

An aerial photograph of a vast mangrove forest. The landscape is a complex network of winding, light-colored waterways that meander through dense, vibrant green mangrove vegetation. The waterways vary in width and form, creating a labyrinthine pattern across the terrain. The overall scene is lush and natural, showcasing the intricate structure of a coastal wetland ecosystem.

Annex

- Country profiles
- Endnotes

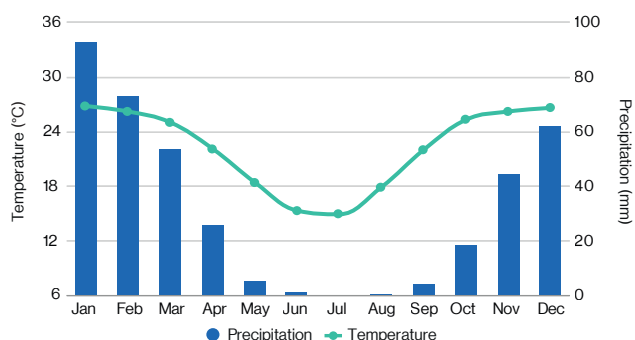


Botswana

Adapted from the World Bank's Climate Risk Country Profiles Series, 2021




Climate trends

Average monthly Temperature (T) and Precipitation (Ppt), 1991–2020¹



Mean annual T/Ppt (1901–2020): 21.6°C; 396.2mm
Mean annual max/min T (1901–2020): 29.6°C; 13.6°C

Country context

 Population 2.3m (2019)	Annual growth rate 2.2% (2019)
 GDP \$18.3bn (2019)	Annual growth rate 3% (2019)
 GDP per capita \$7900 (2019)	

Literacy rate, adult female/male: 87%/86% (2013)
Geography: Landlocked country in southern Africa; land surface dominated by Kalahari Desert, Okavango swamps, Zambezi River, Makgadikgadi Pans; land area: 600,370km²
Broad climate: Arid to semi-arid; warm winters, hot summers

Climate projections²

CMIP5 Ensemble Projection	2020 - 2039	2040 - 2059	2060 - 2079	2080 - 2099
Annual Temperature Anomaly (°C)	+0.6 to +2.2 (+1.4°C)	+1.6 to +3.5 (+2.5°C)	+2.8 to +5.2 (+3.8°C)	+3.9 to +7.1 (+5.0°C)
Annual Precipitation Anomaly (mm)	-18.8 to +11.9 (-2.4mm)	-24.9 to +9.5 (-5.3mm)	-25.6 to +9.3 (-7.1mm)	-32.1 to +6.1 (-9.5mm)

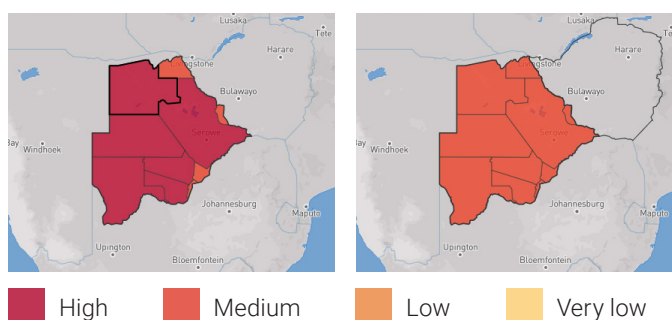
Climate hazards

- Droughts and floods are the most destructive climate-related natural hazards
- Flood disasters have occurred mainly along the Zambezi, Okavango, Boteti and Limpopo Rivers; several urban areas impacted
- Heightened dry conditions and increased pressure on water resources expected by mid-century, particularly for northern, eastern and central areas; severe drought conditions and water scarcity expected by end of century
- Mean monthly temperature expected to increase by 2.5°C by the 2050s and 5°C by end of century under RCP8.5
- Number of hot days expected to increase by 138 days by end of century under RCP8.5

Natural hazards occurrence from 1991-2020³

Hazard	Subtype	Events	Deaths	Affected	Affected per capita per decade
Drought		2	-	38,000	0.69%
	Unstated	2	-	7,475	
Flood	Riverine	6	15	120,602	2.39%
	Flash	1	20	3,500	
Storm	Tropical	-	-	400	0.01%
	Convective	1	-	-	-
Total		12	35	169,977	3.09%

Risk of water scarcity (left)⁴, Risks of extreme heat (right)⁵



ENABLING ENVIRONMENT

Leadership and governance

Climate change (CC) focal point: Department of Meteorological Services, under Ministry of Environment, Wildlife and Tourism

Implementation of CC response policy: Central government. National Climate Change Unit for implementation, monitoring and compliance currently under development

Advisory body to government: National Climate Change Committee

Key adaptation policies

Key policy documents: NAP framework (2020); Climate Change Policy draft (2017); NDC (2016); Botswana Vision 2036 (2016); Integrated Water Resources Management and Water Efficiency Plan (2013); National Water Policy (2012)

Disaster risk management

- Working to integrate an effective disaster management strategy into sectoral policies and programs and to scale efforts across sectors
- Legislation and policies currently coordinated through National Disaster Risk Management Plan (2009)
- **Priorities include:** public awareness and education, improving multi-hazard risk analysis, strengthening early warning systems (EWS) at regional and national level
- **Strategies include:** National Disaster Risk Reduction Strategy 2013–2018 (2013); Africa Regional Strategy for Disaster Risk Reduction (2004); Southern African Development Community's Disaster Risk Reduction Strategy and Plan of Action 2010–2015

ND-GAIN Index⁶

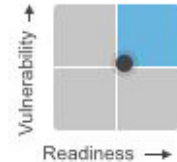
Country Index rank (score): 88 (48.9)

Vulnerability: 0.450

Ecosystem Services 13%, Food 18%, Human Habitat 19%, Health 17%, Infrastructure 19%, Water 13%

Readiness: 0.427

Economic 35%, Governance 49%, Social 15%



ND-GAIN Evolution

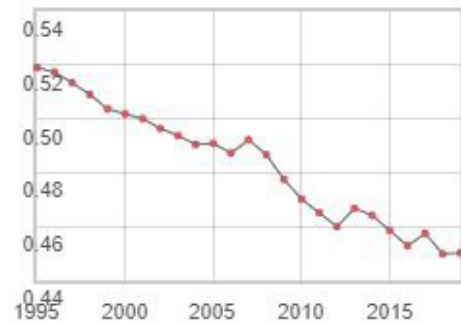


Photo: Lucian Coman/Shutterstock

Botswana

SECTORAL ADAPTATION PLANNING



AGRICULTURE

Rain-dependent, agricultural land (2018): 46% of total land area; most cultivated land is in the eastern region

- **Crops:** sorghum, corn, millet

Main climate change impacts

- Decreased maize & sorghum yields (from 45% to 35% by mid-century) from increasing temperatures and reduced precipitation; decreased recharge & water quality from reduced precipitation
- Increased presence of pests and diseases due to increased temperatures and waterlogging of fields
- Soil erosion and loss of soil fertility due to precipitation seasonality changes
- Droughts and prolonged dry periods will increase soil erosion and exacerbate land degradation, with total annual cost of land degradation estimated at US\$ 353 million, 3.2% of GDP
- Extreme events may change/impact species' composition and alter soil water maintenance, base flows and filtration

Proposed adaptation strategies

- Focus on increasing sustainable crop production and livestock practices such as investment in irrigation structures, conservation agriculture, watershed management, and nutrient and crop management
- Use of more drought-resistant crop varieties; shifting from maize to sorghum to pearl millet
- Diversification of income and greater accessibility of financing options
- Improved livestock diets and genetic characteristics for breeds



WATER

Villages: groundwater reliant

Urban areas: surface water reliant

Main climate change impacts

- Changes in water quality and availability; stream flows for the Okavango catchment expected to decrease by 20%
- Reduced water availability in water-scarce regions (northern, eastern and central) due to increased frequency of droughts, evaporation and evapotranspiration
- Changes in rainfall patterns and evaporation impact the degree of surface water infiltration and recharge rates for groundwater
- Increased soil moisture deficits due to temperature increases, even under conditions of increasing rainfall

Proposed adaptation strategies

- Transboundary water management
- Investment in improved monitoring of irrigation, groundwater wells and aquifers, and investment in water infrastructure
- Increasing pressure on water demands and related infrastructure is expected as development and urbanization occurs. Development planning for urban expansion should be coordinated through CC adaptation strategies to ensure appropriate water management strategies and actions



HEALTH

30% of population exposed to some risks of malaria infection every year, with majority of cases occurring in northern districts of Bobirwa, Tutume, Serowe, Palapye and Boteti

Main climate change impacts

- Malaria infection is influenced by periods of heavy rainfall; risk of malaria expected to increase through the 2050s under a high-emission scenario; increased rainfall variability and extreme events may impact geographic and seasonal distribution of malaria risk
- Vulnerable groups at risk of increased undernutrition and food insecurity if exposed to extreme events
- Increased heat-related deaths, specifically in the elderly (65+ years): Projected increase from ~3 per 100,000 deaths p/y (between 1961 and 1990 baseline) to 136 per 100,000 deaths p/y by 2080s, under RCP8.5 scenario

Proposed adaptation strategies

- Upgrade health-care infrastructure
- Support training and capacity building efforts across the sector
- Support an Integrated Disease Surveillance and Response system
- Improved access and support for social safety nets and public works programs to support food security

Milestones

- Malaria Control Program and Control of Diarrheal Diseases Program have been implemented for combatting CC impacts on health



NEEDS

Research

- Increase understanding of CC vulnerabilities, impacts and possible adaptation responses within key sectors
- Widen participation of public, scientific institutions, women and local communities in planning and management
- Invest in weather stations and expanding national hydro-meteorological and seismological monitoring systems
- Strengthen technical capacity for integrating climate-smart agriculture (CSA) and CC risk management into agriculture sector
- Technology needs assessment to inform adaptation strategies and planning

Institutional

- Ensure that National Environmental Strategy goals are developed within sectoral and regional plans
- Implement cross-sectoral climate-smart solutions at national and subnational levels
- Integrate climate change concerns into relevant policies and planning processes
- Collaborate with climate technology centers for training and information provision to strengthen national capacities

Data and information

- Improve observational data through the addition of weather stations and hydro-meteorological and seismological instrumentation
- Improve technical capacity for analyzing hydro-met data
- Establish institutional capacity for providing timely EWS in coordination with Integrated Disease Surveillance and Response systems
- Promote development of guidelines for green economy transitions

¹WB Climate Change Knowledge Portal (CCKP, 2021). Botswana

²WB Climate Change Knowledge Portal (CCKP, 2021). Botswana Projected Future Climate

³Authors' summary based on CRED EM-DAT database, accessed 10 May 2021: EM-DAT: The Emergency Events Database - Universite catholique de Louvain (UCL) - CRED, D. Guha-Sapir, Brussels, Belgium

⁴ThinkHazard! (2020). Botswana. Water Scarcity

⁵ThinkHazard! (2020). Botswana. Extreme Heat

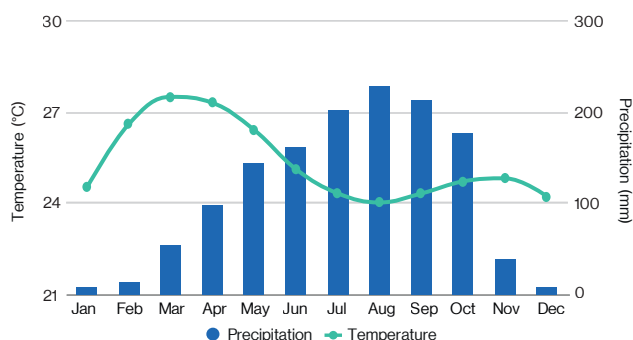
⁶ND-Gain: ND-GAIN Country Index: Botswana

Central African Republic (CAR)

Adapted from the World Bank's Climate Risk Country Profiles Series, 2021

Climate trends

Average monthly Temperature (T) and Precipitation (Ppt), 1991–2020¹



Mean annual T/Ppt (1901–2020): 25.1°C/1396.6 mm
Mean annual max/min T (1901–2020): 31.6°C/18.6°C

Country context

Population	4.7m (2019)	Annual growth rate	1.7% (2019)
GDP	\$470bn (2019)	Annual growth rate	3% (2019)
GDP per capita	\$2.2bn (2019)		

Literacy rate, adult female/male: 26%/50% (2018)
CPIA gender equality rating: 2.5 (2019)
Geography: Landlocked country in central Africa; land area: 623,000 km²
Broad climate: Favorable conditions, primarily hot and humid

Climate projections²

CMIP5 Ensemble Projection	2020 - 2039	2040 - 2059	2060 - 2079	2080 - 2099
Annual Temperature Anomaly (°C)	+0.7 to +1.5 (+1.1°C)	+1.4 to +2.7 (+1.9°C)	+2.3 to +4.2 (+2.8°C)	+3.1 to +5.7 (+3.8°C)
Annual Precipitation Anomaly (mm)	-18.4 to +21.9 (+0.8mm)	-21.0 to +29.6 (+1.7mm)	-21.5 to +38.5 (+3.8mm)	-28.2 to +50.4 (+5.0mm)

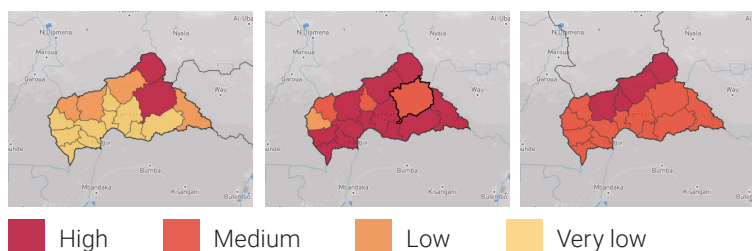
Climate hazards

- Natural hazards dominated by floods, wildfires and droughts. Poverty and political insecurity exacerbate vulnerability to these hazards
- Excess rainfall expected to be strongest in central and southern areas of the country, and is expected to result in flooding, causing riverbank erosion and/or overflows, landslides and waterlogging of agricultural fields leading to likely crop failures
- Climate change (CC) expected to increase risk & intensity of flooding, amount of heavy rainfall received during heavy rainfall events, and likelihood of aridity and water scarcity for some areas
- CC, deforestation, watershed degradation, land use, urbanization and poor management of settlements, slash and burn agricultural techniques have exacerbated issues from flooding and droughts, and increased the risk of wildfires

Climate hazards from 1991–2020³

Hazard	Subtype	Events	Deaths	Affected	Affected per capita per decade
Flood	Unstated	7	7	61,457	0.85%
	Riverine	6	6	40,578	
	Flash	3	3	2,935	
Storm	Unstated	1	-	-	0.20%
	Tropical	-	5	24,476	
	Convective	8	3	-	
Wildfires		2	1	-	0.00%
Landslides		-	-	85	0.00%
Total		27	25	129,531	1.05%

Risk of water scarcity (left), Risk of river flood (centre) and Risks of extreme heat (right)⁴



ENABLING ENVIRONMENT

Leadership and governance

- The Ministry of Environment, Ecology and Sustainable Development is responsible for guiding the country's environmental sustainability plans and climate change responsibilities
- CAR is a member of the Central African Forest Commission (COMIFAC), a treaty organization established to harmonize regional policies on forestry and biodiversity conservation

Key adaptation policies

Key policy documents: NDC (2016); Second National Communications (2015); Law on the Protection of Nature (2015); Environmental Law on Biofuels (2008); Forestry Code (2008); National Adaptation Program of Action (2008); Poverty Reduction Strategy Paper (2007)

Disaster Risk Management (DRM):

- No specific DRM entity wholly responsible for Disaster Risk Reduction (DRR); Ministry of Planning, Economy and International Cooperation has coordinated past efforts
- CAR has partnered with the World Bank and received resources from the GFDRR to develop and conduct risk assessments and institutional capacity building efforts through implementation of short- and medium-term flood mitigation programs
- DRM options include hydro-meteorological services and expansion of observation and forecasting infrastructure to forecast disasters, national Early Warning System (EWS) programs, flood and drought management programs, and riverbank development projects

ND-GAIN Index⁵

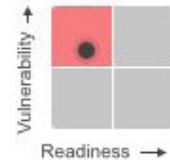
Country Index rank (score): 181 (29.0)

Vulnerability: 0.561

Ecosystem Services 18%, Food 21%, Human Habitat 24%, Health 29%, Water 7%

Readiness: 0.141

Economic 16%, Governance 44%, Social 39%



ND-GAIN Evolution

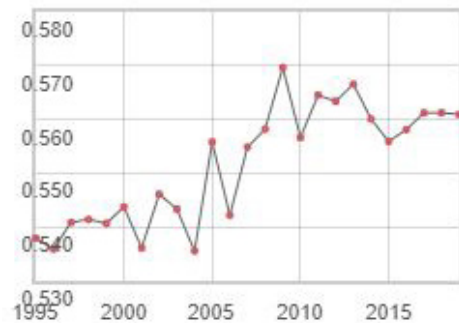


Photo: mbrand85/Shutterstock

Central African Republic (CAR)

SECTORAL ADAPTATION PLANNING



AGRICULTURE

25% of GDP, employs 72% of the population

- 15m ha of agricultural land; 7000km² cultivated p/y
- **Crops:** major staples are beans, maize and cassava

Main climate change impacts

- Extreme rainfall, prolonged dry spells and rising temperatures will impact crop selection and productivity, alter farming practices and pressure farmers to expand cropland into forests
- Rising temperature may increase pest and pathogen dynamics (such as for the cassava mosaic virus) and negatively impact processing/storage of agricultural/perishable products
- Damaged ground transportation infrastructure from floods/rain may increase erosion, raise transport costs, prevent products reaching market before spoiling, negatively impacting farmers
- Planting timelines altered from increased/prolonged dry spells

Proposed adaptation strategies

- Develop and implement environment and agricultural protection policies
- Improve financing mechanisms for small-scale farmers and commercial industries
- Research to increase CC knowledge on the agricultural sector, such as on seasonal information to inform farmers about planting
- Training for farmers to improve sowings and soil quality
- Agricultural extension programmes
- Community involvement for forest ecosystem management
- Improve road & transportation networks for market access
- Crop diversification, establishing seed banks, and promoting sustainable soil management



WATER

Main climate change impacts

- Depends on groundwater & local springs; large availability of water resources but little institutionalised water infrastructure
- Intense rainfall can exacerbate poor water quality especially in urban areas, and increase risk of flooding, pollution, and contamination of drinking water
- Changes in rainfall and evaporation impact surface water infiltration and groundwater recharge, which could decrease reliability of groundwater/surface water sources during droughts
- Increasing temperatures could result in soil moisture deficit, even if rainfall increases

Proposed adaptation strategies

- Mobilization of financial investment opportunities to support key infrastructural investment in water access, irrigation and the potential for hydropower generation
- Comparative assessments and collaborative efforts to support public-private partnerships of sector management
- Improvements to hydro-meteorological forecasting to enhance planning and investment capabilities and for more effective planning and preparation for major rainfall events and flooding
- Research on surface and underground water quality to enhance resource allocation planning
- Adaptation infrastructure to support hydrological variations, to reduce flooding, and improve transport networks
- Improve water management
- Improve supply of potable water



HEALTH

Main climate change impacts

- Increased temperature and rainfall may open new locations suitable for malaria transmission, impacting on lifecycle and habitat of malaria-carrying mosquito and parasites
- Increased temperature and rainfall likely to impact spread of waterborne diseases and emerging infectious diseases
- Higher temperatures, water scarcity, flooding and drought to negatively impact agriculture, leading to increased food insecurity
- Flooding may displace communities and increase the risk of water-borne diseases
- Higher temperatures may threaten food and nutritional security, agricultural livelihoods, and increase heat-related deaths

Proposed adaptation strategies

- Health financing, including the supply of medicines
- Strengthen institutional governance to operationalize health districts, strengthen capacity to manage the district and regional health teams, and organize monitoring and evaluation of service delivery in health facilities at health-district level
- Integrated Disease Surveillance and Response mechanism being reviewed and established
- Human resources observatory being established to develop a human resources plan, including reform of the Health Sciences Faculty and its annexes in the short and longer term



NEEDS

Research

- Increase meteorology, climatology and hydrology teaching in higher education and university
- Research existing resilience mechanisms across sectors
- Develop system for monitoring underground & surface water; establish early warning network for hydrologic hazards & floods
- Strengthen monitoring for environmental management
- Evaluate needs and develop national strategy for technology transfer to support NDC adaptation measures

Institutional

- Establish land-use plans by type of use
- Integrate CC concerns into relevant policies/planning processes
- Finalize and adopt the framework bill on the environment as well as outstanding nature conservation bills
- Finalize regulations to fund and implement impact studies regarding climate change impacts for the country and key sectors

Data and information

- Improve technical capacity to analyze hydro-met data and project impacts across sectors, and establish institutional capacity for timely early warning systems for farmers
- Increase understanding of water resource threats for better long-term management and water use efficiency
- Regulation and enforcement to protect forests, rainforests, and Protected Areas
- Improve data collection on forest loss and land degradation

¹WWBG Climate Change Knowledge Portal (CCKP, 2021). CAR

²WWBG Climate Change Knowledge Portal (CCKP, 2021). Central African Republic Projected Future Climate

³Authors' summary based on CRED EM-DAT database, accessed 10 May 2021: EM-DAT: The Emergency Events Database – Université catholique de Louvain (UCL) – CRED, D. Guha-Sapir, Brussels, Belgium

⁴ThinkHazard! (2020). CAR Overview

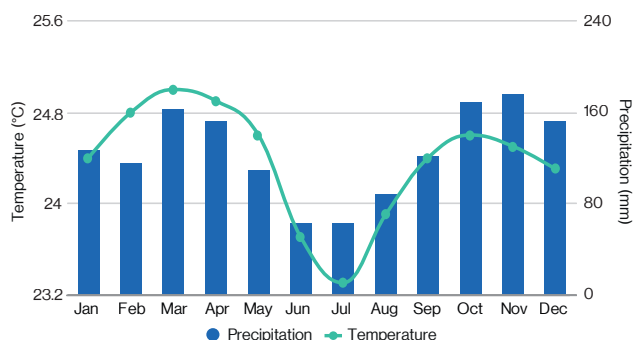
⁵ND-Gain. ND-Gain Index: Central African Republic

Democratic Republic of the Congo (DRC)

Adapted from the World Bank's Climate Risk Country Profiles Series, 2021




Climate trends

Average monthly Temperature (T) and Precipitation (Ppt), 1991–2020¹



Mean annual T/Ppt (1901–2020): 24.1°C; 1,500mm
 Mean annual max/min T (1901–2020): 29.7°C/18.5°C

