 million in 2010 to 360 million by 2100, for 1.8°C global warming.[82] This increases to 440 million for greater than 4°C global warming. People in the large cities of Central, East and West Africa will be particularly at risk (very high confidence).[83]
- Above 2°C, thousands to tens of thousands of additional cases of diarrhoeal disease are projected, mainly in Central and East Africa (medium confidence).[84] These changes risk undermining improvements in health from future socioeconomic development (high agreement, medium evidence).[85]

- Central Africa may expect levels of endemic malaria to increase by 2050 under a medium-level global warming scenario.[86]
- However, at higher levels of global warming, malaria prevalence is projected to decrease in parts of the region, as it becomes too hot for malaria transmission. This is projected to happen in parts of southern Central Africa by 2050 at 2.5°C global warming (high confidence), and large areas of southern Central Africa by 2100, at high global warming above 4°C.[87] Most areas in Cameroon will have almost zero malaria transmission under the highest-emissions scenario.[88]
- The tiger mosquito, currently largely confined to western Central Africa and a vector for dengue fever and other viruses, is expected to expand into Chad by mid-century at 2°C global warming.[89] Under the very highest warming scenarios, it is expected to be too hot for mosquitoes to transmit dengue fever. However, surges may be expected in animal diseases that infect both livestock and humans, such as Rift Valley Fever.[90]

> **At 2.5°C, lethal heat exposure for 100–150 days per year is projected for Central Africa[77]**

The more vulnerable populations exposed to heat waves of at least 15 days over 42°C in African cities are projected to increase from

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.

People in the large cities of Central, East and West Africa will be particularly at risk (very high confidence).

> Above 2°C, risk of sudden and severe biodiversity losses becomes widespread in West, Central and East Africa[91]

Ecosystems and biodiversity

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

Table 2 Risk of biodiversity loss across Africa with increasing global warming[92]

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
>2°C	Plants, insects, vertebrates	>50%	18%	Widespread
>4°C	Plants, insects, vertebrates	>50%	45–73%	Widespread. Higher uncertainty for Central African tropical forests due to lower agreement between biodiversity models

- At 2°C global warming, 36% of African freshwater fish species are vulnerable to local population collapse, 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.[93]
- Above 2°C, risk of sudden and severe biodiversity losses becomes widespread in Central Africa. Climate change is also projected to change patterns of invasive species spread.[94]
- 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).[95] 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.[96]
- While increasing carbon dioxide concentrations could increase woody plant cover, increasing aridity could counteract this, destabilising forest and peatland carbon stores in Central Africa (low confidence).[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[97]

Food systems

- Future warming will negatively affect food systems in Africa by shortening growing seasons and increasing water stress (high confidence).[99]
- 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.[100]
- 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.[101]

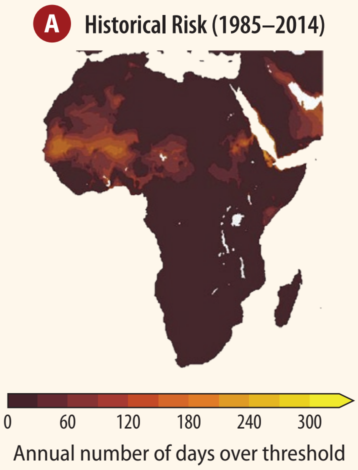
- Climate change threatens livestock production in Central Africa (high agreement, low evidence),[102] including through a combination of negative impacts on the availability and quality of animal fodder, availability of drinking water, direct heat stress on animals (see Figure 2), and the prevalence of livestock diseases.[103]
- Multiple countries in West, Central and East Africa are projected to be at risk from simultaneous negative impacts on crops, fisheries and livestock.[104]

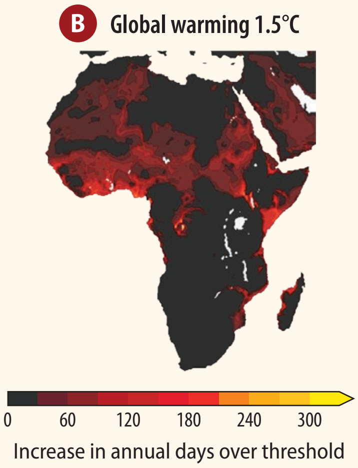
- Ocean warming, acidification and de-oxygenation are projected to affect the early life of several marine food species, including fish and crustaceans.[106] The greater the warming, the more the Maximum Catch Potential of Africa's marine fisheries will decrease.[107]
- People living in Central Africa have a high dependency on marine fish for their nutrition.[108] At 1.7°C global warming, 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 by mid-century.[109]
- Cameroon is among the countries whose people depend heavily on fish for nutrition and whose fisheries are at high climate risk even under a low-warming scenario.[110]
- For inland fisheries, higher levels of global warming are associated with a larger proportion of commercially-harvested fish species facing local population collapse. This will also drive up food security risks in the region.[111]
- For freshwater fisheries, areas where fish are caught mostly in lakes, such as the Great Lakes region, are less likely to experience reductions in fish catch than areas reliant on rivers and floodplains.[112]