Country context

 Population 86.7m (2019)	Annual growth rate 3.2% (2019)
 GDP \$50.4bn (2019)	Annual growth rate 4.4% (2019)
 GDP per capita \$424 (2019)	

Literacy rate, adult female/male: 67%/89% (2019)
CPIA gender equality rating: 3.0 (2019)
Geography: Landlocked country on the equator in central Sub-Saharan Africa; contains 62% of the Congo Basin; land area: 2,345,408 km²
Broad climate: North and west in the Congo River Basin: hot and humid; south, central & east: cool and dry

Climate projections²

CMIP5 Ensemble Projection	2020 - 2039	2040 - 2059	2060 - 2079	2080 - 2099
Annual Temperature Anomaly (°C)	+0.5 to +1.4 (+1.0°C)	+1.2 to +2.4 (+1.7°C)	+2.0 to +3.7 (+2.5°C)	+2.7 to +5.1 (+3.5°C)
Annual Precipitation Anomaly (mm)	-13.7 to +21.6 (+2.6mm)	-17.1 to +25.2 (+3.5mm)	-17.0 to +34.0 (+6.7mm)	-17.8 to +44.0 (+10.5mm)

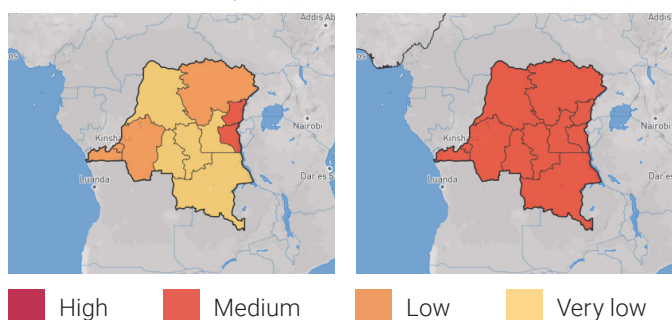
Climate hazards

- Increased rainfall may lead to soil erosion and waterlogging of fields, leading to decreased yields and increased food insecurity
- South especially vulnerable to rising temperature and increased aridity, which will negatively impact water storage capacity
- Deforestation, watershed degradation, land use changes, urbanization and poor management of growing settlements have exacerbated impact from floods, droughts, water scarcity and pollution, limiting water for drinking, agriculture, and other uses
- Heavy rainfall can trigger riverine, coastal and flash floods, especially common in the country's mountain areas and can also trigger landslides and mudslides
- Water drainage systems non-existent and increasing urbanization into flood plains and/or low-lying areas has increased flood risk
- Competing demands between household consumption & agriculture may increase water stress
- Increased heat will further strain water resources, as will impacts from changing rainfall patterns

Climate hazards from 1991–2020³

Hazard	Subtype	Events	Deaths	Affected	Affected per capita per decade
Flood	Unstated	11	275	412,560	0.59%
	Riverine	19	235	513,260	
	Flash	4	206	67,628	
Storm	Unstated	1	17	-	0.04%
	Tropical	1	24	75,000	
	Convective	3	8	-	
Wildfires		3	11	-	0.03%
Landslides		6	280	57,003	0.00%
Total		48	1,056	1,125,451	0.66%

Risk of water scarcity (left)⁴, Risks of extreme heat (right)⁵



ENABLING ENVIRONMENT

Leadership and governance

Sustainable Development Directorate within the Ministry of Environment, Nature Conservation and Tourism

- Responsible for Climate Change (CC) adaptation efforts since early 2000s
- Aims to implement recommendations of the World Commission on Sustainable Development and the COP to the Conventions of Biodiversity, Climate Change and Desertification

Environmental Protection Law

- Promotes mainstreaming of sustainable development issues into policies, plans and programmes across all relevant sectors
- Includes obligation to adopt and implement national measures for adaptation and disaster management

Key adaptation policies

Key policy documents: Climate Change Profile (2018); NDC (2016); Law on the Protection of Nature (2014); Poverty Reduction Strategy Paper (2013); NAPA (2006); NAP (2006)

Disaster Risk Management (DRM):

- Currently working with UNDP on country's first DRM policy
- National Strategic Development Plan (2019–2023) includes climate adaptation and DRM as core pillar
- DRM priorities: improve national capacity to monitor & forecast hazards and transfer this into decision making and planning; strengthen early warning systems; national capacity strengthening; and investments in hydro-meteorological observations

ND-GAIN Index⁶

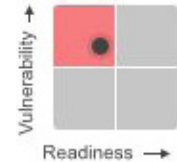
Country Index rank (score): 178 (32.4)

Vulnerability: 0.592

Ecosystem Services 14%, Food 20%, Human Habitat 20%, Health 22%, Infrastructure 11%, Water 12%

Readiness: 0.241

Economic 50%,
Social 49%



ND-GAIN Evolution

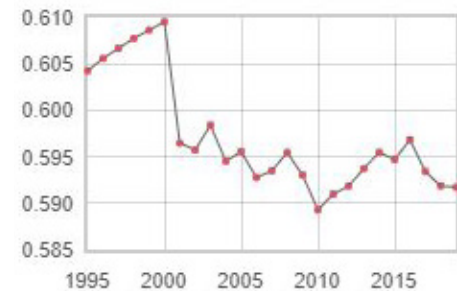


Photo: Travel Stock/Shutterstock

Democratic Republic of the Congo (DRC)

SECTORAL ADAPTATION PLANNING



AGRICULTURE

40% of GDP, employs 70% of the population

- **Arable land:** 80m ha of agricultural land; 12.5% cultivated currently
- **Crops:** Major staples are maize, cassava; other staples: plantains, maize, sweet potato, beans, groundnut, mangoes

Main climate change impacts

- Change in rainfall intensity will damage crops and erode fertile soils, introducing/intensifying crop diseases
- Prolonged dry spells/rising temperatures will reduce yields, pressuring farmers to expand their cropland into forests
- Rising temperatures likely to threaten yield and quality of plantains, soy, dry beans, and coffee
- Prolonged dry spells could lead to significant losses of livestock and/or spoilage of livestock products
- Heavy rainfall and floods may force shifts in the timing of the planting and harvesting seasons, and damage road networks, decreasing access to markets and isolating rural communities

Proposed adaptation strategies

- Research to increase knowledge on CC impacts and improve access to seasonal information to inform timing of planting. Land use zoning plan (in progress) to limit the areas to be allocated specifically to agricultural activities
- Improve transport networks to safeguard market access
- Introduce high-yield crops & improve post-harvest techniques
- Increase funding for agricultural research & extension systems for technologies to be tested and adapted to local environment



WATER

Main climate change impacts

- DRC holds 12,000 km of navigable water and 62% of the Congo Basin. It has one of the highest volumes of freshwater in Africa. However, access to safe water is an issue for rural populations due largely to lack of investment in service provision
- Rising temperatures to impact storage, infiltration, and increase the risk from contaminants
- Rainfall events push rivers and streams beyond their banks, disrupting transportation and damaging infrastructure, and can increase the risk of flooding in rivers, streams and drainage ditches
- Water quality is at risk from more intense rainfall events, especially in urban areas where open sewerage and rubbish can contaminate water sources and increase sedimentation
- Basic sanitation services are limited: an estimated 50 million Congolese lack access to safe water and 80–90% of the population lack access to improved sanitation

Proposed adaptation strategies

- Targeted research to identify water resource challenges and geographic hotspots of risk at community & regional levels
- Hydrological data to address quality of surface and underground water resources
- Target improvement of water infrastructure
- Invest into water management



HEALTH

Main climate change impacts

- In 2014, less than 30% of health facilities were operational
- Damaged sanitation infrastructure through flooding is likely to increase water-borne and diarrheal diseases such as cholera
- Increased forest clearing, leading to increased contact between humans and wildlife, is projected to increase the transmission of Monkeypox virus from wildlife to humans
- Rising temperatures and increased humidity will impact the lifecycle and habitat of malaria-carrying mosquito and parasites
- By 2040, malaria cases are projected to triple; the number of people at risk from endemic malaria projected to increase by 65,000–80,000 in areas where environmental suitability for malaria was previously low

Proposed adaptation strategies

- Investment into climate-sensitive health issues
- Climate vulnerability and risk assessments on human health could help inform priority areas for investments such as health monitoring, and epidemiological tracking of risks and surveillance
- Capacity building of health care to identify diseases as they emerge



NEEDS

Research

- Increase understanding of vulnerabilities and possible adaptation responses
- Improve teaching of meteorology, climatology and general hydrology in higher education and university
- Strengthen monitoring for more effective environmental management
- Rehabilitate the network for collecting meteorological, climatological and hydrological data

Institutional

- Improve National Environment Act
- Integrate CC into policies and planning at state and national levels
- Finalise framework bill on the environment and nature conservation bills, and regulations to fund impact studies on CC on key sectors

Data and information

- Improve technical and institutional capacity for analysing hydro-meteorological data and providing early warning systems to farmers
- Increase understanding of water resources threats and groundwater risks
- Improve regulation and enforcement to protect forests and protected areas; and data collection on forest loss and land degradation

¹WBG Climate Change Knowledge Portal (CCKP, 2021). DRC

²WBG Climate Change Knowledge Portal (CCKP, 2021). DRC Projected Future Climate

³Authors' summary based on CRED EM-DAT database, accessed 10 May 2021: EM-DAT: The Emergency Events Database - Université catholique de Louvain (UCL) – CRED, D.

Guha-Sapir, Brussels, Belgium

⁴ThinkHazard! (2019). Overview: DRC

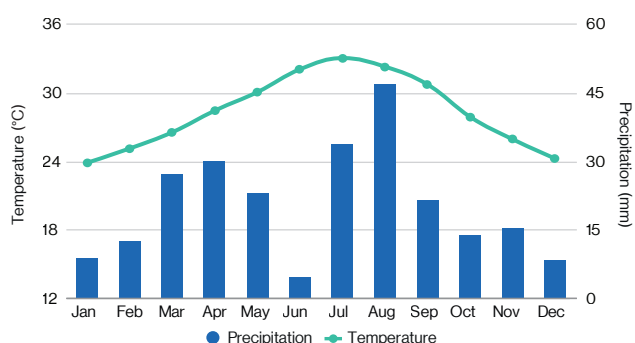
⁵ND-Gain. ND-Gain Index: DRC

Djibouti

Adapted from the World Bank's Climate Risk Country Profiles Series, 2021

Climate trends

Average monthly Temperature (T) and Precipitation (Ppt), 1991–2020¹



Mean annual T/Ppt (1901–2020): 27.8°C; 244.6mm
Mean annual max/min T (1901–2020): 32.2°C/22.5°C

Country context

Population	Annual growth rate
974,000 (2019)	1.5% (2019)
GDP	Annual growth rate
\$3.3bn (2019)	7.5% (2019)
GDP per capita	
\$3,100 (2018)	

Literacy rate, adult female/male: 88.54%/88.29% (2019)

CPIA gender equality rating: 3.0 (2019)

Geography: Located in the Horn of Africa along the Gulf of Aden; land area: >23,000 km², coastline: 372 km; maritime area: 7,190 km²

Broad climate: Arid tropical climate of semi-desert; cool season: mild temperatures, high humidity, sea winds; hot and dry season: high temperatures, hot and dry sand winds

Climate projections²

CMIP5 Ensemble Projection	2020 - 2039	2040 - 2059	2060 - 2079	2080 - 2099
Annual Temperature Anomaly (°C)	+0.6 to +1.4 (+1.0°C)	+1.3 to +2.5 (+1.9°C)	+2.1 to +4.1 (+2.9°C)	+2.6 to +5.4 (+3.8°C)
Annual Precipitation Anomaly (mm)	-8.1 to +20.7 (+2.4mm)	-8.7 to +25.6 (+2.0mm)	-10.3 to +38.0 (+3.2mm)	-10.1 to +49.5 (+7.2mm)

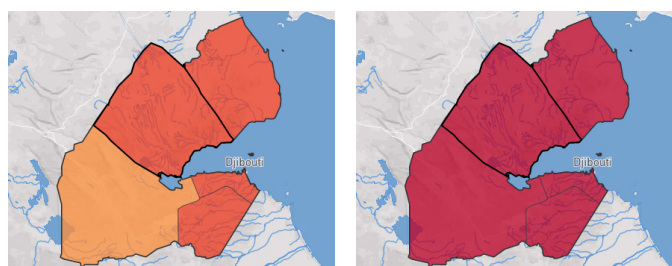
Climate hazards

- An estimated 33% of the population lives in high hazard risk zones
- 35% of the economy is chronically vulnerable to floods and drought; the 2008–2011 drought decreased GDP by 4% and agriculture GDP by 50%, with farmers and herders being the most affected
- Risk and intensity of water scarcity and drought, as well as increased frequency and intensity of extreme rainfall events, is expected to increase under a high emissions scenario
- Average monthly temperatures expected to increase by 1.9°C by 2050s and 5.4°C by end of century
- Sea level rise (SLR) threatens the coastline due to inundation and salinization, increasing risk to port infrastructure and tourism along the coast

Climate hazards from 1991–2020³

Hazard	Subtype	Events	Deaths	Affected	Affected per capita per decade
Drought		6	-	933,008	39.14%
	Unstated	1	8	110,000	
Flood	Riverine	2	145	120,000	24.27%
	Flash	2	62	348,500	
Storm	Unstated	1	2	25,000	
	Tropical	1	-	-	1.08%
	Convective	-	-	775	
Total		13	217	1,537,283	64.49%

Risk of water scarcity (left)⁴, Risks of extreme heat (right)⁵



High Medium Low Very low

ENABLING ENVIRONMENT

Leadership and governance

Climate change (CC) coordination and planning: National Climate Change Committee (CNCC); Secretariat hosted by the Department of Environment and Sustainable Development, within the Ministry of Housing, Urban Planning and Environment. Key priorities of CNCC:

- Water access; promote best practices in agriculture, forestry, fishery and tourism sectors; reduce CC vulnerability for the most exposed sectors; protect and enhance ecosystems and maintain their services; development of sustainable and resilient cities; increase infrastructure resilience and sustainability

Key adaptation policies

Key policy documents: NDC (2016); Strategy of Accelerated Growth and Promotion of Employment (SCAPE) (2015); Vision Djibouti 2035 (2014)

Disaster Risk Management (DRM):

- Working to improve hazards monitoring and communication, specifically for seismic and flood risk, focused around Djibouti City
- Priorities include: strengthening preparedness and response capacities, mainstreaming DRM in land-use planning, increasing awareness and understanding of hazard risk, promoting community-based DRM, disaster risk financing and insurance mechanisms, enhancing early warning systems (EWS)

ND-GAIN Index⁶

Country Index rank (score): 124 (42.4)

Vulnerability: 0.478

Ecosystem Services 19%, Food 18%, Human Habitat 21%, Health 26%, Infrastructure 15%

Readiness: 0.327

Economic 39%, Governance 38%, Social 22%



ND-GAIN Evolution



Photo: Homo Cosmicos/Shutterstock

Djibouti

SECTORAL ADAPTATION PLANNING



AGRICULTURE

Less than 1,000 km² of arable land, 4% of GDP, engages approximately 30% of the population

Main climate change impacts

- Rising temperatures, increasing water scarcity and increased evapotranspiration expected to threaten yields of rainfed crops as well as livestock health
- Increased temperature, sea level rise, and decreased precipitation will exacerbate existing water resources challenges for the sector
- Increase in weeds and diseases due to rising temperatures
- Floods and droughts expected to worsen food security and impact distribution efforts
- Decreased water availability and soil moisture likely to reduce yields and alter suitable areas for agriculture
- Increased evapotranspiration expected to contribute to crop failures and overall yield reductions

Proposed adaptation strategies

- Improve water management capabilities, particularly for water shortages and prolonged periods of drought
- Introduce shaded agro-pastoral perimeters to support agro-pastoral systems
- Increase awareness of diversification options in rural communities
- Increase institutional and sectoral understanding of CC impacts and key adaptation measures



WATER

- High water scarcity, no permanent source of surface water such as rivers or freshwater lakes, relies on deep underground water tables

Main climate change impacts

- Drying up of cisterns and shallow wells during dry season, exacerbated by periods of intense aridity and drought
- Reduced soil moisture, surface water and underground water stocks, and increased desertification due to increases in temperature
- Impact on surface water infiltration and recharge rates for groundwater due to rainfall and evaporation changes

Proposed adaptation strategies

- Improved governance of water points via Community Water Management Committees and Water User Associations
- Building a water pumping plant and aqueducts for conveying water from Ethiopia to supply Ali Sabieh, Dikhil, Arta regions, and Djibouti City
- Improve water management for agro-pastoral resources regarding surface water mobilization
- Repair and construction of tanks for drinking water and livestock, and construction of two small dams
- Sustainable land management for protecting hydraulic infrastructure and regenerating plant cover



COASTAL ZONES AND SEA LEVEL RISE

Coastal zone houses over two-thirds of the population as well as many socio-economic activities

Main climate change impacts

- Coasts are at high risk from sea level rise, coastal erosion and storm surges, with significant retreat of the coastline expected by end of century
- Coastline around and south of Djibouti city at risk of gradual inundation
- Salt water intrusion presents risks specifically for low-lying barriers and river mouths along the country's coastline
- Coastline of the estuaries located between the Eritrean border and Gulf of Tadjoura at risk of erosion

Proposed adaptation strategies

- Construction of coastal protection structures to preserve coastal land and infrastructure
- Rehabilitation efforts of mangroves are ongoing
- Improve management of marine resources as well as develop ecotourism in rural coastal areas
- Increase community awareness about the risks of coastal zone erosion, aquifer salinization and sea level rise



NEEDS

Research

- Increase understanding of vulnerabilities and possible adaptation responses specifically for water resources and sea level rise
- Conduct nationwide water supply, demand and management studies
- Improve cataloging of the fisheries sector to better understand sectoral risks and support local livelihoods along coastal zones
- Widen participation of the public, scientific institutions, women and local communities in planning and management
- Conduct community-level hazard risk assessment
- Strengthen environmental resource management through improved environmental and biodiversity monitoring capabilities
- Increase understanding of coastal zones and SLR impacts specifically for port infrastructure and tourism sectors

Institutional

- Ensure that National Environmental Strategy goals are developed within sectoral and regional plans, in line with financial opportunities with donors
- Develop a national monitoring, reporting and verification (MRV) system
- Consolidate macroeconomic and budgetary frameworks to determine international restraints and opportunities and potential for further economic investment and growth
- Improve understanding of cross-cutting CC impacts
- Improve the validation of mechanisms and tools for continuous evaluation at national, sectoral and regional levels

Data and information

- Develop EWS for hydrometeorological phenomena and improved climate risk management, specifically for SLR, water resources and agriculture and livestock impacts
- Conduct analysis on water transmission infrastructure to determine faults in lines to reduce loss during transport
- Technology transfer, specifically regarding renewable energy and for the construction of geothermal, wind or photovoltaic power plants

¹WB Climate Change Knowledge Portal (CCKP, 2020). Djibouti.

²WB Climate Change Knowledge Portal (CCKP, 2020). Djibouti Projected Future Climate.

³Authors' summary based on CRED EM-DAT database, accessed 10 May 2021: EM-DAT: The Emergency Events Database - Universite catholique de Louvain (UCL) - CRED, D. Guha-Sapir, Brussels, Belgium.

⁴ThinkHazard! (2020). Djibouti – Coastal Flooding.

⁵ThinkHazard! (2020). Djibouti – Extreme Heat.

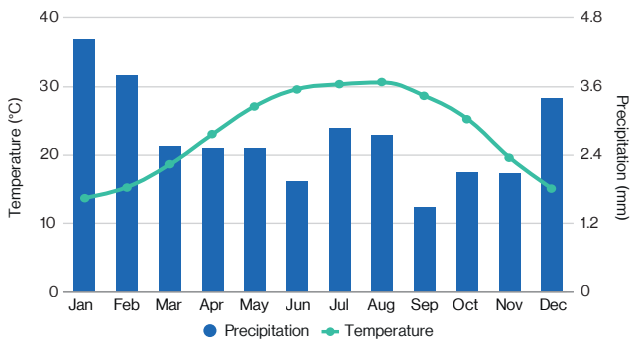
⁶ND-Gain: ND-GAIN Country Index: Djibouti.

Egypt

Adapted from the World Bank's Climate Risk Country Profiles Series, 2021

Climate trends

Average monthly Temperature (T) and Precipitation (Ppt), 1991–2020¹



Mean annual T/Ppt (1901–2020): 22.5°C; 33mm
 Mean annual max/min T (1901–2020): 29.9°C/15.1°C

Country context

Population	100.3m (2019)	Annual growth rate	2% (2019)
GDP	\$250.9bn (2019)	Annual growth rate	5.6% (2019)
GDP per capita	\$2,500 (2019)		

Literacy rate, adult female/male: 66%/77% (2019)
Geography: Located in the northeast of Africa, with the northern border on the Mediterranean Sea. Land area: 995,450 km². Coastline: 3,500 km along the Mediterranean and the Red Sea
Broad climate: Dry, hot, and dominated by desert

Climate projections²

CMIP5 Ensemble Projection	2020 - 2039	2040 - 2059	2060 - 2079	2080 - 2099
Annual Temperature Anomaly (°C)	+0.6 to +1.7 (+1.6°C)	+1.5 to +3.0 (+2.1°C)	+2.4 to +4.5 (+3.3°C)	+3.4 to +6.2 (+4.4°C)
Annual Precipitation Anomaly (mm)	-21.6 to +20.1 (-0.5mm)	-27.3 to +21.0 (-1.9mm)	-26.3 to +26.7 (+1.6mm)	-30.2 to +26.2 (-2.9mm)

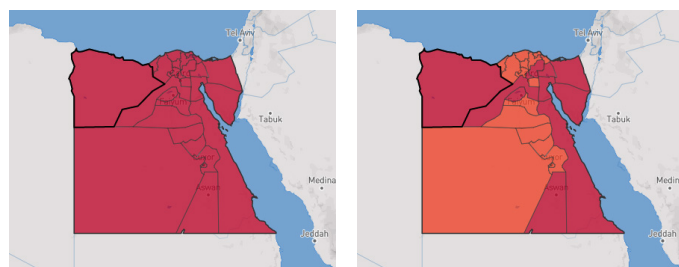
Climate hazards

- Egypt's Nile Delta is recognized as one of the world's three 'extreme' vulnerability hotspots: dependence on the Nile River's water makes Egypt vulnerable to rising temperatures, reduced rainfall for the upper Nile Basins as well as the reduction of rainfall on the east Mediterranean coastal zone
- Sea level rise is projected to lead to the loss of much of the northern part of the Nile Delta due to inundation and erosion, leading to loss of agricultural land, infrastructure and urban areas
- Most of the population and infrastructure are concentrated in the Nile Delta and along the Mediterranean coast, making Egypt additionally vulnerable to sea level rise
- Key sectors impacted include water resources, agriculture, fisheries, health, housing, biodiversity, telecommunications, energy, tourism, and coastal zones
- Increased temperatures and degraded agricultural conditions will adversely affect 'working days', impacting vulnerable groups

Climate hazards from 1991–2020³

Hazard	Subtype	Events	Deaths	Affected	Affected per capita per decade
Flood	Unstated	2	18	-	0.06%
	Riverine	5	638	114,960	
	Flash	3	53	20,260	
Storm	Unstated	1	-	-	0.01%
	Tropical	-	106	32,600	
Extreme temperatures	Convective	5	13	-	0.00%
	Cold	1	3	-	
Total		20	995		0.07%

Risk of water scarcity (left), Risks of extreme heat (right)⁴



High Medium Low Very low

ENABLING ENVIRONMENT

Leadership and governance

- **Climate change (CC) adaptation efforts:** led by the Environmental Affairs Agency and Ministry of State for Environmental Affairs
- The National Committee of Climate Change spearheads UNFCCC implementation and representation
- Other national partners include the Ministry of Foreign Affairs, the Ministry of Water Resources and Irrigation, the Ministry of Agriculture and Land Reclamation, the Ministry of Electricity and Energy, the Ministry of Trade and Industry, Economic Development and Defense, and the New and Renewable Energy Authority

Key adaptation policies

Key policy documents: NDC (2016); Third National Communication (2016); Climate Change Adaptation Strategy (2013); National Strategy for Adaptation to Climate Change and Disaster Risk Reduction (2011); Egypt National Environmental, Economic and Development Study for Climate Change (2010); Egyptian National Action Plan to Combat Desertification (2005)

Disaster Risk Management (DRM):

- Crisis and DRM department established in 2000 at the Information and Decision Support Center of the Egyptian Cabinet of Ministers
- DRM priorities include: strengthening regional coordination and investment in technological innovations to address water scarcity; exploring disaster risk financing and insurance mechanisms; enhancing early warning systems; and building the capacity and financial resources of its Information and Decision Support Center

ND-GAIN Index⁵

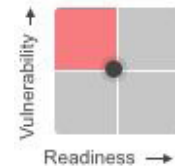
Country Index rank (score): 110 (44.9)

Vulnerability: 0.438

Ecosystem Services 15%, Food 19%, Human Habitat 13%, Health 17%, Infrastructure 17%, Water 18%

Readiness: 0.241

Economic 30%, Governance 35%, Social 34%



ND-GAIN Evolution

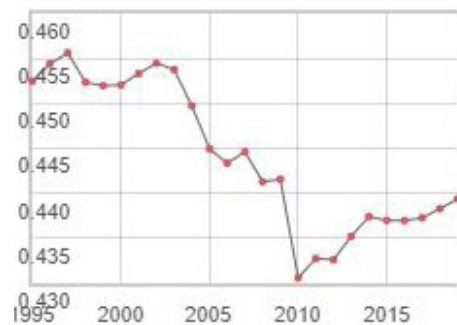


Photo: givaga/Shutterstock

Egypt

SECTORAL ADAPTATION PLANNING



AGRICULTURE

13.5% of GDP, employs 55% of the population

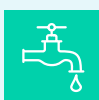
- 2.8% of land is arable; predominantly irrigated
- Agricultural land categorised into: 'Old land', comprising the Nile Valley and Nile Delta, heavily irrigated and intensively cultivated since early civilisations; 80% of the cultivated area. 'New land' is recently reclaimed land; 20% of the cultivated area
- Cultivated field crops include maize, rice, cotton, and sugarcane in the summer, and alfalfa, wheat, barley, green bean, clover, and sugar beet in the winter

Main climate change impacts

- Subsistence dryland farmers vulnerable to CC due to their small scale and reliance on rainfed agriculture and water resources
- Fruit species are grown under marginal chilling conditions and are susceptible to even small temperature increases
- Warming trends expected to adversely impact yields, which will likely result in price increases for rice, wheat, and maize
- As evaporation increases, crops will consume more water leading to decrease in productivity of wheat, maize, rice, tomatoes (staple foods), and sugar cane and milk
- Wheat, rice, maize, and citrus expected to decrease between 10%-20%; cotton yields expected to increase by 20% by the 2060s
- Heat stress from radiation, temperature, humidity and wind speed makes heat dissipation difficult, reducing milk production and reproduction, particularly for dairy cows

Proposed adaptation strategies

- Climate smart agriculture practices, improved water management and early warning systems, and development of new crop varieties and technologies to support farming
- Introduce high-value and drought-resistant crops
- Improve biological diversity of livestock, fishery and poultry
- Agro-economic systems to protect land from degradation



WATER

- Rain falls mainly on the north coast; Egypt is solely dependent on the Nile river for water

Main climate change impacts

- CC may impact River Nile's natural flow: increased evaporation rates from rising temperatures could decrease water availability by up to 70%, or, increased rainfall in the Ethiopian highlands & Blue Nile Basin may increase flows by 15%-25%
- Most of the population lives close to the Nile and are exposed to flood events. The urban poor are particularly vulnerable
- River Nile sources are located outside Egypt, so the country is vulnerable to changing conditions and shocks within and outside its borders
- Rainfall and evaporation changes also impact rates of surface water infiltration and the recharge rates for groundwater. Low water storage capacity increases the country's dependence on unreliable rainfall patterns

Proposed adaptation strategies

- Adaptation actions under implementation: upgrading water quality & sanitation to minimize pollution; constructing new infrastructure for water collection in flash flood areas; increasing use of renewable energy for water desalination, increasing storage of drainage & fresh water in coastal lakes; improving public awareness campaigns on water scarcity & water shortage
- Investment in modern irrigation systems, and developing policies to encourage citizens to use water responsibly



HEALTH

Main climate change impacts

- Dust and sandstorms, expected to increase in severity and frequency, linked to infectious diseases like influenza and pneumonia, and non-infectious diseases like asthma and pulmonary fibrosis
- Indirect health effects from flooding: impact on food production, water provision, ecosystem disruption, infectious disease outbreak and vector distribution
- Diarrheal deaths and heat-related deaths projected to increase
- Vector-borne diseases and respiratory infections, sensitive to shifts in climatological environments, expected to worsen

Proposed adaptation strategies

- Health surveillance, risk mapping, and monitoring systems to address the potential adverse outcomes to health
- Research to identify key health vulnerabilities, such as urban heat islands, as well as vector-borne and communicable diseases
- Raise community awareness about CC induced risks and adaptation options; increase the efficiency of the healthcare sector to improve the capacity for dealing with CC related health concerns



NEEDS

Research

- Improve understanding of CC-related vulnerabilities and adaptation responses, and enhance public, community and institutional participation in adaptation planning
- Invest in risk assessments, particularly in coastal zones
- Research on vulnerabilities and adaptation of biodiversity
- Strengthen technical capacity to integrate climate-smart agriculture and CC risk management into agriculture sector
- Design and implement a Technology Needs Assessment

Institutional

- Integrate National Environmental Strategy goals within sectoral and regional plans and in line with financial opportunities with donors
- Institutionalise systematic observations of sea surface temperature, coastal land use & sea level variations to ensure availability of results for scientific community and policymakers
- Implement cross-sectoral climate-smart solutions at national & subnational levels for agriculture & water management sectors

Data and information

- Map agricultural products for more effective land use
- Improve early warning systems for water management
- Enhance nation-wide CC and atmosphere monitoring systems

¹WB Climate Change Knowledge Portal (CCKP, 2020). Egypt

²WB Climate Change Knowledge Portal (CCKP, 2020). Egypt Projected Future Climate

³Authors' summary based on CRED EM-DAT database, accessed 10 May 2021: EM-DAT: The Emergency Events Database - Université catholique de Louvain (UCL) - CRED, D. Guha-Sapir, Brussels, Belgium

⁴ThinkHazard! (2020). Egypt: Overview

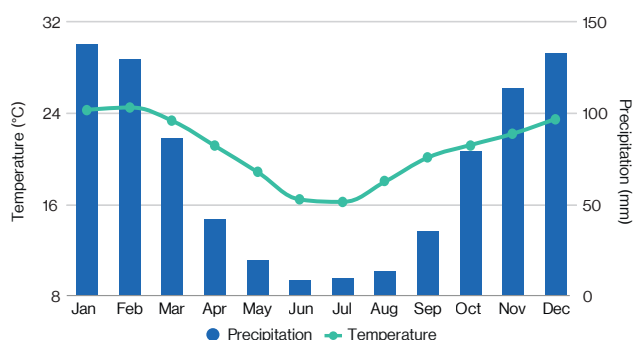
⁵ND-Gain. ND-Gain Index: Egypt

Eswatini

Adapted from the World Bank's Climate Risk Country Profiles Series, 2021

Climate trends

Average monthly Temperature (T) and Precipitation (Ppt), 1991–2020¹



Mean annual T/Ppt (1901–2020): 20.7°C / 810.8mm
Mean annual max/min T (1901–2020): 27°C/14.6°C

Country context

Population
1.16m (2019)

GDP
\$3.9bn (2020)

GDP per capita
\$3,400 (2020)

Annual growth rate
1% (2019)

Annual growth rate
-1.6% (2020)

Literacy rate, adult female/male: 88.54%/88.29% (2018)

Geography: Situated in southeastern Africa, total land area: 17,360 km²

Broad climate: Subtropical with wet hot summers and cold dry winters

Climate projections²

CMIP5 Ensemble Projection	2020 - 2039	2040 - 2059	2060 - 2079	2080 - 2099
Annual Temperature Anomaly (°C)	+5.1 to +1.48 (+0.97°C)	+1.23 to +2.40 (+1.75°C)	+2.17 to +3.73 (+2.79°C)	+3.04 to +5.15 (+3.82°C)
Annual Precipitation Anomaly (mm)	-26.03 to +27.56 (0.29mm)	-30.45 to +27.75 (-1.96mm)	-32.11 to +31.08 (-0.06mm)	-37.25 to +32.71 (-1.13mm)

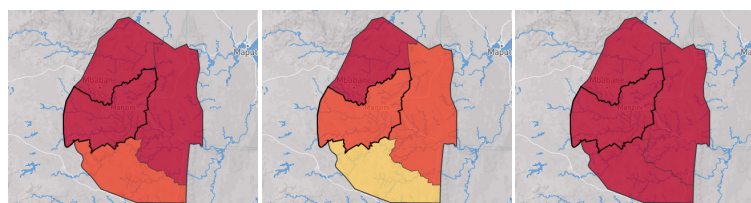
Climate hazards

- Eswatini is at high risk of natural hazards, which are expected to primarily affect the agricultural sector through seasonal flooding and periods of drought
- Changes in rainfall regimes, including heavy rainfall events and extreme weather conditions, as well as land degradation and resulting erosion, are also expected to have increasingly adverse effects on agricultural production
- Eswatini is at high risk to river flooding as well as urban flooding and wildfire, which will impact project design, construction and infrastructure development, and have potential health ramifications on the population
- Increased heat will further strain existing water resources, increase evapotranspiration and impacts from changing rainfall patterns

Climate hazards from 1991–2020³

Hazard	Subtype	Events	Deaths	Affected	Affected per capita per decade
Drought		4	-	2,104,000	67.69%
Flood	Riverine	2	-	274,500	8.84%
	Flash	1	11	400	
Storm	Unstated	2	-	-	0.24%
	Convective	-	1	7,425	
Wildfires		1	2	-	0.05%
Total		10	14	2,387,825	76.82%

Risk of river flood, urban flood and wildfires (left to right)⁴



High Medium Low Very low

ENABLING ENVIRONMENT

Leadership and governance

Institutionalization of climate change (CC) issues and processes:

- Eswatini Meteorological Services, under the Ministry of Tourism and Environmental Affairs, which also houses the National UNFCCC Focal Point

Development and coordination of adaptation programs and projects, and education and public awareness campaigns:

- National Climate Change Committee (NCCC)

Additional partnerships include the University of Eswatini, the Eswatini Water and Agricultural Development Enterprise, the Eswatini Water Services Corporation, and the Eswatini Electricity Company

Key adaptation policies

Key policy documents: NDC 2016; Third National Communication to the UNFCCC (2016); National Sustainable Energy for All, Country Action Plan (2014); Comprehensive Agricultural Sector Policy (2005); National Food Security Policy for Eswatini (2005); National Biodiversity Conservation and Management Policy (2001)

Disaster Risk Management (DRM):

- Working to implement a drought monitoring and early warning system, produce drought vulnerability profiles and related costs, design drought contingency plans, and establish risk financing measures for affected communities
- Key policies and frameworks include: National progress report on the implementation of the Hyogo Framework for Action (2013–2015), Disaster Management Act (2006), and the National Disaster Preparedness and Response Plan

ND-GAIN Index⁵

Country Index rank (score): 139 (40.4)

Vulnerability: 0.512

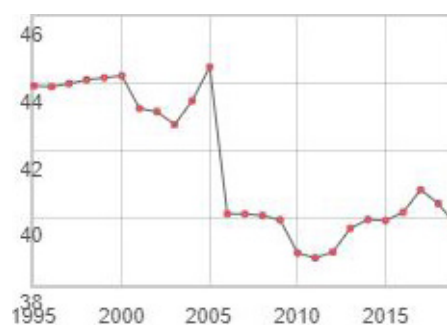
Ecosystem Services 20%, Food 21%, Human Habitat 19%, Health 22%, Water 17%

Readiness: 0.321

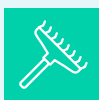
Economic 31%, Governance 44%, Social 24%



ND-GAIN Evolution



SECTORAL ADAPTATION PLANNING



AGRICULTURE

11% of GDP; occupies 75% of cropland

Main climate change impacts

- Projected decrease in precipitation may determine if certain crops or farm practices remain viable, and if reduced water availability might require a shift to more drought-resistant crops or if farmers are required to shift investments into irrigation
- Changes in precipitation provides a critical background to understand which other factors can become important, such as the temporal gaps between individual rainfall episodes, the availability of water during critical times of the seasonal cycle, or the intensity of individual rainfall events
- As temperatures increase, daily maximum temperatures may offer insights on these upper thresholds for specific crops, translating these potentially into changing yields

Proposed adaptation strategies

- Increase contribution of agriculture to economic development, and focus on poverty reduction to make poorer farming households more resilient to anticipated climatic changes
- Specific activities: conservation tillage, crop diversification, greenhouse farming, hydroponics, livestock selective breeding, micro irrigation and organic farming
- Crop production: shifting planting periods, growing of drought-tolerant crops, and raising suitable crops in appropriate regions
- Adaptation in livestock production: raising dairy cattle mainly in the Highveld and wet Middleveld which is typically cooler
- Invest in agricultural development opportunities to reduce the country's food insecurity



WATER

Primary water sources are surface water

- Seven river catchment/drainage systems are the Komati, Lomati, Mbuluzi, Usutu, Ngwavuma, Pongola and Lubombo
- Irrigation uses 95% of surface water resources

Main climate change impacts

- Grasslands likely impacted by decreasing water availability, impacting vegetation, biodiversity & people's livelihoods
- Riskier agricultural production environment from increased temperatures will result in greater cropland evapotranspiration, resulting in an arid production environment reliant on already stressed and deficient water resources
- Increasing number of consecutive dry days will increase evaporation and stress limited water resources, affecting irrigation
- Changing rates of surface water infiltration & groundwater recharge will reduce reliability of unimproved groundwater and surface water sources during droughts or prolonged dry period

Proposed adaptation strategies

- Align national climate change policy with the National Water Policy and Water Act (2003)
- Develop water pricing structures to encourage efficient water use as well as reduce consumption throughout the value chain
- Integrate water resource management systems across all sectors, including land use and the environment
- Artificial groundwater recharge, integrated river basin management, leakage detection systems, scaled use and access for rainwater harvesting mechanisms, sand dams, solar pumps for borehole water pumping, and water recycling and reuse



HEALTH

Main climate change impacts

- Increasing temperatures and changing precipitation patterns will affect the basic requirements for maintaining a healthy population requiring clean air and water and sufficient food
- Catastrophic weather events, variation in weather systems that affect food and water supplies, ecosystem changes all pose health risks
- These risks may result in increased deaths due to heat waves, and natural hazards such as floods, vector-borne diseases such as malaria, and other existing and emerging infectious diseases
- Record high temperatures and increased night temperatures can result in decreased opportunity for natural cooling

Proposed adaptation strategies

- Develop and/or implement a health adaptation strategy for CC
- Increase awareness and understanding of relationship between CC and health impacts through training of personnel
- Increase in training & capacity to improve level of knowledge and skills to prevent diseases connected with climatic factors
- Improve monitoring and surveillance systems to allow observations of trends and make advance forecasts to direct interventions against climate-sensitive diseases
- Increased investment, and climate-health-adaptation research agenda, to support the identification and analysis of trends and develop indicators to improve health sector capacity to react



NEEDS

Research

- Improve science-based understanding of the nature and magnitude of physical and biophysical climate change impacts
- Improve understanding of key vulnerabilities, development impact, cost, and adaptation needs
- Widen participation of the public, scientific institutions, women and local communities in planning and management

Institutional

- Upscale construction of small dams and enable communities to use captured water to produce crops
- Implement cross-sectoral climate-smart solutions
- Establish a National Steering Committee on Climate Change to ensure the integration of low-carbon, climate-resilient considerations into development planning
- Establish Regional Southern African Steering Committee on Climate Change to serve as a platform for continuous coordination of regional efforts to address and adapt to CC

Data and information

- Improve collection of observational data through addition of weather stations and hydro-meteorological instrumentation
- Establish early warning systems for dangerous hydro-meteorological phenomena and climate risk management
- The National Meteorology Department should produce simplified versions of seasonal weather forecast reports
- Train agricultural extension officers on CC issues, as well as in interpreting seasonal weather reports

¹WBG Climate Change Knowledge Portal (CCKP, 2021). Eswatini

²WBG Climate Change Knowledge Portal (CCKP, 2021). Eswatini Projected Future Climate

³ThinkHazard! (2020). Eswatini: Overview

⁴Authors' summary based on CRED EM-DAT database, accessed 10 May 2021: EM-DAT: The Emergency Events Database - Universite catholique de Louvain (UCL) - CRED, D. Guha-Sapir, Brussels, Belgium

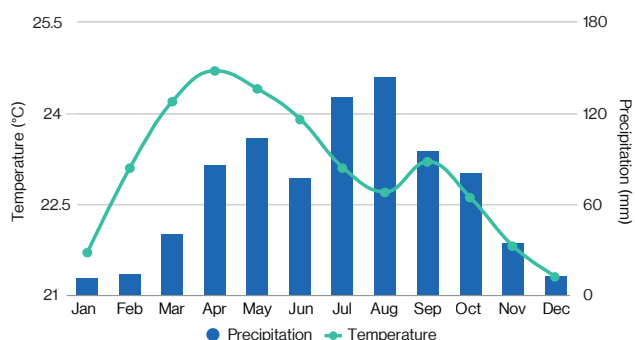
⁵ND-Gain. ND-Gain Index: Eswatini

Ethiopia

Adapted from the World Bank's Climate Risk Country Profiles Series, 2021




Climate trends

Average monthly Temperature (T) and Precipitation (Ppt), 1991–2020¹



Mean annual T/Ppt (1901–2020): 22.6°C; 815.8 mm
Mean annual max/min T (1901–2020): 29.5°C/15.8°C

Country context

 Population 112m (2019)	Annual growth rate 2.6% (2019)
 GDP \$95.5bn (2019)	Annual growth rate 8.4% (2019)
 GDP per capita \$4,300 (2019)	

Literacy rate, adult female/male: 89%/88% (2019)
Geography: Landlocked country in northeast Africa; land area: 1,104,300 km²
Broad climate: South & southwest: equatorial rainforest, high rainfall and humidity; northeast, east & southeast lowlands: desert-like conditions

Climate projections²

CMIP5 Ensemble Projection	2020 - 2039	2040 - 2059	2060 - 2079	2080 - 2099
Annual Temperature Anomaly (°C)	+0.6 to +1.5 (+1.0°C)	+1.2 to +2.6 (+1.8°C)	+2.1 to +4.0 (+2.8°C)	+2.8 to +5.5 (+3.7°C)
Annual Precipitation Anomaly (mm)	-14.4 to +21.2 (+2.2mm)	-16.8 to +27.4 (+3.1mm)	-18.8 to +37.6 (+6.0mm)	-17.5 to +50.0 (+9.7mm)

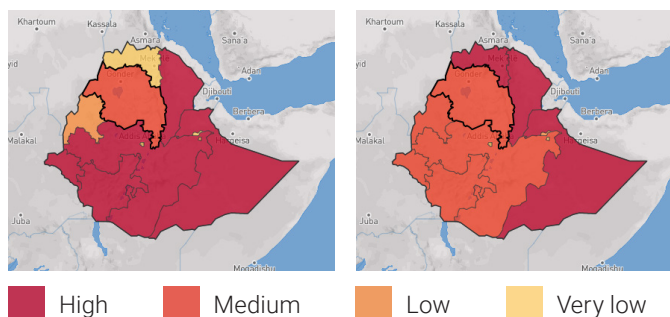
Climate hazards

- Drought is the single most destructive climate-related natural hazard in Ethiopia with the southern and eastern parts of the country often severely hit; recent major droughts have reduced the country's GDP by 1% to 4%
- Average number of hot days per year projected increase: 19–40% of days by the 2060s; 26–69% of days by the 2090s
- Floods regularly cause crop and infrastructure damage and contribute to widespread land degradation
- Expected 20% increase in extreme high rainfall events by the end of century
- Other primary environmental problems are soil erosion, deforestation, desertification, and loss of biodiversity and wildlife

Climate hazards from 1991–2020³

Hazard	Subtype	Events	Deaths	Affected	Affected per capita per decade
Drought		10	-	49,691,879	21.10%
	Unstated	10	86	516,630	
Flood	Riverine	29	1,096	1,376,297	1.24%
	Flash	8	863	1,029,182	
Wildfires		1	-	-	0.00%
Land-slides		7	115	-	0.00%
Total		65	2,160	52,613,988	22.34%

Risk of river flood (left)⁴, Risks of extreme heat (right)⁵



ENABLING ENVIRONMENT

Leadership and governance

Disaster risk management (DRM) leadership:

- Disaster Management and Food Security Sector under the Ministry of Agriculture

Management of climate finance flows:

- Climate Resilient Green Economy (CRGE) Secretariat

Implementation of CRGE strategy: Ministry of Agriculture and Natural Resources, Ministry of Industry, Ministry of Mines, Petroleum and Natural Gas, Ministry of Transport, Ministry of Urban Development, Housing and Construction, and Ministry of Water, Irrigation and Electricity