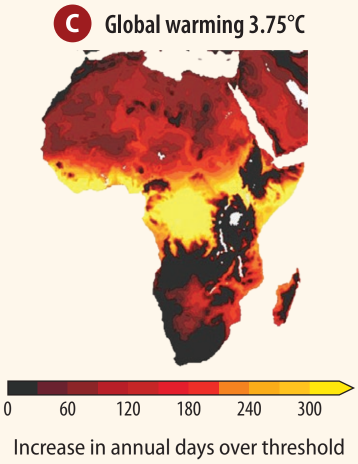
- Production will not be the only aspect of food security that is impacted by climate change. Processing, storage, distribution and consumption will also be affected.[113]

Figure 2 Severe heat stress duration for cattle in Africa with increased global warming[105]

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).







Plantain farmer, Cameroon. © Shutterstock/Media Lens King

Water for people

- There is increasing demand for water for agricultural and energy production in Central Africa. Governments are responding with ambitious plans to expand irrigation and hydropower infrastructure. 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. One study found that hydropower revenues in the driest climate scenarios could be 7% lower in the Congo basin (by 2050) than they would be in the current climate.[114]
- Another study finds that runoff in the Congo River system may increase by up to 50% under the very highest global warming scenario,[115] especially in the wet season, enhancing flood risks in the entire Congo basin, particularly in the central and western parts. Average river flows are expected to increase in most parts of Central Africa, with expected increases in total potential hydropower production.[116]
- 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).[117]

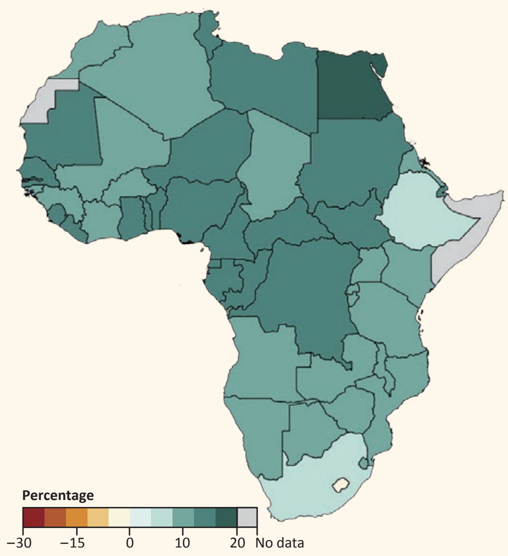


Figure 3 Differences in GDP per capita for African countries for the period 2081–2100, if global warming is limited to 1.5°C versus 2°C above pre-industrial temperatures[121]

For example, the map shows that GDP per capita for most countries in Central Africa (excluding Chad) is projected to be around 15% higher by 2100 at 1.5°C global warming, than it would be at 2°C global warming.[122]

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.[119]
- 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.[120]

Human settlements and infrastructure

- 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.[123] Approximately 59% of urban dwellers live in informal settlements, with this percentage expected to increase (very high confidence).[124] These trends will increase the number of people exposed to climate hazards, particularly floods and heatwaves – and especially in low-lying coastal towns and cities.[125]

- Towns and cities are growing so rapidly in West, Central and East Africa that the area of urban land exposed to arid conditions will increase 700% between 2000–2030.[126] The urban area exposed to high frequency flooding will increase by 2,600% in the same period.[127]

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.[128]

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.[129] With 1.7°C global warming by 2050, 2.6 million people could migrate internally (within countries) in Central Africa.[130]

Heritage

- Most African heritage sites are neither prepared for, nor adapted to, future climate change (high confidence).[131]

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 (high confidence).[132]
- 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.[133]

Child receiving medical care in Chai, North Kivu in the Democratic Republic of Congo. © istock/Jon_Brown

CENTRAL 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 Central 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.[134] Central 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.[135]

- **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.[136] 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).[137] For example, 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.[138]

  Beyond 1.5°C of global warming, certain ecosystems – such as marshes and mangroves – will be irreversibly damaged and thus will contribute less to nature-based adaptation solutions.[139]