Provision of guidance and sector-specific support: Commission of Environment, Forest and Climate Change and the Ministry of Finance and Economic Cooperation

Key adaptation policies

Key policy documents: Updated NDC (2021); NAP (2019); Multi Sector Investment Plan for Climate Resilient Agriculture and Forest Development 2017–2030; Growth and Transformation Plan (GTP II) (2016); Climate Resilient Green Economy (CRGE) Strategy (2011)

Disaster Risk Management:

- National Policy and Strategy on Disaster Management (2007)
- Disaster Risk Management Strategic Program and Investment Framework (2007)
- Climate Change National Adaptation Program of Action (2007)

ND-GAIN Index⁶

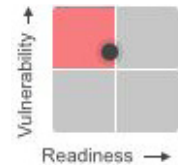
Country Index rank (score): 157 (37.8)

Vulnerability: 0.559

Ecosystem Services 14%, Food 18%, Human Habitat 18%, Health 23%, Infrastructure 11%, Water 15%

Readiness: 0.315

Economic 38%, Governance 37%, Social 24%



ND-GAIN Evolution

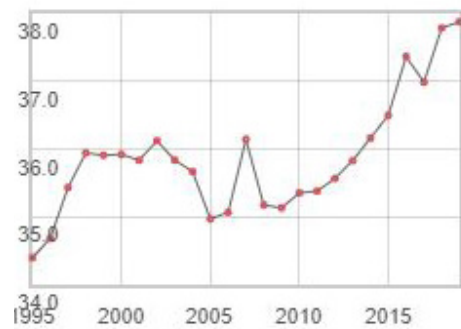
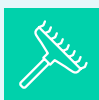


Photo: ivepoint six/Shutterstock

Ethiopia

SECTORAL ADAPTATION PLANNING



AGRICULTURE

34% of GDP; rain dependent; agricultural land: 71.05% of land area; 1% of all cultivated land is irrigated
Smallholder farming households account for approximately 95% of agricultural production and provide around 85% of all employment

Main climate change impacts

- Loss of arable land due to recurring drought and increased desertification, resulting in increased dependence on food aid
- Decreased recharge and quality of ground and surface water supply due to reduced precipitation
- Increased presence of pests and diseases due to increased temperatures and waterlogging of fields
- Increased soil erosion and loss of soil fertility due to changes in seasonality of precipitation and intense rainfall and flooding
- Heat stress impacts on livestock through reduced milk production and reproduction in dairy cows
- Reduced crop yields and crop failure due to increased heat and water scarcity conditions (further exacerbated by resulting increased evapotranspiration)
- Decreased productivity due to land degradation and soil erosion, exacerbated by recurrent flood and drought

Proposed adaptation strategies

- Improved water capture and storage, and investments in irrigation structures, particularly in more arid agricultural areas
- Conservation practices regarding soil erosion, watershed management, and nutrient and crop management
- Semi-stabled cattle systems in highland agricultural areas
- Diversification of income through more accessible financing options such as climate insurance schemes, safety net programs and food security initiatives
- Improved weather monitoring network and weather information systems, and improved data dissemination



WATER

Sources include 12 river basins with groundwater potential of approximately 2.6bn m³

Main climate change impacts

- Changes in rates of surface water infiltration and groundwater recharge due to changing rainfall and evaporation rates, exacerbating impacts of unreliable and unimproved water sources during droughts or prolonged dry seasons
- Reduced water availability in water-scarce regions (particularly southern, eastern and central areas) due to increased frequency of droughts, increased evaporation and evapotranspiration, and changes in rainfall patterns and runoff
- Increased soil moisture deficits due to rising temperatures, even under conditions of increasing rainfall
- Increased water contamination of surface sources and shallow wells due to storms and flooding
- Despite progress in water, sanitation and hygiene services, decreased availability and/or compromised quality of surface water supply will heighten vulnerabilities

Proposed adaptation strategies

- Investments to support existing monitoring of groundwater wells and aquifers, improve water management infrastructure and alignment with sanitation and quality
- A water resources management policy to enhance and promote national efforts towards the efficient, equitable and optimum utilization of water resources
- National Irrigation Policy objectives include increasing irrigated surfaces and improving their management



HEALTH

75% of the population lacks access to clean water, 80% live without adequate sanitation; 50% live over 10 km from the nearest health facility

Main climate change impacts

- Expanded range of malaria to highland areas from increased temperatures
- Increased flooding may spread more water-borne diseases
- Over 70,000 deaths annually are tied to indoor and outdoor air pollutants, which a hotter, more drought-prone climate will aggravate

Examples of adaptation strategies

- Extensive health system reviews to identify and prioritize highly vulnerable areas and population segments
- Adopting standardized international methodologies and links with meteorological and geographic information systems (GIS) for strengthened monitoring and improved forecasting

Milestones

- Ethiopia's Growth and Transformation Plan II has emphasized improved implementation of environmental and health services in poor, rural and urban areas



NEEDS

Research

- Increase understanding of vulnerabilities and possible adaptation responses
- Widen participation of the public, scientific institutions, women and local communities in planning and management
- Strengthen technical capacity to integrate climate-smart agriculture and climate change risk management

Institutional

- Ensure that National Environmental Strategy goals are developed within sectoral and regional plans
- Implement cross-sectoral climate-smart solutions at national and subnational levels
- Integrate climate change concerns into relevant policies and planning processes

Data and information

- Improve observational data through the addition of weather stations and hydro-meteorological instrumentation
- Establish institutional and technical capacity for providing timely early warning systems

Other

- Cross-sectoral integration of development and adaptation planning

¹WBG Climate Change Knowledge Portal (CCKP, 2021). Ethiopia.

²WBG Climate Change Knowledge Portal (CCKP, 2021). Ethiopia Projected Future Climate

³Authors' summary based on CRED EM-DAT database, accessed 10 May 2021: EM-DAT: The Emergency Events Database - Université catholique de Louvain (UCL) - CRED, D. Guha-Sapir, Brussels, Belgium.

⁴ThinkHazard! (2020). Ethiopia River Flood.

⁵ThinkHazard! (2020). Ethiopia Extreme Heat

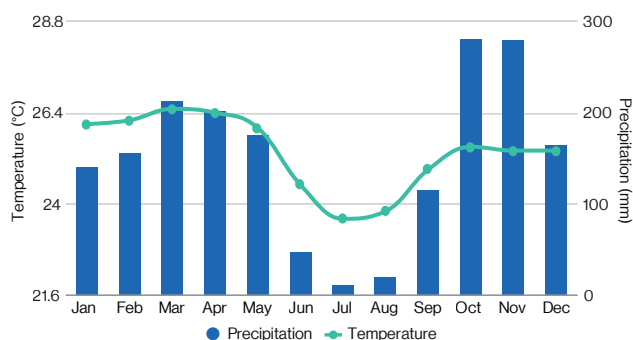
⁶ND-Gain: ND-GAIN Country Index: Ethiopia

Gabon

Adapted from the World Bank's Climate Risk Country Profiles Series, 2021

Climate trends

Average monthly Temperature (T) and Precipitation (Ppt), 1991–2020¹



Mean annual T/Ppt (1991–2020): 25°C/1,800 mm
Mean annual max/min T (1991–2020): 29.4°C/20.9°C

Country context

Population	2.2m (2019)	Annual growth rate	2.5% (2019)
GDP	\$16.6bn (2019)	Annual growth rate	3.4% (2019)
GDP per capita	\$7,800 (2019)		

Literacy rate, adult female/male: 44%/59% (2017)
CPIA Gender Equality Rating: 3.5 (2019)

Geography: Located in West Africa; coastal border runs along the Atlantic Ocean south of Bight of Biafra; land area: 268,000 m²

Broad climate: Tropical region, moist & hot

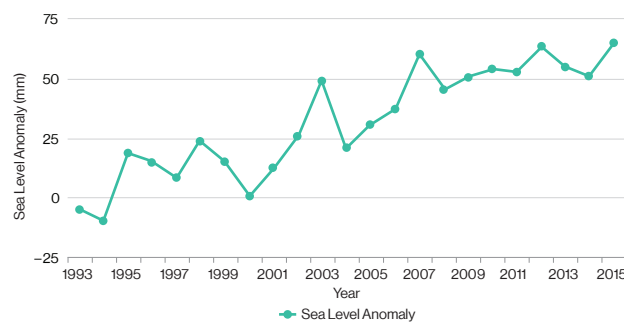
Climate Projections²

CMIP5 Ensemble Projection	2020 - 2039	2040 - 2059	2060 - 2079	2080 - 2099
Annual Temperature Anomaly (°C)	+0.6 to +1.3 (+0.9°C)	+1.3 to +2.3 (+1.6°C)	+2.0 to +3.6 (+2.5°C)	+2.7 to +4.8 (+3.3°C)
Annual Precipitation Anomaly (mm)	-18.2 to +30.6 (6.2mm)	-15.1 to +52.7 (17.0mm)	-7.3 to +80.5 (31.5mm)	-12.0 to +87.3 (37.7mm)

Climate hazards

- Rising temperatures and extreme weather events are expected to impact agriculture & water sectors, and wider population health. Rural communities, the poor and elderly are at particular risk
- Coastal, urban & riverine floods are high-hazard. Life-threatening, damaging river floods expected at least once in the next 10 years
- Flood-risk regions are concentrated in central Gabon along Ogooué river with 2 hotspots: Ogooué-Ivindo and Moyen-Ogooué provinces. River flooding expected as an immediate and long-term hazard for rural and urban areas
- Sea level rise and coastal area flooding may impact coastal cities by damaging infrastructure (e.g., the port of Gentil is only 4m above sea level), and oil extraction operations

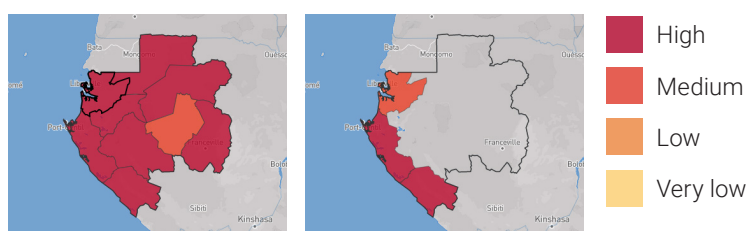
Sea level rise³



Climate hazards from 1991–2020⁴

Hazard	Subtype	Events	Deaths	Affected	Affected per capita per decade
Flood	Riverine	1	1	77,845	1.81%
Storm	Tropical	-	-	3,530	0.08%
	Convective	3	-	-	
Total		4	1	81,375	1.90%

River flood risk (left) and coastal flood risk (right)⁵



ENABLING ENVIRONMENT

Leadership and governance

- Climate change (CC) strategies led by Ministry of Forests, Water, Fisheries and the Environment and the Protection of Nature
- Member to the Central African Forests Commission (COMIFAC)
- National Council on Climate Change and its Climate Change Communication Committee established in 2010, prepares and manages the National Climate Plan

Key adaptation policies

Key policy documents: NDC (2016); Second National Communication the UNFCCC (2011); National Strategy on Coastal Adaptation to Climate Change (2013); National Climate Plan (2012)

Disaster Risk Management (DRM):

- No sectoral risk assessments, or functional data flow mechanism to understand impact of hazards
- Working to establish scientific and technical expertise within the Disaster Management Agencies
- Department of Disasters to scale up operational capacities and collaboration across existing sectors, and institute contingency plans and procedures

ND-GAIN Index⁶

Country Index rank (score): 116 (43.6)

Vulnerability: 0.418

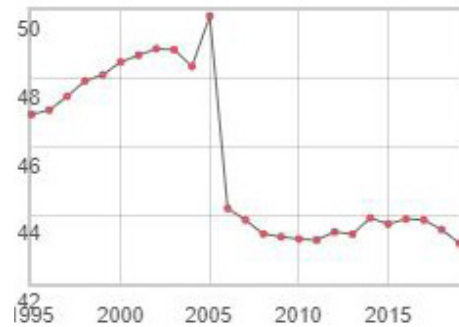
Ecosystem Services 19%, Food 19%, Human Habitat 29%, Health 17%, Infrastructure 6%, Water 15%

Readiness: 0.289

Economic 24%, Governance 41%, Social 24%

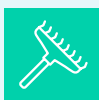


ND-GAIN Evolution



Gabon

SECTORAL ADAPTATION PLANNING



AGRICULTURE

5% of GDP; employs 20% of the population (2014)

- Relies on food imports for majority of domestic food consumption sourced from France, South Africa and Cameroon
- 22m ha of forest; 1m ha (5%) of arable land

Main climate change impacts

- Changes in temperature and precipitation expected to impact composition of soil, erosion, and balance of micro-organisms
- Increased temperatures will stress crops and alter the length of growing seasons and increase likelihood of pests and fire; water scarcity likely to increase evapotranspiration
- Droughts and dry periods will exacerbate land degradation

Proposed adaptation strategies

- Irrigation to minimise CC impacts; research to define climate thresholds for local crops; Improved technical capacity for traditional cultivation practices
- Soil protection & restoration measures to improve soil fertility
- Enhance non-timber forest products



WATER

Main climate change impacts

- Increased rainfall may impact discharge, intensity, time period/frequency of floods & droughts, soil humidity, ground water recharge, and amount of water flowing through rivers
- This may impact vegetation, marshlands, fish population distributions, and water-borne diseases
- Flooding may damage sanitation infrastructure and spread faecal waste through flood water

Proposed adaptation strategies

- Dikes/flood protection to control water flow & protect embankments; dams/basins to increase water storage capacity
- Dredging to reduce water flow resistance, and enlarging waterways for lower water levels and improved navigability
- Early Warning Systems (EWS) to manage rapid water rise (e.g., in the Ogooué Basin); flood risk prevention plans and mapping to identify at-risk areas
- Social protection measures for populations living in at-risk areas
- Integrating climate resilience into technical designs, management and operation of water and sanitation systems
- Develop national database and rainfall-runoff models to project the effects of rainfall changes (for climate variability and CC) on runoff and discharges (including peak and low flows)



COASTAL ZONE AND SEA LEVEL RISE

Maritime area: 265,000 km²; territorial sea of 12 nautical miles

Main climate change impacts

- Increase in sea surface temperature, ocean acidification, decline in oxygen content, sea level rise, and increased ultraviolet exposure will adversely affect marine organisms and associated ecosystem goods & services derived from them, like fisheries

Proposed adaptation strategies

- Construction and expansion of embankments, dikes and walls along the sea front from Pointe Clairette to Pointe Iguri
- Beach recharging from Cape Lopez to Pointe Ozouri
- Backfilling of the lowlands inland along the Atlantic coastline and the deltaic plain of Mbéga-Mandorové
- Invest in municipalities for water treatment infrastructure
- Research to define sea level rise, ongoing coastal erosion, and increasing risk of salinization of fresh water sources
- Better coastal resources management



HEALTH

Main climate change impacts

- More frequent heat waves will threaten human health, particularly for the elderly and chronically ill
- Major health risk from climate variability will be the projected increase in water-borne diseases
- Projected temperature increase will present more conducive environments for bacteria, pathogens & vector borne diseases
- Warmer and drier conditions may favor spread of diseases borne by food or water, such as diarrhoea and dysentery

Proposed adaptation strategies

- Training and capacity building of healthcare personnel on adaptation to CC to mitigate negative health impacts; general awareness campaigns on CC and health for vulnerable groups
- EWS for timely information on effects of atmospheric state on organisms; biometeorological forecasts to provide daily public information on expected meteorological conditions to give reliable advice on health protection and symptoms prevention
- Strengthen screening for river blindness and improved drinking water purification and delivery systems
- Research on links between population displacement, human health and the risks of climate-related diseases



NEEDS

Research

- Data collection on the nature and magnitude of CC impacts under differing scenarios, specifically for health sector and coastal zones
- Risk assessments to understand indicators of CC impacts to define key vulnerabilities in the energy, agriculture and fisheries sectors
- Develop monitoring and evaluation systems to observe changes to coastlines and land usage
- Widen the participation of public, scientific institutions, women and local communities in planning and management
- Invest in technical improvements to national hydrometeorological observation equipment, networks and technical analysis capabilities

Institutional

- Establish institutional capacity for providing timely early warning systems
- Coordinate the activities of various actors and sectors, including government agencies, ministries, and private entities and firms
- Integrate climate into national planning: sectoral plans should be developed for the next 20–30 years and beyond

Data and information

- Improve meteorological database and weather service capabilities, especially coastal storm detection
- Improve data availability for key sectors such as agriculture, tourism, water resources, and others, to estimate future CC impacts
- Make data openly available and paid for by the public budget

¹WBG Climate Change Knowledge Portal (CCKP, 2021). Gabon

²WBG Climate Change Knowledge Portal (CCKP, 2021). Gabon Projected Future Climate

³WBG Climate Change Knowledge Portal (CCKP, 2021). Climate Risk Country Profile: Gabon

⁴Authors' summary based on CRED EM-DAT database, accessed 10 May 2021: EM-DAT: The Emergency Events Database - Université catholique de Louvain (UCL) - CRED, D. Guha-Sapir, Brussels, Belgium

⁵ThinkHazard! (2020). Gabon: Overview

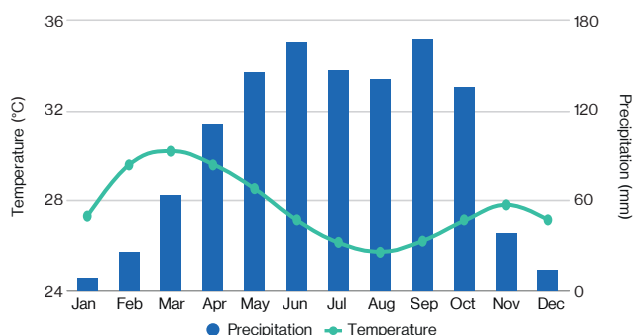
⁶ND-Gain. ND-Gain Index: Gabon

Ghana

Adapted from the World Bank's Climate Risk Country Profiles Series, 2021

Climate trends

Average monthly Temperature (T) and Precipitation (Ppt), 1991–2020¹



Mean annual T/Ppt (1901–2020): 27.3°C; 1,190 mm
Mean annual max/min T (1901–2020): 32.5°C; 22.1°C

Country context

Population	30.4m (2019)	Annual growth rate	2.2% (2019)
GDP	\$66.9bn (2019)	Annual growth rate	6.5% (2019)
GDP per capita	\$2,200 (2019)		

Literacy rate, adult female/male: 42%/62% (2015)
CPIA gender equality rating: 3.50 (2019)
Geography: Located along the south-central coast of west Africa; land area: 239,460 km²; sea territory: 200 nautical miles
Broad climate: Southern region: forest zone; rest of country: Northern Savannah Ecological Zone

Climate projections²

CMIP5 Ensemble Projection	2020 - 2039	2040 - 2059	2060 - 2079	2080 - 2099
Annual Temperature Anomaly (°C)	+0.6 to +1.5 (+0.9°C)	+1.2 to +2.7 (+1.7°C)	+1.7 to +3.8 (+2.7°C)	+2.3 to +5.3 (+3.6°C)
Annual Precipitation Anomaly (mm)	-16.7 to +22.0 (+0.9mm)	-22.2 to +30.4 (+0.3mm)	-22.9 to +38.9 (+2.9mm)	-29.7 to +45.2 (+1.6mm)

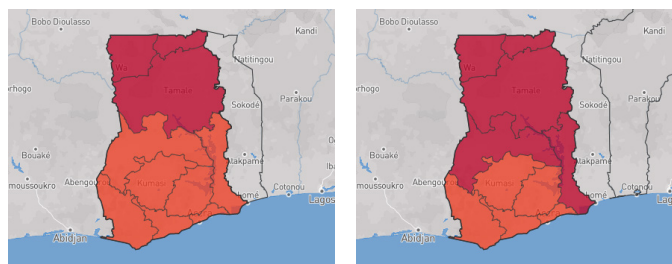
Climate hazards

- The country is exposed to risks from weather-related hazards, primarily those from floods and droughts in the Northern Savannah belt
- Heightened dry conditions and increased pressure on water resources expected by mid-century; severe drought conditions and water scarcity expected by end of century
- Average number of hot days and nights (under RCP8.5 scenario; reference period 1986–2005) expected increase by 18–59% by mid-century
- Primary sectors affected by climate change are water, agriculture, forestry, and health
- Climate change (CC) and variability are already affecting Ghana's water resources; increased exposure and flood damages are projected to cost US\$ 160 million annually

Climate hazards from 1991–2020³

Hazard	Subtype	Events	Deaths	Affected	Affected per capita per decade
Flood	Unstated	7	95	1,126,283	7.07%
	Riverine	15	402	3,619,124	
	Flash	1	13	-	
Storm	Tropical	-	20	-	0.00%
	Convective	1	-	-	
Total		24	530	4,745,407	7.07%

Risk of water scarcity (left)⁴, Risks of extreme heat (right)⁵



High Medium Low Very low

ENABLING ENVIRONMENT

Leadership and governance

- **Disaster risk management (DRM):** Ghanaian Government
- **Coordination of CC strategy:** Environmental Protection Agency
- **Strategy leadership:** Ministry of Environment, Science, Technology and Innovation
- **Cross-sectorial efforts:** National Development Planning, Forestry, and Energy Commissions and the Ministries of Food and Agriculture, Lands and Natural Resources, and Power

Key adaptation policies

Key policy documents: NDC (2016); National Climate Change Master Plan Action Programs for Implementation 2015–2020 (2015); National Climate Change Adaptation Strategy (2012)

Disaster Risk Management:

- Working on greater integration of DRM in national and local development policies and urban and land use planning
- Ghana Plan of Action for Disaster Risk Reduction and Climate Change Adaptation (2012)
- National Disaster Risk Reduction Policy (2011–2015)
- DRM priorities include addressing flood risks in major urban areas, and increasing the resilience of coastal communities

ND-GAIN Index⁶

Country Index rank (score): 111 (44.8)

Vulnerability: 0.456

Ecosystem Services 17%, Food 21%, Human Habitat 23%, Health 16%, Infrastructure 11%, Water 11%

Readiness: 0.353

Economic 33%, Governance 46%, Social 20%



ND-GAIN Evolution

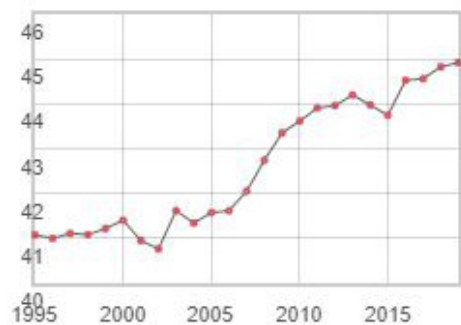


Photo: Frank TG Herben/Shutterstock

Ghana

SECTORAL ADAPTATION PLANNING



AGRICULTURE

~20% of GDP, ~50% of export earnings, employs over 50% of the population, rain-dependent, agricultural land (2018): 59.78% of land area, 2% irrigation potential in use, Fisheries: 4.5% of GDP and provides livelihoods for 2.2m people

- **Crops:** Industrial: cocoa, rubber, oil palm, coconut, cotton; starchy and cereal staples: cassava, yam, maize, rice, plantain; fruits and vegetables: pineapple, banana, cashew, citrus, mango
- **Key fish species:** anchovies, sardines, tilapia, catfish

Main climate change impacts

- Lowered yields in staple crops due to rising temperatures, increasing interannual rainfall variability, and shortened growing seasons. Expected decrease in cassava: 29.6% by 2080, and maize: 7% by 2050
- Crop failure cases projected to occur once every five years in northern region due to delayed or diminished rainfall
- Decreasing suitability for cocoa production, mainly along the coast, due to temperature increase, floods, soil salinization & coastal erosion
- Increased presence of pests, diseases and wildfire risks due to rising temperatures
- Altered migratory patterns and reproductive cycles of key fish species

Proposed adaptation strategies

- Investment in climate-smart agriculture, improved water management, monitoring and early warning systems, knowledge and decision-support systems
- Increased drought-resistant crop varieties and integration of nutrient management for improving staple crops yield
- Household practices in northern savannah zone include expansion of cultivated areas, dry season gardening, cultivation of early yielding and high value crops, diversification into livestock rearing, and increasing fertilizer use
- Aquaculture development, more formal restocking of fingerlings, and improved extension services

Milestones

- The Climate Smart Agriculture Investment Plan (CSAIP) identifies interventions that will help the agriculture sector deal better with climate change



WATER

- Freshwater covers nearly 5% of total land area (primarily made of the Volta, southwestern and coastal river systems)
- Around 50% of water originates from international rivers (Volta, Bia, Tano)

Main climate change impacts

- Around 25% of the population lacks access to clean water. This issue will be compounded by declining rainfall, increased levels of drought and rising temperatures
- Volta Basin flows could be reduced by 24% by mid-century and 45% by end of century
- Increased salinization in coastal water sources and wells due to rising sea levels
- Impact on rates of surface water infiltration and recharge rates for groundwater due to rainfall and evaporation changes
- Soil moisture deficits due to rising temperatures, even under conditions of increasing rainfall

Examples of adaptation practices

- Water harvesting and improved rainwater collection and storage at household or community levels
- Flood retention development is ongoing in upper east and central regions. Additional dam construction, rehabilitation and de-silting is also essential
- The National Irrigation Policy objectives include increasing irrigated surfaces, improving their management, and increasing climate change resilience as a result of sustainable irrigation service delivery



NEEDS

Research

- Increase understanding of climate risks and vulnerabilities
- Greater participation of the public, scientific institutions, women and local communities in planning and management processes
- Increase effectiveness of environmental management through strengthened monitoring capabilities
- Investment in weather stations for improved hydro-meteorological monitoring systems
- Strengthen technical capacity for integrated climate-smart agriculture into the agriculture sector
- National CC impacts assessment for the health sector

Institutional

- Incorporate National Environmental Strategy goals into sectoral and regional plans
- Implement cross-sectoral climate-smart solutions
- Ensure climate-informed policies and planning processes at state and national levels

Data and information

- Develop early warning systems
- Ensure maintenance and enhancement of national CC and atmosphere monitoring systems

Other

- Available surface water resources are reported to be adequate to meet projected demand through to 2025, but significant investments in, for example, irrigation, water supply, sanitation, and electricity, are required to achieve mid- and long-term objectives
- Irrigation infrastructure and access to reliable water for agriculture would make a substantial difference for the country's resilience, as well as boost production opportunities and thus livelihoods for smallholder farmers



¹WBG Climate Change Knowledge Portal (CCKP, 2021). Ghana

²WBG Climate Change Knowledge Portal (CCKP, 2021). Ghana Projected Future Climate

³Authors' summary based on CRED EM-DAT database, accessed 10 May 2021: EM-DAT: The Emergency Events Database - Université catholique de Louvain (UCL) - CRED, D.

Guha-Sapir - www.emdat.be, Brussels, Belgium

⁴ThinkHazard! (2020). Ghana - Extreme Heat

⁵ThinkHazard! (2020). Ghana - Water Scarcity

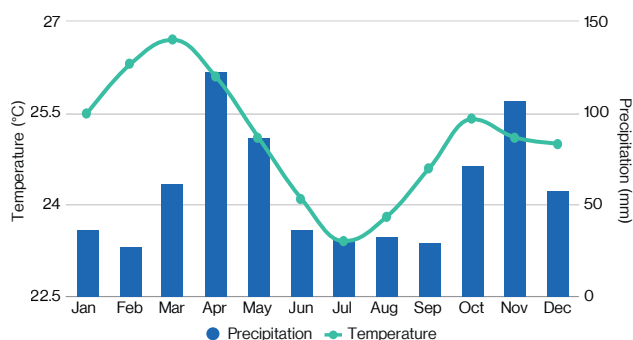
⁶ND-Gain: ND-GAIN Country Index: Ghana

Kenya

Adapted from the World Bank's Climate Risk Country Profiles Series, 2021

Climate trends

Average monthly Temperature (T) and Precipitation (Ppt), 1991–2020¹



Mean annual T/Ppt (1901–2020): 24.3°C/670 mm
Mean annual max/min T (1901–2020): 30.3°C/18.3°C

Country context

Population	Annual growth rate
52.6m (2019)	2.3% (2019)
GDP	Annual growth rate
\$95.5bn (2018)	5.4% (2019)
GDP per capita	
\$1,800 (2019)	

Literacy rate, adult female/male: 31%/62% (2014)
CPIA gender equality rating: 2.0 (2019)
Geography: Located in east Africa; Kenyan highlands in southwest; southeast coastline borders Indian Ocean; land area: 582,646 km²

Climate projections²

CMIP5 Ensemble Projection	2020 - 2039	2040 - 2059	2060 - 2079	2080 - 2099
Annual Temperature Anomaly (°C)	+0.5 to +1.4 (+1.0°C)	+1.2 to +2.4 (+1.7°C)	+2.0 to +3.7 (+2.5°C)	+2.7 to +5.1 (+2.5°C)
Annual Precipitation Anomaly (mm)	-13.7 to +21.6 (2.6mm)	-17.1 to +25.2 (3.5mm)	-17.0 to +34.0 (6.7mm)	-17.8 to +44.0 (10.5mm)

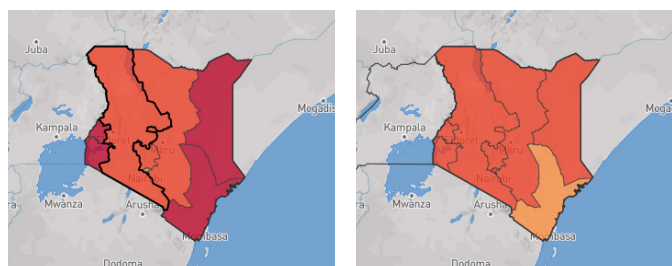
Climate hazards

- Drought has impacted GDP by 8% every five years, with drought cycles increasing in frequency from every 5–10 to every 2–3 years
- Average number of hot nights expected to occur on: 45–75% days by mid-century and 64–93% days by end of century
- Average number of hot days expected to occur on 19–45% of days by mid-century
- Floods risks expected to increase, leading to mudslides and landslides, particularly in mountainous areas; flash floods common in high plateau areas, and can trigger mudflows
- Climate change (CC) expected to impact water, agriculture, health, and forestry sectors, as well as coastal zones

Climate hazards from 1991–2020³

Hazard	Subtype	Events	Deaths	Affected	Affected per capita per decade
Drought		12	196	53,350,000	47.23%
	Unstated	8	586	1,941,810	
Flood	Riverine	36	1,106	2,225,120	3.94%
	Flash	7	128	279,893	
Land-slides		5	153	-	0.00%
Total		68	2,169	57,796,769	51.17%

Risk of river flood (left)⁴, Risks of water scarcity (right)⁵



High Medium Low Very low

ENABLING ENVIRONMENT

Leadership and governance

Disaster risk management (DRM) preparedness and response:

Disaster Risk Management Authority

Coordination of CC activities: National Climate Change Council (2016), housed in the Ministry of Environment and Forestry

Tracking progress: Ministry of Planning and Devolution

Data generation for forecasting and early warning systems (EWS):

Kenya Meteorological Department

Access to climate finance: Through the National Environment Management Authority

Key adaptation policies

Key policy documents: Landscape of Climate Finance in Kenya (2021); updated first NDC (2020); Climate Smart Agriculture Implementation Framework 2018–2027 (2018); Climate Change Act, National Climate Change Policy Framework (2016); NAP (2016); National Climate Change Action Plan 2013–2017, Vision 2030; National Climate Change Action Plan: Adaptation Technical Analysis (2012)

Disaster Risk Management:

- DRM Authority working at national and sub-national levels to implement Vision 2030 strategy. Capacity building of DRM is ongoing
- Common Program Framework for Ending Drought Emergencies (2015)
- National Policy for Disaster Risk Management (2009)

ND-GAIN Index⁶

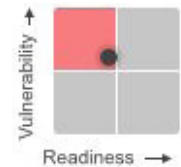
Country Index rank (score): 148 (38.9)

Vulnerability: 0.518

Ecosystem Services 15%, Food 19%, Human Habitat 18%, Health 20%, Infrastructure 10%, Water 17%

Readiness: 0.297

Economic 36%, Governance 42%, Social 21%



ND-GAIN Evolution

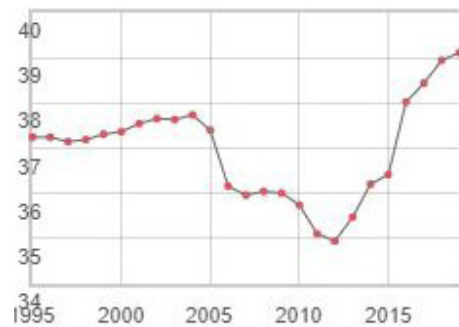


Photo: Sopotnicki/Shutterstock

Kenya

SECTORAL ADAPTATION PLANNING



AGRICULTURE

28% of GDP; contributions to agricultural GDP: Crops (78%); livestock (20%); fisheries (2%). Over 65% of exports, rain-dependent, agricultural land (2018): 28.99% of total land area; provides 80% of total employment and supports over 80% of rural population

- **Crops:** maize, wheat, rice, tea, coffee

Main climate change impacts

- Increased short-term crop failures and long-term production declines due to changes in precipitation patterns
- Production losses magnified by indirect impacts of drought and flooding such as increased rates of runoff and soil erosion, and insect, disease and weed infestations
- Altered mix and distribution of agriculture and livestock pests due to rising temperatures
- Crops yields may increase in temperate and tropical highlands, Rift Valley and high plateaus, due to increases in rainfall and slightly warmer temperatures
- Decrease in key crops yields in arid and semi-arid regions due to drought, rising temperatures and increased pests and diseases
- Reduced productivity and livestock numbers due to increasing water scarcity

Proposed adaptation strategies

- Improved knowledge base of CC-related impacts; and improved accessibility of seasonal information for farmers and fishers
- Improved water resources management, specifically increased use of irrigation and water management models at basin scales
- Improved land management action for conservation of grasslands and forests
- Use of water and resource-efficient technologies (e.g., drip irrigation), or more resilient crop varieties



WATER

Main climate change impacts

- Kenya categorized as water scarce in 1992; expected decrease in water scarcity index from 586m³ per capita in 2010 to 293m³ per capita by 2050
- Increasing challenges of water availability in cities (e.g., Mombasa) (which result in rationing and use of private sources) due to rising temperatures and rainfall variability
- Reduced water supply and increased salinization in coastal areas due to sea level rise
- Accelerated glacial loss on Mount Kenya due to rising temperatures
- Impact on river flows, irrigation potential, and water management due to annual decreases in rainfall
- Changes in rates of surface water infiltration and groundwater recharge due to changing rainfall and evaporation rates

Proposed adaptation strategies

- Currently government is encouraging states, via Kenya's devolution structure, to enact adaptation strategies alongside sub-basin management plans
- Support implementation of National Water Master Plan
- Restoration of regenerative ecological and physical functions of water bodies through improved water resource management
- Identify water resource challenges at community and regional level through targeted research
- Implement large-scale irrigation projects that are informed by vulnerability assessments



HEALTH

Main climate change impacts

- Increased risk of water-borne diseases and displacement due to flooding
- Threatened food and nutritional security due to higher temperatures
- Increased heat-related deaths, specifically in the elderly (65+ years): Projected increase from <2 per 100,000 deaths per year (between 1961 and 1990 baseline) to 45 per 100,000 deaths per year by 2080, under RCP8.5 scenario
- Rises in respiratory illnesses and urban air pollution (Nairobi, Mombasa) due to warmer and drier conditions

Proposed of adaptation strategies

- Ongoing climate vulnerability and risk assessment of CC impacts and variability on human health
- Increasing public awareness of CC impacts on human health
- Design and implementation of disease surveillance and monitoring to enhance health early warning systems



NEEDS

Research

- Increase understanding of CC vulnerabilities, impacts and possible adaptation responses within key sectors
- Invest in weather stations and expand the Kenya Meteorological Department's national hydro-meteorological and seismological monitoring system

Institutional

- Ensure that National Environmental Strategy goals are developed within sectoral and regional plans
- Implement cross-sectoral climate-smart solutions at national and subnational levels
- Integrate CC concerns into relevant policies and planning processes
- Integrate seasonal forecasts and long-term climate change trends into healthcare policy and planning

Data and information

- Improve observational data through the addition of weather stations and hydro-meteorological and seismological instrumentation and mapping
- Improve technical capacity for analyzing hydro-met data, particularly for monitoring sea level rise
- Establish institutional capacity for providing timely early warning systems
- Increase understanding of water resource threats and groundwater risks to improve water use efficiency in agriculture and urban management

¹WBG Climate Change Knowledge Portal (CCKP, 2020). Kenya

²WBG Climate Change Knowledge Portal (CCKP, 2020). Kenya Projected Future Climate

³Authors' summary based on CRED EM-DAT database, accessed 10 May 2021: EM-DAT: The Emergency Events Database - Université catholique de Louvain (UCL) - CRED, D. Guha-Sapir

⁴ThinkHazard! (2020). Kenya River Flood

⁵ThinkHazard! (2020). Kenya Water Scarcity

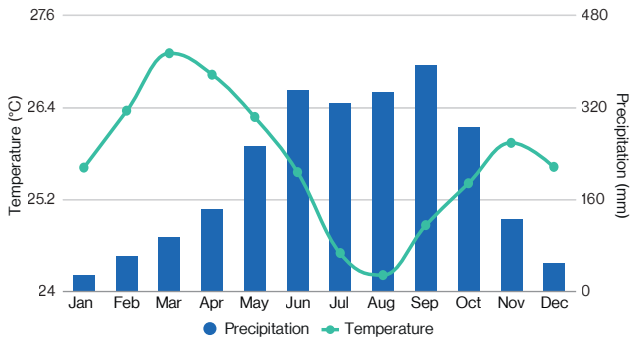
⁶ND-Gain: ND-GAIN Country Index: Kenya

Liberia

Adapted from the World Bank's Climate Risk Country Profiles Series, 2021

Climate trends

Average monthly Temperature (T) and Precipitation (Ppt), 1991–2020¹



Mean annual T/Ppt (1901–2020): 25.7°C / 2,467.07mm
 Mean annual max/min T (1901–2020): 31.2°C/20.3°C

Country context

Population	5m (2020)	Annual growth rate	2.4% (2020)
GDP	\$2.95bn (2020)	Annual growth rate	-2.9% (2020)
GDP per capita	\$580 (2020)		

Literacy rate, adult female/male: 85%/68% (2014)

CPIA gender equality rating: 4.0 (2019)

Geography: Located in the centre of the Upper Guinea Rainforest Region along the west coast of Africa; land area: 111,369 km²

Broad climate: Predominantly equatorial climate; one of the wettest countries in the world

Climate projections²

CMIP5 Ensemble Projection	2020 - 2039	2040 - 2059	2060 - 2079	2080 - 2099
Annual Temperature Anomaly (°C)	+0.6 to +1.3 (+0.9°C)	+1.2 to +2.4 (+1.6°C)	+1.7 to +3.6 (+2.4°C)	+2.1 to +4.8 (+3.2°C)
Annual Precipitation Anomaly (mm)	-28.9 to +32.5 (-1.17mm)	-37.1 to +33.8 (-1.3mm)	-40.5 to +51.5 (+4.4mm)	-47.9 to +63.0 (+4.7mm)

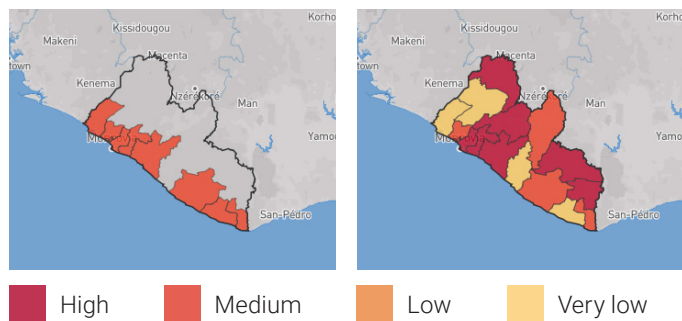
Climate hazards

- Vulnerability to climate hazards is exacerbated by the high levels of poverty and high dependence on climate change (CC) sensitive sectors: agriculture, fisheries, mining and forestry
- Liberia has a high number of rivers, catchments and aquifers as well as its low-lying coastal zone, and so changes to precipitation are likely to result in high-risk flooding scenarios
- CC may reduce land area along the Mesurado river delta and along the coastline exposed to erosion and sea level rise
- River flood hazard is classified as high, with potential for damaging, life-threatening river floods occurring throughout the country
- Population densities, i.e. capital city of Monrovia, the urban area of Greater Monrovia, and coastal urban areas, overlap with key flood zones and areas of high vulnerability

Climate hazards from 1991–2020³

Hazard	Subtype	Events	Deaths	Affected	Affected per capita per decade
Flood	Unstated	1	-	15,431	0.54%
	Riverine	5	14	38,070	
Storm	Unstated	1	-	-	0.00%
	Convective	1	-	-	
Total		8	14	53,501	0.54%

Coastal flood risk (left) and urban flood risk (right)⁴



ENABLING ENVIRONMENT

Leadership and governance

- Liberia's Environmental Protection Agency (EPA) is the primary agency responsible for preparing the National Communication under the UNFCCC and the National Adaptation Programme of Action (NAPA)
- The EPA is focused on integrating CC across government ministries
- The National Environmental Policy Council shapes priorities for environmental targets & objectives
- The National Climate Change Steering Committee and Secretariat are responsible for creating an intergovernmental framework for combatting CC

Key adaptation policies

Key policy documents: Updated NDC (2021); Second National Communication (2021); National Policy and Response Strategy on Climate Change (2018); Initial National Communication (2013); National Disaster Management Policy (2012); National Adaptation Programme of Action (NAPA) (2008); Environmental Protection and Management Law (2002)

Project foci to address main CC issues:

- Agriculture adaptation
- A National Meteorological and Hydrological Monitoring System
- Coastal defence

Disaster Risk Management (DRM):

- DRM guided by National Disaster Management Policy to ensure the reduction disasters through coordinated efforts across agencies
- Working to improve resilience to increased risk of natural hazards and extreme events, and to reduce vulnerability of local communities and institutions in order to better prepare for, mitigate and respond to natural hazards and increased threats from CC

ND-GAIN Index⁵

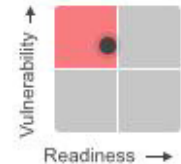
Country Index rank (score): 173 (34.1)

Vulnerability: 0.606

Ecosystem Services 18%, Food 21%, Human Habitat 23%, Health 24%, Water 13%

Readiness: 0.289

Economic 28%, Governance 40%, Social 31%



ND-GAIN Evolution

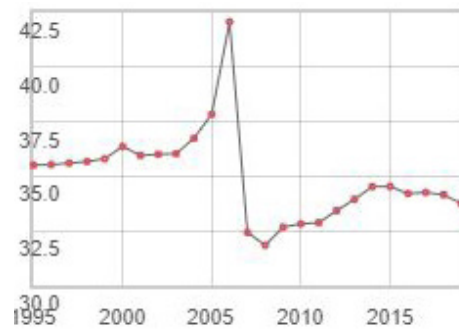


Photo: Gianfranco Vini/Shutterstock

Liberia

SECTORAL ADAPTATION PLANNING



AGRICULTURE

42.6% of GDP

- Rice, cassava and vegetable production: 85% of cultivated land
- 80% of agriculture sector is made up of subsistence farming dependent on rainfed agriculture
- Primary staple crop: rice, cultivated by 74% of farmers; cassava is the country's second most important staple; major agricultural exports: rubber, cacao and coffee

Main climate change impacts

- Rice is sensitive to increased humidity temperatures, intense rainfall, and to the pests that thrive in these conditions
- Increasing intensity of rainfall may damage rubber production and increase costs to maintain proper drainage on plantations
- Rising temperatures, reducing moisture levels, and proliferating pests and diseases may stress cacao and coffee

Proposed adaptation strategies

- Cassava, more resilient to CC (particularly higher temperatures), may provide a key alternative food source
- Expanded areas of cultivation should be considered and trialled in the central and northern agricultural zones of the country
- Investments in research and extension services can enhance the capacity and delivery of information to the agricultural sector
- Harness land & water resources that sustain crop-area expansion in an appropriate policy, legal, and investment environment
- Improvements to weather monitoring network and associated weather information systems



WATER RESOURCES AND SANITATION (WASH)

Main climate change impacts

- Poor water quality from mining, farming, & industrial activities
- Water in rural areas mainly supplied from shallow wells whose levels fluctuate with rainfall variability; intense precipitation in urban areas to impact sewer systems & water treatment plants
- Increased water volumes could overwhelm sewer systems and water treatment plants, washing sediment, nutrients, pollutants, trash, animal waste, etc. into water supplies
- Increased rainfall, flooding and heat expected to increase prevalence of water & vector-borne diseases
- Storms and flooding may cause storm water flows, increasing water contamination of surface sources and shallow wells

Proposed adaptation strategies

- Investment into WASH and water management infrastructure, planning for urban expansion, and quality drinking water
- Support protection of river catchments and other sources of freshwater (including aquifers) to secure a steady supply of freshwater across all sectors and communities
- Vulnerability Assessment for water resources sector
- An increase in urban and rural domestic water supplies and urban sewage services to combat sanitation vulnerabilities
- Mainstream CC impacts in water resources management plans and programs to secure environmental safety and sustainable fresh water supply for the country