- In agriculture, there is considerable 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 – but often farmers with the lowest incomes cannot afford these without assistance.[140] 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).[141]

- **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 works better when decision-making involves a wide range of actors affected by decisions.[142]

> **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)[143]**

- 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.[144]

> **Subsistence farmers in Mount Oku and Mbaw in Cameroon have used their indigenous knowledge to cope with the impacts of climate variability and change[145]**

- 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.[146]

- **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.[147] 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.[148]
- **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 (e.g., vector-borne disease and crops).[149]
- The ability of Central African communities and sectors to pursue effective adaptation options to the full is **constrained by lack of finance**.[150]

The greatest gains in wellbeing can be achieved by prioritising investment to reduce climate risk for low-income and marginalised residents, including people living in informal settlements (high confidence)[151]

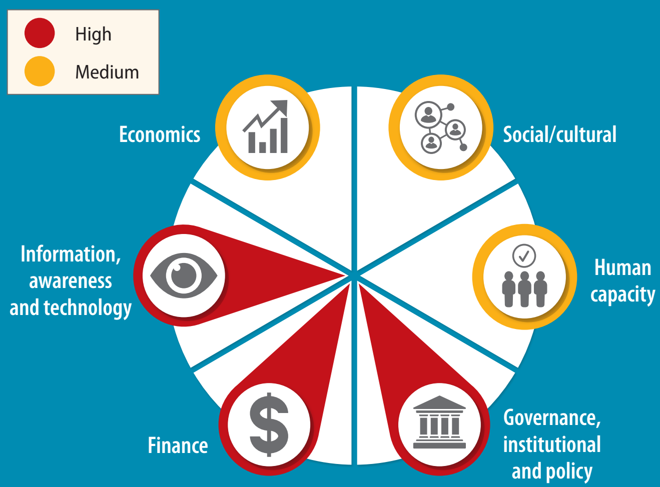


Figure 4 Constraints for the African continent that make it more difficult to plan and implement adaptation[152]

Agroforestry in the village of Minwoho, Lekié, Center Region, Cameroon. © Ollivier Girard/CIFOR

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, can reinforce inequality, and fail to address underlying social vulnerabilities.[153] Access to adequate financial resources is crucial (see page xx below).[154]

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 and long-term adaptation commitment are ignored (high confidence).[155] These include infrastructure and institutions that are inflexible and costly, and increase risk and impacts (high confidence).[156]

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 renewable energy displaces subsistence farming and food crops, and so threatens food security; or displaces biodiversity-rich areas that provide resilience. Overuse of fertilisers leading to environmental degradation is another form of maladaptation that undermines resilience.[157]

KEY INVESTMENT AREAS FOR A CLIMATE-RESILIENT CENTRAL 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.

> **Climate-resilient development is a process of implementing greenhouse gas mitigation and climate change adaptation measures to support sustainable development for all**[158]

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.[159]

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).[160] 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.[161]

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.[162]

Aligning sovereign debt relief with climate goals could increase finance by redirecting debt-servicing payments to climate resilience.[163]

> **Adaptation finance commitments for Central Africa actually decreased in the period 2014–2018; and only 33% of commitments were disbursed**[164]

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.[165] 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 (ie., known as 'climate literacy').[166,167] However, this is hindered by low climate literacy rates (from as low as 48% in Central Africa),[168] and limited weather and climate data.

> Research on the impacts of human-induced climate change on society is still scarce in many regions, especially North and Central Africa[169]

Increased funding for African partners, and direct control of research design and resources can provide more actionable insights on adaptation in Africa.[170]

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, research on Africa received just 3.8% of climate-related research funding globally.[171] Of this, only 14.5% went to African institutions, while 78% went to EU and North American institutions to do research on Africa.

Governance

Governance for climate-resilient development includes long-term planning, all-of-government approaches, transboundary cooperation and benefit-sharing, development pathways that increase adaptation and mitigation and reduce inequality, and the implementation of Nationally Determined Contributions (NDCs).[172] 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.[173]

There are multiple possible pathways to 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).[174]

Robust legislative frameworks that develop or amend laws are an important basis for mainstreaming climate change across government and society. No country in Central Africa has enacted a climate change law, although the Central African Republic and Gabon have integrated climate change considerations into existing law.[175]

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.[176] Cross-sectoral approaches provide significant opportunities for large co-benefits and/or avoided damages (very high confidence).[177]

Examples of co-benefits include climate change adaptation supporting Covid-19 pandemic preparedness and 'One Health' approaches benefiting human and ecosystem health.[178] 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.[179]

Carrying water near Yangambi, Democratic Republic of Congo. © Axel Fassio/CIFOR

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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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