COASTAL ZONES AND SEA LEVEL RISE

Main climate change impacts

- Approximately 95 km² of land in the coastal zone will be inundated from 1m sea level rise, with about 50% of total land loss from inundation on the sheltered coast and shoreline retreat
- 230,000+ people are at risk and 2,150 km² will be lost with a 1m sea level rise by the end of the century
- Damages and losses (infrastructure and land) for major cities are estimated at US\$ 250 million
- Rapid coastal erosion (both from sea level rise and sand mining) puts settlements and infrastructure at risk
- Sea level rise will increase migration to higher lands and/or result in shock waves of migration to the interior
- Much of the country's coast is protected by mangroves, at risk from erosion from rising sea temperatures and intense rainfall

Proposed of adaptation strategies

- Develop policies for aquaculture, urban infrastructure, integrated coastal management and flood-related disaster risk responses
- Institute physical planning and building control measures to protect coastline; avoid allocating in flood-prone areas
- Build coastal infrastructure such as roads, seaports, fish landing and hotel and residential buildings so marginal increase in the height of the structures for sea level rise can be mitigated
- Offer incentives for people in high-risk areas to relocate
- Direct support towards rehabilitation, management, and protection of wetlands and mangroves to buffer coastal communities from storm surge and coastal erosion
- Coastal Defence Strategies to reduce vulnerability of coastal urban areas to erosion, floods, and siltation



NEEDS

Research

- Improve understanding of occurrence and magnitude of CC trends, key vulnerabilities, development impact, and adaptation responses, and enhance public, community and institutional participation in adaptation planning
- Strengthen environmental monitoring capabilities and technical capacity for CC risk management at farmer level
- Rebuild national hydro-meteorological monitoring system
- Assessment of geographic risks & role of gender in adaptation
- Research to estimate cost of implementing NDC

Institutional

- Integrate NDC goals & adaptation efforts into sectoral/regional plans, city governments, land authorities & DRM agencies
- Ensure long-term spatial planning in urban zones considers projected disaster and CC impacts
- Implement cross-sectoral, climate-smart solutions, and regional-scale cooperation among west African countries
- Establish a National Steering Committee on CC to ensure integration of climate resilience in development planning

- Ensure policies are designed to create an enabling environment for agriculture and improved education, as well as expanded WASH services
- Develop systems to appropriately manage natural resources, and resolve disputes over natural resources and land

Data and information

- Utilise weather stations and hydro-met instrumentation
- Establish institutional capacity for early warning systems
- Increase data on urbanisation and information settlements to determine settlements located in disaster areas or flood zones

¹WBG Climate Change Knowledge Portal (CCKP, 2020). Liberia

²WBG Climate Change Knowledge Portal (CCKP, 2020). Liberia Projected Future Climate

³Authors' summary based on CRED EM-DAT database, accessed 10 May 2021: EM-DAT: The Emergency Events Database - Université catholique de Louvain (UCL) – CRED, D. Guha-Sapir, Brussels, Belgium

⁴ThinkHazard! (2020). Liberia: Overview

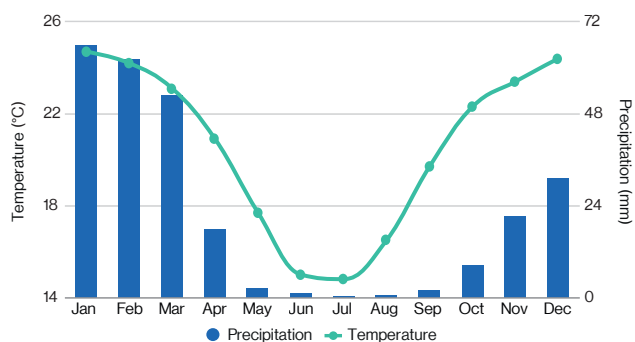
⁵ND-Gain. ND-Gain Index: Liberia

Namibia

Adapted from the World Bank's Climate Risk Country Profiles Series, 2021

Climate trends

Average monthly Temperature (T) and Precipitation (Ppt), 1991–2020¹



Mean annual T/Ppt (1901–2020): 20.6°C / 270mm
Mean annual max/min T (1901–2020): 28°C/13.2°C

Country context

Population	2.5m (2020)	Annual growth rate	1.8% (2020)
GDP	\$10.7bn (2020)	Annual growth rate	-8% (2020)
GDP per capita	\$4,211 (2020)		

Literacy rate, adult female/male: 50%/73% (2017)
CPIA gender equality rating: 3.50 (2019)

Geography: Located in southwest Africa; land area of 825,418 km²; 1,500 km coastline along South Atlantic Ocean

Broad climate: Droughts, unpredictable rainfall patterns, high temperature variability, and water scarcity

Climate projections²

CMIP5 Ensemble Projection	2020 - 2039	2040 - 2059	2060 - 2079	2080 - 2099
Annual Temperature Anomaly (°C)	+0.6 to +1.8 (+1.2°C)	+1.5 to +2.9 (+2.1°C)	+2.5 to +4.5 (+3.2°C)	+3.3 to +6.0 (+4.3°C)
Annual Precipitation Anomaly (mm)	-11.8 to +10.2 (-1.2mm)	-15.7 to +69.9 (-3.4mm)	-17.7 to +5.9 (-4.3mm)	-21.3 to +5.2 (-6.1mm)

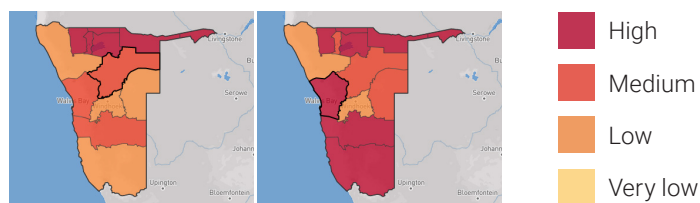
Climate hazards

- Namibia is prone to recurrent drought conditions and wildfires due to its hot and dry climate and erratic rains. Drought is the most devastating hazard
- It is likely that climate change trends will lead to an increase in drought frequency and intensity as well as an increase in the physical area of drought proneness; this will likely impact water scarcity
- Daily maximum temperatures are projected to increase by 5°C to 6°C by end of century
- Flooding is an annually recurring event which is worsening each year, with the northern and northeastern regions being the worst affected. Flooding frequency has increased in recent years and is estimated to impact 70,000 people annually, and is estimated to have potential economic damage for up to US\$ 100 million per year
- Forest and wildfires are common, especially in the northeastern part of the country; an estimated damaged of 3-7 million ha of land annually

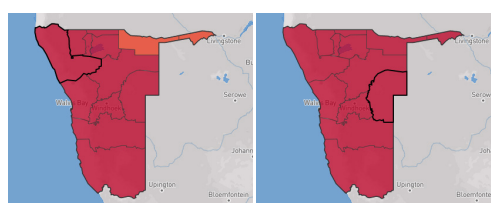
Climate hazards from 1991–2020³

Hazard	Subtype	Events	Deaths	Affected	Affected per capita per decade
Drought		7	-	2,182,844	36.91%
Flood	Unstated	3	-	8,502	18.65%
	Riverine	11	262	1,082,450	
	Flash	1	2	12,000	
Total		22	264	3,285,795	55.56%

Risk of river flood and urban flood (left to right)⁴



Risk of water scarcity and wildfires (left to right)⁴



ENABLING ENVIRONMENT

Leadership and governance

Implementation of climate change (CC) policy: National Climate Change Committee (NCCC), chaired by the Ministry of Environment and Tourism (MET) and reporting to the Permanent Secretary of the MET via the head of the Department of Environmental Affairs

Key adaptation policies

Key policy documents: NDC (2016); Fourth National Communication (2020); Third Biennial Update Report (2018); National Policy on Climate Change (2011); National Agricultural Policy (2015); Water Sanitation and Supply Policy (2008); National Policy on Tourism (2008); National Health Policy Framework (2010–2020) (2010); National Disaster Risk Management Policy (2012); Climate Change Strategy and Action Plan (2013–2020) (2013)

Disaster Risk Management (DRM):

- The National Disaster Risk Management Policy (2009) prioritizes improvement of early warning system (EWS) and the tracking, monitoring, and disseminating of information on disaster-related phenomena
- National Disaster Risk Management Plan (NDRMP) and Emergency Management Operational Procedures to support NDRMP

ND-GAIN Index⁵

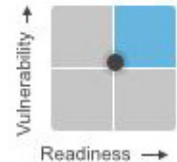
Country Index rank (score): 107 (45.7)

Vulnerability: 0.469

Ecosystem Services 18%, Food 18%, Human Habitat 19%, Health 17%, Infrastructure 15%, Water 13%

Readiness: 0.383

Economic 33%, Governance 48%, Social 18%



ND-GAIN Evolution

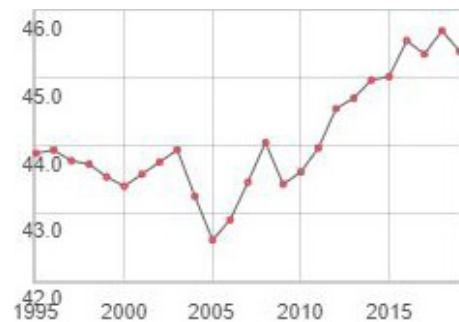


Photo: Hendrik Werner/Shutterstock

Namibia

SECTORAL ADAPTATION PLANNING



AGRICULTURE

7–10% of GDP

- 2% of total surface area is arable; 46% is appropriate for perennial natural pasture

Main climate change impacts

- From temperature increase and rainfall changes, cereal crop yields estimated to decline by up to 20% in the northeastern region and by 50% in the northcentral region
- In the central savannah and woodland areas, rainfed crop production could cease as cereal crop farming becomes futile
- Heat & water stress on such livestock likely to lead to decreases in feed intake, milk production, and rates of reproduction
- Productive fishing grounds are due to the Benguela current, which causes up-welling, bringing nutrient-rich waters up from the depths which stimulate growth of microscopic marine organisms that support fish populations. Fish stocks could be reduced by lower coastal upwelling and increased frequency of Benguela Nino events

Proposed adaptation strategies

- Expand irrigation infrastructure
- Introduce drought-tolerant and early maturing crop varieties
- Increase & upgrade storage facilities increase food security
- Enhance agricultural extension services
- Coordinating timing of ploughing/planting with rainfall events
- Implementing soil & water conservation policies and practices
- Foster year-long food production through irrigation, water harvesting, and conservation agriculture
- Increase access to seed and fertilizer
- Restore rangelands & improve livestock management strategies



WATER

45% from groundwater sources; 33% from the Border Rivers; 22% from impoundments on ephemeral river

Main climate change impacts

- Projected changes in rainfall over Angola and Zambia of up to between 10–20% by 2050 likely to lead to reduction of 20–30% in runoff and drainage of perennial rivers in northern Namibia
- Changing rainfall patterns over the catchments of the Zambezi, Kavango, Cuvelai, and Kunene rivers likely to lead to a 25% reduction of runoff and drainage in these river systems by 2065
- Droughts likely to result in falling groundwater tables and reduced surface water flows
- A temperature rise of 3°C will likely increase evaporation by 5%–15%, thereby leaving even less water available for discharge and storage, reducing the length of inundation of seasonally flooded wetlands, drying out shallow floodplains which could disrupt the seasonal breeding of many invertebrates and fish
- Increased salt content of pans and pools, decreasing their consumption suitability, due to drying wetlands

Proposed adaptation strategies

- Measures to reduce evaporation and to enhance efficiency of water resources utilization
- Water reclamation, artificial recharge of aquifers and desalination of both saline inland resources and seawater
- Optimization of surface and ground water use and improved water demand management
- Recycling of waste water



HEALTH

Main climate change impacts

- Increased temperatures, more intense and frequent extreme weather events, and increased duration and severity of aridity and drought likely to result in increased water and food insecurity, higher exposure to ultraviolet radiation, and changes in infectious and vector-borne disease transmission patterns
- Heat stress likely to increase due to increases in extremely hot days, thereby increasing incidences of dehydration, and reduced ability to cope with other stressors/diseases
- Floods likely to increase water-borne diseases (cholera, typhoid, leptospirosis, E. coli, and hepatitis A) in northern regions
- Increased occurrence of intense rainfall events and water runoff may induce formation of open waters, presenting more breeding grounds for vector borne diseases and insects

- Flooding and drought will pose health threats through the destruction of sanitation facilities and roads, as well as shortages of water
- Increased malnutrition due to decreased food security

Proposed of adaptation strategies

- DRM and preparedness
- Improved cholera outbreak and malaria control
- Improved nutrition through improved nutrition surveillance and staff trainings for malnutrition prevention and treatment
- Strengthening transport and communication systems between health facilities
- Improved water and sanitation systems
- Improved data collection and management



NEEDS

Research

- Improve teaching of meteorology, climatology, and general hydrology in higher education and university channels
- Enhance capabilities for handling CC data
- Evaluate needs and develop a national strategy for technology transfer to support NDC adaptation measures
- Monitor ecosystem and biodiversity changes and their impacts
- Undertake research on impact of sea level rise along the coast
- Develop and project CC scenarios at higher resolutions

Institutional

- Institutionalize DRM & mainstream CC in national/local policies
- Strengthen & enhance international collaboration, linkages, and networking among stakeholders involved in CC related issues
- Review and update existing legislation to reflect CC issues
- Establish land-use plans by type of use
- Integrate CC concerns into relevant policies and planning
- Finalize regulations to fund and implement impact studies regarding CC impacts for the country and key sectors

Data and information

- Improve technical capacity to analyse hydro-met data
- Establish institutional capacity for early warning systems
- Improve regulation and enforcement to protect forests, rainforests, and protected areas
- Strengthen information exchange by enhancing technology transfer and capacities necessary to promote environment and CC adaptation through education
- Increase active public participation in CC adaptation debate
- Establish Climate Change Resource Centre and CC database

¹WBG Climate Change Knowledge Portal (CCKP, 2021). Namibia

²WBG Climate Change Knowledge Portal (CCKP, 2021). Namibia Projected Future Climate

³Authors' summary based on CRED EM-DAT database, accessed 10 May 2021: EM-DAT: The Emergency Events Database - Université catholique de Louvain (UCL) – CRED, D. Guha-Sapir, Brussels, Belgium

⁴ThinkHazard! (2020). Namibia: Overview

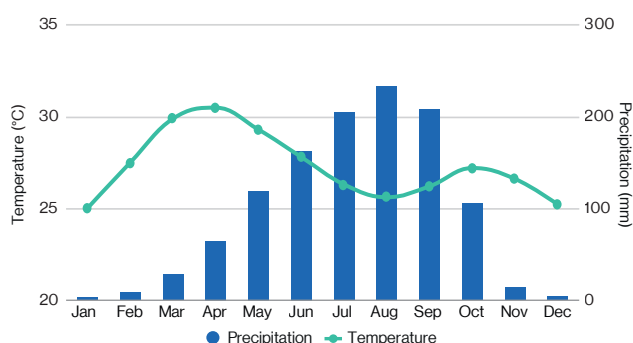
⁵ND-Gain. ND-Gain Index: Namibia

Nigeria

Adapted from the World Bank's Climate Risk Country Profiles Series, 2021

Climate trends

Average monthly Temperature (T) and Precipitation (Ppt), 1991–2020¹



Mean annual T/Ppt (1901–2020): 27.2°C / 1,160mm
Mean annual max/min T (1901–2020): 33.2°C/21.3°C

Country context

Population	206.1m (2020)	Annual growth rate	2.5% (2020)
GDP	\$432.29bn (2020)	Annual growth rate	1.8% (2020)
GDP per capita	\$2,100 (2020)		

Literacy rate, adult female/male: 27%/44% (2018)

CPIA gender equality rating: 2.50 (2019)

Geography: Located along the inner corner of the Gulf of Guinea on the west coast of Africa; land area: 923,768 km²; coastline: 853 km

Broad climate: Characterized by high temperatures with a relatively wet coastland and highly arid northern zones

Climate projections²

CMIP5 Ensemble Projection	2020 - 2039	2040 - 2059	2060 - 2079	2080 - 2099
Annual Temperature Anomaly (°C)	+0.0 to +1.5 (+1.0°C)	+1.3 to +2.8 (+1.8°C)	+2.0 to +4.2 (+2.7°C)	+2.9 to +5.7 (+3.7°C)
Annual Precipitation Anomaly (mm)	-18.6 to +21.5 (+0.4mm)	-25.6 to +29.6 (-0.3mm)	-28.0 to +39.4 (+2.3mm)	-36.0 to +47.0 (+1.6mm)

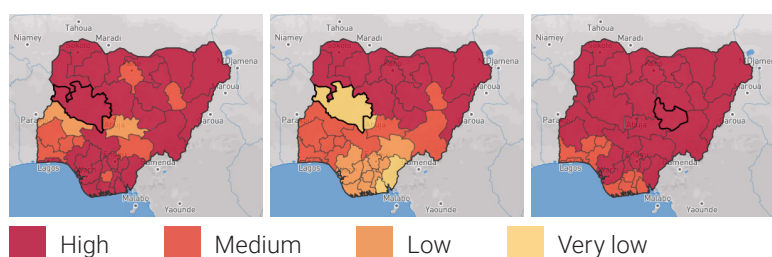
Climate hazards

- Agriculture is heavily impacted by flooding and drought
- 25% of the population (41 million people) living in high climate exposure areas, with highest exposure in coastal states; 27–53 million people at risk from relocation from 0.5m sea level rise
- Coastal erosion, rising seas & oil pollution destroying mangrove forests, which buffer against sea storm surges
- Disasters result in land & infrastructure degradation from erosion, direct crop failure from floods and heavy rains, and nutrient leaching, and fungal growth from humidity
- Heavy rainfall can trigger riverine & flash floods, common in hill areas, triggering landslides & mudslides and consequently gully erosion in sedimentary terrains
- Climate change (CC), deforestation, watershed degradation, land use, urbanization have exacerbated impacts from flooding & droughts and have increased the risk of wildfires
- Water stress likely to be exacerbated with competing demands from household, industrial consumption and agriculture

Climate hazards from 1991–2020³

Hazard	Subtype	Events	Deaths	Affected	Affected per capita per decade
Flood	Unstated	20	587	2,268,267	
	Riverine	26	980	9,411,491	2.75%
	Flash	6	330	98,565	
Storm	Unstated	2	-	-	
	Tropical	-	54	16,000	0.00%
Extreme Temperatures	Convective	3	100	-	
	Cold	1	18	-	
Land-slides	Heat	1	60	-	0.00%
	Unstated	2	32	-	
Total		61	2,161	11,794,323	2.76%

Risk of urban flood, water scarcity and extreme heat (left to right)⁴



ENABLING ENVIRONMENT

Leadership and governance

- **Coordination of CC:** Department of Climate Change (DCC)
- Inter-Ministerial Committee on Climate Change facilitates cross-sector coordination
- In 2012, the Federal Executive Council adopted the Nigeria Climate Change Policy Response and Strategy. Several sector- or issue-specific policies and programs were created under this strategy

Key adaptation policies

Key policy documents: Updated NDC (2021); Third National Communication (2020); First Biennial Update Report (2018); National Agricultural Resilience Framework (2015); Second National Communication (2014); Post-Disaster Needs Assessment 2012 Floods (2013); National Adaptation Strategy and Plan of Action for Climate Change for Nigeria (2011); National Disaster Framework (2010); First National Communication (2003)

Disaster Risk Management (DRM):

- Nigeria passed the National Disaster Management Framework in 2011; the 2012 flood was a turning point in national strategy to support long-term DRM
- Annual release of the Seasonal Climate Prediction by Nigeria Meteorological Agency (NiMET) and the Annual Flood Outlook by the Nigeria Hydrological Services Agency (NIHSA)

ND-GAIN Index⁵

Country Index rank (score): 161 (36.8)

Vulnerability: 0.493

Ecosystem Services 15%, Food 19%, Human Habitat 20%, Health 19%, Infrastructure 9%, Water 17%

Readiness: 0.23

Economic 33%, Governance 39%, Social 27%



ND-GAIN Evolution

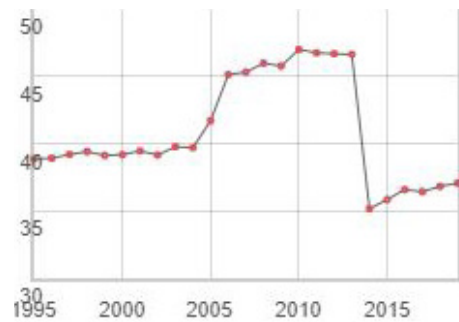


Photo: bolarzeal/Shutterstock

Nigeria

SECTORAL ADAPTATION PLANNING



AGRICULTURE

24.4% of GDP (2016)

- 78% of total land (708,000 km²) is cultivated: 48% arable lands; 42.8% permanent meadows; 9.2% permanent crop production
- Significant imports: wheat, fish, rice, sugar; second-largest rice importer & one of the largest producers of cassava in the world

Main climate change impacts

- High CO₂ levels may lead to nutrient declines in rice of 17%; cassava is well adapted to hot, dry conditions, but is susceptible to water logging/production yields from heavy rainfall
- In southern zones, flooding, erosion and soil loss are likely; in the north, a traditional livestock production zone, decreasing precipitation and increased temperatures are likely
- Trends are likely to adversely impact livestock productivity in arid & semi-arid regions, affecting ecosystems due to over-stressed grazing lands and the direct impacts of heat on livestock
- Shortened growing seasons likely due to higher temperatures, impacting rice production

Proposed adaptation strategies

- Expanding and optimising irrigation infrastructure through national investment schemes and private sector companies leading procurement opportunities
- Agricultural insurance and enhancing extension services
- Diversify livestock and improve range management; increase access to drought-resistant crops and livestock feeds; adopt better soil management practices; and provide early warning/meteorological forecasts and related information
- Increase irrigation systems that use low amounts of water; increase rainwater & sustainable ground water harvesting; plant native vegetation cover; intensify crop and livestock production



WATER

214 km³ of fresh water covering a surface area of over 20M ha

Water resources include 200 dams storing 31bn m³

In rural areas, 88% of households use surface water, with 83% of those being among the poorest households in the country

Main climate change impacts

- Much of the population is at risk of water stress, with under 40% with access to potable water
- Rainfall variability may lead to flooding in humid areas in the south; reduced precipitation in the northern savannah may result in droughts
- Drought and desertification are resulting in biodiversity loss, loss of land cover and depletion of water resources; and will impact population dynamics through migration to urban areas
- Changes in hydrology expected from reduction in water sources
- Rising temperatures and dry spells will impact water quality by raising water temperature, accelerating bacterial growth

Proposed adaptation strategies

- Empowering agencies under the Ministry of Water Resources to focus on strategies to optimize use of Nigeria's water resources
- Ongoing adaptation strategies include reducing water loss from dams such as Kainji, Challawa, Tiga and Bakolori, like use of biodegradable suppressants
- Implement more irrigation and enhance storage of reservoirs
- Recycle wastewater to improve agriculture in peri-urban areas
- Water transfers to redistribute freshwater
- Improve water management strategies and domestic/industrial waste management practices



HEALTH

Main climate change impacts

- Under a high-emissions scenario, diarrheal deaths from CC in children under 15 years old projected to be about 9.8% of the over 76,000 diarrheal deaths projected in 2030
- Heat-related deaths in the elderly (65+ years) projected to increase to 80 deaths per 100,000 by 2080 compared to baseline of about 3 deaths per 100,000 p/y from 1961–1990
- Flooding from sea level rise could result in increased risk of water and vector-borne diseases
- Air pollution is expected to worsen with rising temperatures; extreme heat intensifies ground-level ozone, which combines with fine particulate pollutants (soot and dirt from coal combustion, diesel engines, or fires) and chemicals like carbon monoxide or sulfur dioxide to reduce air quality

Proposed of adaptation strategies

- Undertake research to understand health impacts of CC and strengthen disease protection, early warning, and treatment
- Promote adoption of practices and technologies that reduce exposure and health impacts from extreme heat
- Increase high quality health services and promote climate-health education in schools
- Train health care system personnel on relationship between CC, seasonal variability and health impacts



NEEDS

Research

- Improve meteorology, climatology and hydrology scientific capabilities for the Nigerian Meteorological Agency
- Enhance capabilities for handling CC data through the Climate Change Department of Federal Ministry of Environment
- Develop early warning systems

Institutional

- Establish land-use plans by type of use (road infrastructure, oil and gas distribution, agriculture and animal husbandry, forests, coastal zones, urban spaces etc.)
- Finalize regulations to fund and implement impact studies regarding CC impacts for the country and key sectors
- Develop Monitoring, Evaluation and Learning (MEL) framework to assess the efficiency of policies and measures to increase resilience

Data and information

- Strengthen transboundary flood monitoring, forecasting and nation-wide probabilistic flood modelling
- Increase understanding of water resource threats and groundwater risks to improve water use efficiency
- Improve regulation and enforcement to protect forests
- Strengthen information exchange to promote environment and CC adaptation through education and public awareness

¹WBG Climate Change Knowledge Portal (CCKP, 2021). Nigeria

²WBG Climate Change Knowledge Portal (CCKP, 2021). Nigeria Projected Future Climate

³Authors' summary based on CRED EM-DAT database, accessed 10 May 2021: EM-DAT: The Emergency Events Database - Université catholique de Louvain (UCL) - CRED, D. Guha-Sapir, Brussels, Belgium

⁴ThinkHazard! (2020). Nigeria: Overview

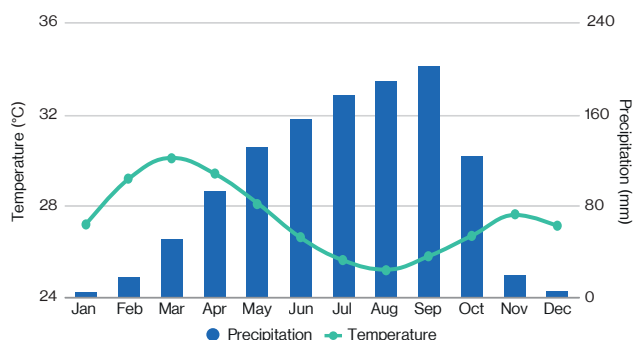
⁵ND-Gain. ND-Gain Index: Nigeria

Togo

Adapted from the World Bank's Climate Risk Country Profiles Series, 2021

Climate trends

Average monthly Temperature (T) and Precipitation (Ppt), 1991–2020¹



Mean annual T/Ppt (1991–2020): 27.0°C/1,169.9 mm
 Mean annual max/min T (1991–2020): 32.7°C/21.5°C

Country context

Population
8.1m (2020)

GDP
\$5.5bn (2019)

GDP per capita
\$680 (2019)

Annual growth rate
2.4% (2019)

Annual growth rate
5.3% (2019)

Literacy rate, adult female/male: 73.09%/83.20% (2015)

CPIA gender equality rating: 3.0 (2019)

Geography: Located in west Africa, along the Gulf of Guinea; land area: 54,600 km²

Broad climate: Northern area: dry with prevailing south-westerly winds; southern area: wet and humid

Climate projections²

CMIP5 Ensemble Projection	2020 - 2039	2040 - 2059	2060 - 2079	2080 - 2099
Annual Temperature Anomaly (°C)	+0.6 to +1.5 (+1.5°C)	+1.2 to +2.7 (+1.7°C)	+1.8 to +4.1 (+2.6°C)	+2.5 to +5.6 (+3.5°C)
Annual Precipitation Anomaly (mm)	-16.8 to +21.3 (1.3mm)	-24.1 to +29.2 (-0.5mm)	-24.8 to +36.1 (2.8mm)	-32.5 to +41.6 (0.6mm)

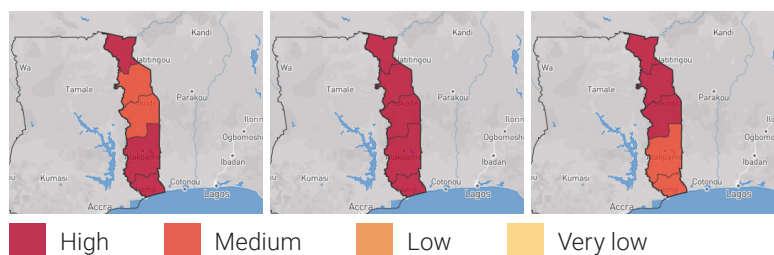
Climate hazards

- Climate change is expected to increase the risk and vulnerability of local communities to extreme events, coastal storms, and natural hazards such as heatwaves, droughts, floods, and wildfires
- Average temperatures are projected to increase, while rainfall may decrease or increase in parts of the country. Agriculture, energy, health, housing, water resources, and coastal areas will be particularly vulnerable to these climatic changes
- Flooding is intensified by deforestation, increasing its effects on infrastructure, food security and land resources. Events have become more widespread across the country and future floods are likely to encourage communicable and water-borne diseases
- Coastal areas are subject to flooding due to high levels of coastal erosion; expected increased coastal flooding could cover 20%–35% of coastal areas

Climate hazards from 1991–2020³

Hazard	Subtype	Events	Deaths	Affected	Affected per capita per decade
Flood	Unstated	5	11	115,465	3.32%
	Riverine	8	72	459,165	
Total		13	83	574,630	3.32%

Risk of river flood (left)⁴, Risk of wildfires (centre) and Risk of extreme heat (right)⁵



ENABLING ENVIRONMENT

Leadership and governance

- **Implementing environmental management and climate change (CC) policy, and designated authority to UNFCCC:** Environmental Directorate within the Ministry of the Environment and Forest resources
- **Committees:** National Climate Change Committee; National NAPA Committee; National NAMA Committee; Designated National CDM Authority
- **National programs, strategies and plans for planning, monitoring and evaluation:** National Environmental Policy; National Environmental Management Program; National Sustainable Development Strategy (NSDS); National Medium Term Priority Framework (NMTPF) for Togo (2010–2015); Adapting Agriculture in Togo to Climate Change (ADAPT)

Key adaptation policies

Key policy documents: NAP (2018); NDC (2016); National Multi-Risks Contingency Plan (2021); First Biennial Update Report (2017); Third National Communication (2015); Forest Action Plan (2009)

Disaster Risk Management (DRM):

- Togo has integrated DRM activities through its Accelerated Growth and Employment Promotion Strategy (2013) and National Development Plan (2018–2022)
- Strategies and plans include: National Action Program for Adaptation to Climate Change (2009); National Investment Program for Environment and Natural Resources (2010); and National Strategy for Reducing the Risk of Catastrophes in Togo
- DRM priorities include developing analytical tools to enhance risk identification, elaborating the National Strategy for Disaster Risk Reduction (SNRRC), operationalization of the flood early warning system (EWS); establishing a disasters database (DesInventar); establishing a Sendai Framework Monitor (SFM) database

ND-GAIN Index⁶

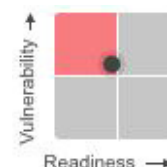
Country Index rank (score): 139 (40.4)

Vulnerability: 0.505

Ecosystem Services 17%, Food 19%, Human Habitat 20%, Health 18%, Infrastructure 14%, Water 11%

Readiness: 0.313

Economic 35%, Governance 38%, Social 26%



ND-GAIN Evolution

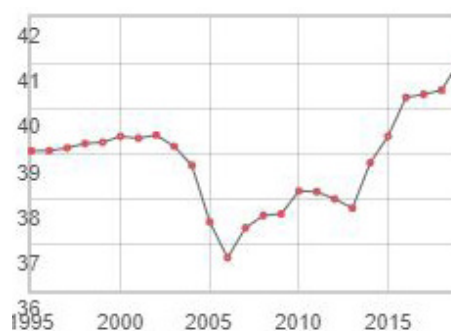


Photo: mbrand85/Shutterstock

Togo

SECTORAL ADAPTATION PLANNING



AGRICULTURE

- ~40% of GDP; 26% food crops, 4% cash crops, 5% livestock products, 2% fishery products and aquaculture, 2% forestry production; employs over 70% of the population; 20% of export revenue; rainfed dependent; agricultural land (2018): 44.76% of land area; 2% of cultivated land is irrigated

Main climate change impacts

- Decreased productivity of coffee and cocoa due to increasing temperatures
- Maize yields could decline by more than 25% by mid-century
- Tuber crops, such as yams, may benefit from higher temperatures and increasing rainfall; cassava yields could double by end of century
- Increased prevalence of pests and diseases due to increasing temperatures and rainfall, thereby affecting crop yields
- Flash flooding may introduce diseases in livestock, such as trypanosomiasis in cattle, while drying of watering points and pasture degradation may lead to death of livestock
- Decrease in fish production due to disturbances in fish productivity cycles and salinization of freshwater bodies
- Rising sea surface temperatures may lead to increased evapotranspiration in surface water and force fish to lower depths, thereby decreasing catches

Examples of adaptation practices

- Building technical capacity of key research institutions
- Breeding crops and livestock resistance to pests and diseases and promoting small-scale irrigation
- Improving sustainable forest and land management through promoting fast-growing tree species for wood energy and developing a national monitoring program for land use
- Construction and/or improvement of reservoirs for micro-irrigation and livestock watering in rural areas
- Support for vulnerability mapping
- Promotion of rice production systems

Milestones

- The country has committed to the Climate-Smart Agriculture process laid out in the agricultural policy of the Economic Community of West African States (ECOWAS) and the National Policy for the Agricultural Development of Togo 2013–2022



COASTAL ZONE

More than 500,000 people live in precarious housing along the coast; 250 m coastline recession due to coastal erosion

Main climate change impacts

- Projected increase in sea level rise (baseline 1986–2005): by up to 0.16 m (by 2025), 0.34 m (by 2050), 0.55 m (by 2075) and 0.74 m (by end of century), based on conservative RCP2.6 scenario
- Increased salination in drinking water due to salt water intrusion from rising sea levels
- Loss of farms for those carrying out farming activities such as market gardening along the coast
- Rising sea levels will exacerbate coastal erosion, impacting coastal infrastructure; current average loss of coastline of 5 m/year likely to reach recession of 10 m/year, with an annual erosion rate of 20 m along the eastern section of Lomé
- Increased flooding in the lower region of the city of Lomé, where 40%–50% of the population lives and 80% of infrastructure, industries and hotels are located
- Rising sea surface temperatures may lead to losses of coastal habitats such as mangroves as well as key food sources such as plankton. Continued

ocean acidification will result in reduced protein intake and nutrition deficits for human population

Examples of adaptation practices

- Intensifying national action under the west African regional program against coastal erosion (West African Economic and Monetary Union) and West Africa Coastal Areas management program (WACA)
- Awareness raising on coastal vulnerabilities and sustainability
- Consolidation of data observation and databases
- Construction of barriers against salt water intrusion
- Resettlement of those in risk zones along the coast
- Rehabilitation of lagoons

Milestones

- Plans to be adopted: A Coastal Development Master Plan (SADL); Multisectoral Investment Plan (MSIP); Strategie Nationale pour la Mer et le Littoral (SNML); Cadre Strategique pour le Developpement de l'Economie Maritime et Cotiere au Togo



NEEDS

Research

- Improve understanding of vulnerabilities and possible adaptation responses
- Education on meteorology, climatology and general hydrology
- Build capacity of hydro-met service staff
- Enhance capabilities for handling climate change data at national, regional and local levels
- Research into renewable energy and sea level rise
- Improve cooperation between research institutions and universities on climate change issues; develop early warning systems for climate change related human diseases
- Enable informed decision-making and action through research

Institutional

- Institutionalize and strengthen disaster risk management with strengthened capacities at all levels of government and communities
- Mainstream climate change in national, local and sector policies and reinforce institutional frameworks for implementation of UNFCCC commitments
- Strengthen and enhance international collaboration, linkages and networking among stakeholders
- Strengthen institutional and regulatory framework for action on health and environment
- Build capacity of national experts in various state departments for implementation, follow-up, quality control and reporting
- Integrate climate change concerns into relevant policies and planning processes at the state and national levels

Data and information

- Improve technical capacity to analyze hydro-met data and project impacts across sectors, specifically regarding health and natural disaster events
- Create national observatories and strengthen national capability for documenting, archiving and storing observational data
- Establish institutional capacity for providing timely early warning systems to farmers
- Increase understanding of water resource threats and groundwater risks
- Improve regulation and enforcement to protect forests, rainforests and protected areas
- Enhance technology transfer to promote climate change adaptation through education and public awareness



Photo: Homo Cosmicos/Shutterstock

¹WBG Climate Change Knowledge Portal (CCKP, 2021). Togo

²WBG Climate Change Knowledge Portal (CCKP, 2021). Togo Projected Future Climate

³Authors' summary based on CRED EM-DAT database, accessed 10 May 2021: EM-DAT: The Emergency Events Database - Université catholique de Louvain (UCL) - CRED, D. Guha-Sapir, Brussels, Belgium

⁴ThinkHazard! (2020). Togo River Flood

⁵ThinkHazard! (2020). Togo Extreme Heat

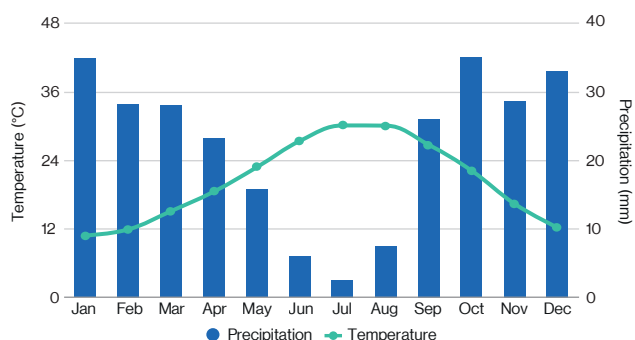
⁶ND-Gain. ND-Gain Index: Togo

Tunisia

Adapted from the World Bank's Climate Risk Country Profiles Series, 2021




Climate trends

Average monthly Temperature (T) and Precipitation (Ppt), 1991–2019¹



Mean annual T/Ppt (1901–2020): 19.4°C/263.5 mm
Mean annual max/min T (1901–2020): 25.4°C/13.5°C

Country context

 Population 11.7m (2019)	Annual growth rate 1.1% (2018)
 GDP \$38.7bn (2019)	Annual growth rate 1% (2019)
 GDP per capita \$3,400 (2018)	

Literacy rate, adult female/male: 51.24%/77.26% (2015)
CPIA gender equality rating: 3.0 (2019)
Geography: Located in North Africa, along the southern shore of the Mediterranean sea; land area: 164,000 km²; coastline: 1,300 km²
Broad climate: Northern area: hot summers and rainy winters; western, central and mountainous area: arid steppe climate; southern area: semi-arid to arid

Climate projections²

CMIP5 Ensemble Projection	2020 - 2039	2040 - 2059	2060 - 2079	2080 - 2099
Annual Temperature Anomaly (°C)	+0.5 to +2.2 (+1.3°C)	+1.5 to +3.3 (+2.3°C)	+2.0 to +4.9 (+3.3°C)	+3.0 to +6.5 (+4.6°C)
Annual Precipitation Anomaly (mm)	-5.9 to +5.2 (-0.5mm)	-7.0 to +4.9 (-1.3mm)	-8.8 to +4.5 (-1.6mm)	-9.4 to +3.7 (-3.0mm)

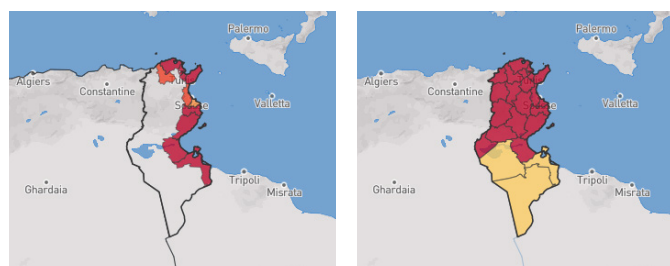
Climate hazards

- Tunisia is projected to experience heightened dry conditions and drought severity
- Water stress likely to be experienced most acutely in the central and northwestern areas, in the 2050s and 2090s, respectively
- Sea level rise is projected to lead to the loss of a sizable proportion of the northern and eastern coastlines due to a combination of inundation and erosion, with consequential loss of agricultural land, infrastructure, and urban areas
- Increased frequency of intense precipitation events will lead to a heightened risk of flooding, river bank overflow, and flash flooding

Natural hazards occurrence from 1991-2020³

Hazard	Subtype	Events	Deaths	Affected	Affected per capita per decade
Flood	Riverine	3	12	28,500	0.34%
	Flash	5	52	75,000	
Wildfires		1	-	-	0.01%
Land-slides		1	-	-	0.00%
Total		9	64	105,000	0.34%

Risk of coastal flood (left)⁴ and Risk of wildfires (right)⁵



■ High
 ■ Medium
 ■ Low
 ■ Very low

ENABLING ENVIRONMENT

Leadership and governance

Coordination of climate change (CC) agendas and adaptation efforts: Ministry of Local Affairs and Environment, National Agency for Energy Management, Ministry of Agriculture, and the Ministry of Water Resources and Fisheries. These agencies also serve as the Designated National Authority for the Clean Development Mechanism of the Kyoto Protocol

Responsible for updating water policies and strategies: National Water Council (2013)

Key adaptation policies

Key policy documents: NAP (2016); NDC (2016); Third National Communication (2019); Second Biennial Update Report (2016); De-Risking Renewable Energy Investment (2014)

Disaster Risk Management (DRM):

- Disaster Risk Management directed and managed by the Tunisian Civil Protection National Office; Tunisia's Civil Protection program is under preparation
- DRM priorities include strengthening regional coordination and investment in technological innovations to address water scarcity, sea level rise and storms; disaster risk financing and insurance mechanisms; enhancing early warning systems (EWS); integrating resilience into urban infrastructure investments

ND-GAIN Index⁵

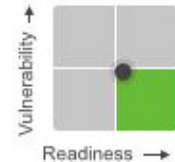
Country Index rank (score): 69 (52.1)

Vulnerability: 0.382

Ecosystem Services 16%, Food 17%, Human Habitat 18%, Health 14%, Infrastructure 18%, Water 16%

Readiness: 0.423

Economic 39%, Governance 35%, Social 25%



ND-GAIN Evolution

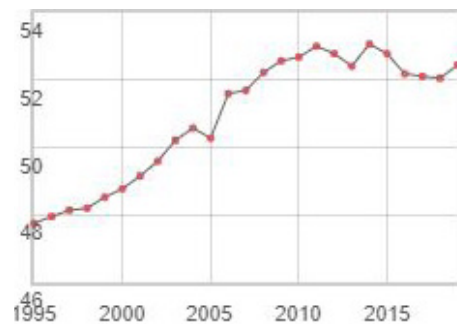


Photo: Romas_Photo/Shutterstock

Tunisia

SECTORAL ADAPTATION PLANNING



AGRICULTURE

~14% of GDP (2012); provides income for 470,000 farmers; more than 10m ha of agricultural land; 62% of total land area; currently uses 80% of all water resources

- Top agricultural commodities: olive oil, dates, citrus, grain, meat, poultry
- Main export crops: cereals, olive oil, dates, citrus fruits

Main climate change impacts

- Threatened yields of irrigated and rainfed crops by end of century due to rising temperatures, increasing evapotranspiration, and decreasing availability of water resources
- Area of non-irrigated orchards could be reduced by 800,000 ha (nearly 50% of current production area), particularly in central and southern areas
- Areas of irrigated cereals expected to decrease by 20% in the 2020s; rainfed cereal crops could decrease by 30% by the 2030s
- Increased weeds and diseases due to higher temperatures
- Crop losses, mainly wheat, barley, and irrigated potatoes, and increased food insecurity, due to floods and droughts
- Dryness and impaired soil health will negatively impact fruit and olive oil production

Examples of adaptation practices

- Increased meteorological and climatic monitoring, primarily focused on extreme events which can cause significant crop damage
- Strengthened participative debates between managers, farmers and rural inhabitants for improved localized adaptation planning
- Introducing climate monitoring and early warning systems
- Climate insurance mechanisms for agriculture
- Developing innovative systems for arable crops

Milestones

- Adoption of the National Program on Water Savings in 1995 has resulted in localized irrigation (drip irrigation) now applied to 46% of the total area of irrigated land



WATER

Significant imbalances in water resource distribution regarding service availability, water quality and access; 81% of water needs of the irrigated sector from underground resources

Main climate change impacts

- Increased intensity and frequency of dry periods and water scarcity due to decreases in average rainfall, likely to most affect those in rural areas (due to drying up of springs) and women (due to household responsibility for supply and hygiene)
- Reduced soil moisture, surface water, and underground water stocks due to increased temperatures
- Coastal aquifers threatened by sea level rise and increased threats from overexploitation, degradation and salinization
- Impact on surface water infiltration and recharge rates for groundwater due to rainfall and evaporation changes

Examples of adaptation practices

- Re-use of wastewater
- Transference of surplus water from northern to inland regions
- Water and soil conservation to reduce water demand from key sectors

Milestones

- The Djerba desalination plant became operational in 2018. Investment in this, as well as the Sfax, Zarrat, and Sousse plants, are projected to secure drinking water supply required through 2030



NEEDS

Research

- Improve understanding of vulnerabilities and possible adaptation responses
- Widen participation of the public, scientific institutions, women and local communities in planning and management
- Strengthen environmental monitoring capabilities for more effective environmental management
- Increase understanding of climate risks and impacts on coastal zones, sea level rise and coastal agricultural zones
- Strengthen technical capacity for integrating climate-smart agriculture and climate change risk management into the agricultural sector
- Design and implement a technology needs assessment

Institutional

- Develop and implement a national monitoring, verification and reporting (MRV) system
- Ensure integration of National Climate Change Strategy goals within sectoral and regional plans
- Support facilitation of energy efficiency options through improved financing and legal backing for public-private partnerships
- Implement cross-sectoral climate-smart solutions at national and subnational levels

Data and information

- Develop EWSs for improved climate risk management, specifically for sea level rise, water resources and health impacts
- Improve EWSs to support agriculture, livestock and water resources and strengthen preparedness for increased aridity and longer dry seasons
- Ensure maintenance of EWSs, including monitoring networks at appropriate spatial density and frequency



Photo: Romas_Photo/Shutterstock

¹WB Climate Change Knowledge Portal (CCKP, 2020). Tunisia

²WB Climate Change Knowledge Portal (CCKP, 2020). Tunisia Projected Future Climate

³Authors' summary based on CRED EM-DAT database, accessed 10 May 2021: EM-DAT: The Emergency Events Database - Université catholique de Louvain (UCL) - CRED, D. Guha-Sapir, Brussels, Belgium

⁴ThinkHazard! (2019). Tunisia - Coastal Flooding

⁵ThinkHazard! (2019). Tunisia - Wildfire

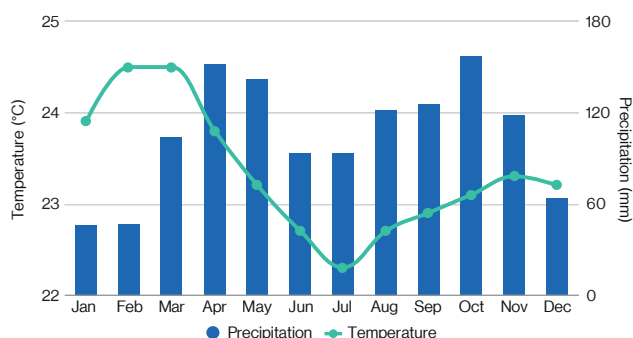
⁶ND-Gain: ND-GAIN Country Index: Tunisia

Uganda

Adapted from the World Bank's Climate Risk Country Profiles Series, 2021

Climate trends

Average monthly Temperature (T) and Precipitation (Ppt), 1991–2020¹



Mean annual T/Ppt (1901–2020): 22.4°C / 1,200 mm
Mean annual max/min T (1901–2020): 28.7°C/16.2°C

Country context

Population	44.3m (2019)	Annual growth rate	3.6% (2019)
GDP	\$35.1bn (2019)	Annual growth rate	4.5% (2019)
GDP per capita	\$4,400 (2019)		

Literacy rate, adult female/male: 72%/86% (2014)

Geography: Landlocked country in eastern Africa lying in both the northern & southern hemispheres; land area: 241,500 km²

Broad climate: North lies outside tropical zone; rest: humid equatorial climate zone

Climate projections²

CMIP5 Ensemble Projection	2020 - 2039	2040 - 2059	2060 - 2079	2080 - 2099
Annual Temperature Anomaly (°C)	+0.6 to +1.5 (+1.0°C)	+1.2 to +2.5 (+1.8°C)	+1.9 to +3.9 (+2.8°C)	+2.6 to +5.2 (+3.7°C)
Annual Precipitation Anomaly (mm)	-23.5 to +25.9 (+1.4mm)	-25.9 to +32.5 (+2.9mm)	-26.5 to +45.1 (+7.4mm)	-26.0 to +63.1 (+13.6mm)

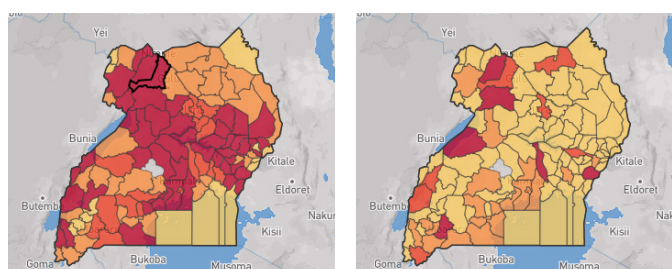
Climate hazards

- Flooding presents the largest risk, particularly in low-lying areas
- During rainy seasons, heavy rainfall can cause flash flooding, destroying roads and bridges and causing food shortages and inaccessible health facilities & schools as areas become impassable
- Each year, floods impact ~50,000 people and cost over US\$ 62 million
- Extreme weather events lead to landslides & mudslides, especially in the mountain regions such as Mbale in the Mt Elgon region
- Drought affected around 2.4 million people from 2004-2013. Drought conditions from 2010-2011 caused a loss and damage value of around US\$ 1.2 billion, 7.5% of Uganda's 2010 GDP
- Most drought-prone areas are the districts in the 'Cattle Corridor'. Extreme drought has been most prevalent in the Karamoja region

Climate hazards from 1991–2020³

Hazard	Subtype	Events	Deaths	Affected	Affected per capita per decade
Drought		6	194	3,850,000	4.49%
	Unstated	9	82	77,000	
Flood	Riverine	16	278	786,730	1.13%
	Flash	5	79	108,600	
Storm	Unstated	3	-	-	
	Tropical	-	31	8,700	0.01%
	Convective	2	-	-	
Wildfires		-	-	147,069	0.00%
Land-slides		9	591	-	0.17%
Total		50	1,255	4,978,099	5.81%

River flood risk (left) and urban flood risk (right)⁴



High Medium Low Very low

ENABLING ENVIRONMENT

Leadership and governance

- **Lead entity responsible for climate change (CC) issues:** Ministry of Water and the Environment
- Ministry's Climate Change Directorate is the lead facilitator to regional and international actors on behalf of the government, including the development of National Communications and the 2015 National Climate Change Policy
- Disaster risk management (DRM) coordinated through the Department of Disaster Preparedness and Management

Key adaptation policies

Key policy documents: Uganda One Health Strategic Plan (2018); National Adaptation Plan for the Agricultural Sector (2018); NDC (2016); National Climate Change Policy (2015); Climate Smart Agriculture Policy (2015); Uganda Vision 2040 (2007)

Disaster Risk Management (DRM):

- Economic development framework and 2010 Poverty Reduction Strategy Paper state DRM as an enabling sector to achieve sustainable development
- Disaster Management Policy (2011) outlines DRM priorities: strengthening institutions & financing for CC adaptation; developing multi-sectoral adaptation plans; implementing programs to reduce the socio-economic impact of CC and natural disasters; and increasing community-level resilience to CC
- DRM support for municipalities enables leaders to establish their own Disaster Prevention, Mitigation, and Response Committees

ND-GAIN Index⁵

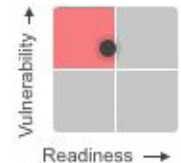
Country Index rank (score): 167 (35.9)

Vulnerability: 0.582

Ecosystem Services 18%, Food 22%, Human Habitat 19%, Health 25%, Water 15%

Readiness: 0.299

Economic 35%,
Governance 43%,
Social 21%



ND-GAIN Evolution

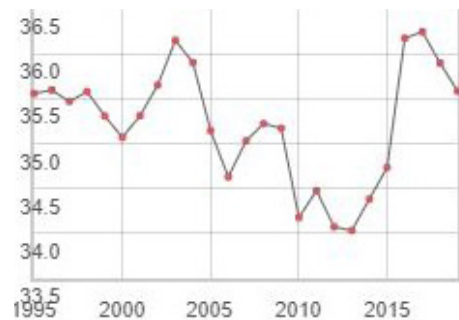


Photo: Travel Stock/Shutterstock

Uganda

SECTORAL ADAPTATION PLANNING



AGRICULTURE

25% of GDP; employs 70% of the population (2014)

Main climate change impacts

- Rising temperatures will increase crop diseases like blast and bacterial leaf blight in rice, aflatoxin in maize, fungal/viral diseases in banana & beans, coffee rust in coffee trees
- Rainfall may impact post-harvest storage, for example on maize, beans, coffee and rice which need to be dried in the sun
- Coffee & tea, major export crops, could see reduction in yields. Combined economic losses: US\$ 1.4 billion by mid-century
- Climate-induced losses: 10–50% yield losses; reduction in foreign exchange earnings by US\$ 15–US\$ 80 million per year
- Water scarcity risks quality of fields through waterlogging, decreasing recharge, and increased evaporation
- Animals are vulnerable to heat stress, which may reduce milk production and reproduction for livestock

Proposed adaptation strategies

- Improve water capture and storage; invest in irrigation in arid areas, and introduce flood- and drought-prone crops
- Pasture management such as no-burn agricultural practices
- Semi-stabled cattle systems
- Income diversification for farmers and financing options such as climate-risk insurance schemes
- Improve weather monitoring systems; frequent publication & distribution of agriculture-specific weather forecasts



WATER

Main climate change impacts

- Unmet water demand by 2050 could reach US\$ 5.5 billion. Largest losses expected in Lake Victoria and Albert Nile, and Lake Kyoga Watersheds
- 82% of recharge water in Lake Victoria comes from precipitation from two main rainy seasons (2,100 mm per year). In 2006, Lake Victoria reached an 80-year low
- Risk of water contamination of surface sources & wells from flooding
- Surface water infiltration and recharge rates for groundwater at risk from changes in rainfall

Proposed adaptation strategies

- Focus adaptation strategies on increasingly variable rainfall patterns, with specific attention on the most at-risk area on the cattle corridor axis
- Support groundwater monitoring wells
- Improve water infrastructure and protection of lake and river catchments, and other sources of freshwater including aquifers
- Adaptation strategies for water should be included in development strategies for agriculture, infrastructure, and energy sectors
- Mainstream CC in all water resources management plans and programs



HEALTH

Main climate change impacts

- Under high & low emissions scenarios, by 2070 around 108 million people are projected to be at risk of malaria
- Increased temperatures and flooding around rivers and lakes likely to increase vector and water-borne diseases such as schistosomiasis, dengue, and cholera. Districts such as Buikwe, Masaka, Mpigi, Jinja and Mayuge are at risk
- Under a high emissions scenario, heat-related deaths in the elderly (65+ years) are projected to increase to about 81 deaths per 100,000 by the 2080s compared to the estimated baseline of under 2 deaths per 100,000 annually between 1961 and 1990
- Outdoor workers and the agricultural industry are at risk to heat stress, dehydration and prolonged exposure can lead to chronic kidney disease and cardiovascular diseases

Proposed adaptation strategies

- Training and capacity building of healthcare personnel on relationship between CC and health, and adaptation to CC to mitigate negative health impacts
- Improve monitoring and surveillance systems of trends to forecast direct interventions against climate-sensitive diseases
- Investment and research to support identification and analysis of trends and develop indicators to improve health sector capacity to react
- Develop health early warning systems (EWS), especially for heat wave and flooding warnings



NEEDS

Research

- Increase understanding of vulnerabilities and adaptation responses
- Involve public, scientific institutions, women and local communities in adaptation planning
- Strengthen environmental monitoring
- Invest in weather stations and expand hydro-meteorological monitoring systems
- Strengthen technical capacity to integrate climate-smart agriculture and CC risk management into the agricultural sector
- Conduct household surveys to collect poverty data for climate resilience

Institutional

- Integrate National Environmental Strategy goals in sectoral & regional plans
- Implement cross-sectoral climate-smart solutions at national and subnational levels
- Integrate climate change concerns into relevant policies and planning processes at the state and national levels

Data and information

- Improve observational data by adding weather stations and hydro-meteorological instrumentation
- Improve technical capacity to analyse meteorological data
- Institutional capacity strengthening for EWS
- Develop a tool to quantify economic losses from disasters in various infrastructure sectors

¹WBG Climate Change Knowledge Portal (CCKP, 2021). Uganda

²WBG Climate Change Knowledge Portal (CCKP, 2021). Uganda Projected Future Climate

³Authors' summary based on CRED EM-DAT database, accessed 10 May 2021: EM-DAT: The Emergency Events Database - Universite catholique de Louvain (UCL) - CRED, D. Guha-Sapir, Brussels, Belgium

⁴ThinkHazard! (2020). Uganda Urban Flood

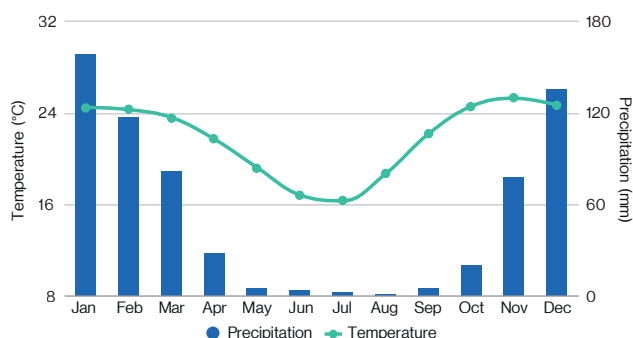
⁵ND-Gain. ND-Gain Index: Uganda

Zimbabwe

Adapted from the World Bank's Climate Risk Country Profiles Series, 2021

Climate trends

Average monthly Temperature (T) and Precipitation (Ppt), 1991–2020¹



Mean annual T/Ppt (1991–2020): 21.3°C / 669.9mm

Mean annual max/min T (1991–2020): 28.2°C/14.5°C

Mean annual T increase (1970–2016): 0.03°C p/y

Country context

Population
14.6m (2019)

GDP
\$21.4bn (2019)

GDP per capita
\$1,700 (2019)

Annual growth rate
-8.1% (2019)

Literacy rate, adult female/male: 83%/91% (2018)

Geography: Landlocked country in southern Africa; Land area: 390,757 km²

Broad climate: North: subtropical climate with dry winter/hot summer; South: hot arid, steppe climate

Climate projections²

CMIP5 Ensemble Projection	2020 - 2039	2040 - 2059	2060 - 2079	2080 - 2099
Annual Temperature Anomaly (°C)	+1.1 to +1.5 (+1.2°C)	+1.9 to +2.7 (+2.2°C)	+3.2 to +4.0 (+3.4°C)	+4.2 to +5.8 (+4.6°C)
Annual Precipitation Anomaly (mm)	-12.5 to +1.0 (-3.3mm)	-19.6 to +1.9 (-5.1mm)	-27.8 to -1.3 (-7.4mm)	-32.3 to -0.1 (-8.2mm)

Climate hazards

Drought

Annual likelihood of severe drought projected increase compared to 1986-2005 baseline under RCP8.5 scenario:

- 21% in 2040–2059; 47% in 2080–2099

Number of very hot days (Tmax >35°C) per year expected increase (from reference period under RCP8.5):

- 39 days in 2040–2059; 108 days in 2080–2099

Number of days of consecutive dry spell per year (or days without significant rainfall of at least 1mm) projected increase:

- 13 days in 2040–2059; 25 days in 2080–2099

CMIP5 multi-model ensemble projection

Climate hazards from 1991–2017³

Hazard	Subtype	Events	Deaths	Affected	Affected per capita per decade
Drought		6	-	21,022,618	57.65%
	Unstated	1	13	30,000	
Flood	Riverine	9	271	247,020	0.76%
	Flash	2	29	1,000	
Storm	Unstated	-	887	370,000	
	Tropical	4	41	2,000	1.02%
	Convective	2	-	-	
Total		24	1,241	21,672,638	59.43%

ENABLING ENVIRONMENT

Leadership and governance

Governmental level

The Ministry of Environment, Water and Climate (MEWC)

- Guides compliance to multilateral agreements; chairs national technical committee responsible for NDC implementation; Initiated NAP development process

High Level National Steering Committee

- Provides policy direction on NDC implementation in line with National Development Objectives

The Environmental Management Agency (EMA)

- Responsible for natural resource management (NRM), environmental protection, and preparation of Environmental Plans

International level

Zimbabwe Vulnerability Assessment Committee (ZimVAC)

- Responds to food insecurity, a consortium of Government, UN agencies, NGOs, etc., led and regulated by the government, chaired by Food and Nutrition Council (FNC)

Key adaptation policies

Key policy documents: NAP (2019); National Climate Policy (2016); NDC (2016); Zimbabwe Agriculture Investment Plan (2013–2017); National Climate Change Response Strategy (2015)

Disaster Risk Management (DRM):

- Disaster Risk Management Bill focuses on reactive DRM
- New policy and act under development with emphasis on DRM preparation, response and recovery
- DRM options: adopting multistakeholder approach; enhance early warning systems (EWS), hydro-meteorological services and building standards and codes; investing in climate-resilient social infrastructure; promoting climate-indexed insurance and enabling market frameworks

ND-GAIN Index⁴

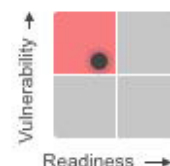
Country Index rank (score): 171 (34.9)

Vulnerability: 0.520

Ecosystem Services 20%, Food 21%, Human Habitat 22%, Health 25%, Water 11%

Readiness: 0.219

Economic 39%, Governance 40%, Social 20%



ND-GAIN Evolution

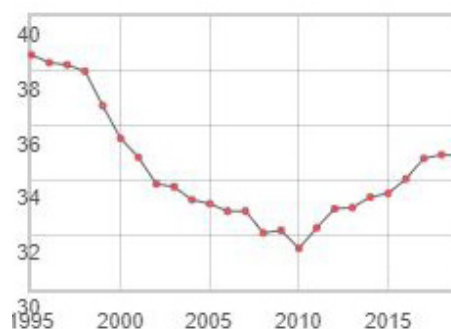


Photo: Eva Mont/Shutterstock

Zimbabwe

SECTORAL ADAPTATION PLANNING



AGRICULTURE

Agricultural area: 42% of total land area; accounts for 56% of employment; rainfed agriculture 80%, irrigated 20%; total irrigated area: 123,000m ha

- **Crops:** Grain: maize, sorghum, mhunga, rapoko, oilseeds; Industrial: tobacco, cotton, edible dry beans and paprika; High market value: tobacco, cotton and maize

Main climate change (CC) impacts

- Rainfed and irrigated agriculture at risk from droughts & floods
- Limited precipitation & extreme heat likely to diminish rangeland productivity and decrease livestock production. Net primary production projected to drop from 8 tons per hectare p/y to 5 tons per hectare p/y by 2080
- Zimbabwe is trending towards more arid and nonarable climatic conditions, which could lead to food insecurity, an increase in unemployment and reduction in economic growth

Proposed adaptation strategies

- Financial needs: US\$ 34.9 billion by 2030 under business as usual (BAU) (75% international support, 25% from national budget)
- Frameworks for sustainable intensification, commercialization of agriculture, science-based crop production, post-harvest technologies and management practices
- Capacity strengthening for new knowledge, technologies and agricultural support services; and to identify and promote livestock breeds tolerant to climate-related stresses
- EWS on cropping season quality, rangelands conditions, droughts and floods to enhance farmer preparedness
- Research for development and integrated management of agricultural water resources



WATER

Annual water generation: 23bn m³; surface water resources: 90%; ground water resources: 10%; 8000 dams in total; river catchments: Gwayi, Manyame, Mazowe, Mzingwane, Runde, Sanyati & Save

Main climate change impacts

- Impacts of CC on water resources management include increased water loss through evapotranspiration
- Lower rainfall may negatively affect groundwater recharge and water runoff, with such changes limiting hydropower generation
- Without adaptation measures, the population at very high risk of groundwater drought could rise from 32% to 86%
- Analysis of mean annual river runoff and potential evapotranspiration (PET) using 121 climate scenarios (CMIP3 and CMIP5) showed similar conclusions

Proposed adaptation strategies

- Water sector is mainly guided by the Water Act of 1998 and National Water Policy of 2013; a National Water Resources Master Plan for 2020–2040 (NWRMP) is in the process of being developed
- Promote water harvesting as an adaptation strategy
- Rehabilitate and maintain surface and groundwater resources
- Strengthen and intensify monitoring systems for hydrometeorological parameters
- Strengthen institutional capacity, research and extension for integrated water resources management
- Conduct more frequent yield assessments of surface and groundwater resources



FORESTRY

Forestry rents: 4.1% of GDP

Main climate change impacts

- Ratio of forest area to total land area decreased from 57% (1990) to 36% (2015) from lack of sustainable land-use and forest management systems, and frequent wildfires
- CC expected to influence plantation species composition of forest ecosystems, extents of forest ecosystems, species volume and density, biodiversity, frequency and intensity of forest fires
- High fire density appears in northern and southeastern parts of the country. Wildfire is associated with more than 1 million ha of loss in rangelands and forests per year

Proposed adaptation strategies

- Develop and enforce policies that regulate change from one land-use to another, especially the clearance of forests and woodlands to other land-uses
- Promote establishment of land-use plans at district, ward, village and farm management levels that clearly identify forestry as a recognized land-use
- Strengthen research, planning and financial support to forestry and natural resources management in order to develop cost-effective adaptation options
- Build capacity for forest management in a changing climate
- Promote and strengthen biodiversity conservation management and the integrity of natural ecosystems by using an ecosystem-based approach to adapt to climate change

Estimated groundwater recharge (Giga-Liter/Year) for Zimbabwean catchments⁵

Catchment	Current (World Climate Data)	2050 Business as usual scenario (A2a)	2050 Ecologically aware scenario (B2a)	2080 Business as usual scenario (A2a)	2080 Ecologically aware scenario (B2a)
Gwayi	1,596	1,438 (-10%)	1,520 (-5%)	1,359 (-15%)	1,549 (-3%)
Manyame	1,907	1,868 (-2%)	1,932 (1%)	1,839 (-4%)	1,944 (2%)
Mazowe	1,918	1,791 (-7%)	1,901 (-1%)	1,811 (-6%)	1,844 (-2%)
Mzingwane	632	537 (-15%)	558 (-12%)	473 (-25%)	566 (-12%)
Rundee	1,449	1,215 (-16%)	1,277 (-12%)	1,096 (-24%)	1,265 (-13%)
Sanyati	2,750	2,549 (-7%)	2,668 (-3%)	2,441 (-11%)	2,694 (-2%)
Save	2,660	2,279 (-14%)	2,439 (-8%)	2,197 (-17%)	2,418 (-9%)

¹WBG Climate Change Knowledge Portal (CCKP, 2021). Climate Data: Historical

²WBG Climate Change Knowledge Portal (CCKP, 2021). Climate Data: Projections

³Authors' summary based on CRED EM-DAT database, accessed 10 May 2021: EM-DAT: The Emergency Events Database - Universite catholique de Louvain (UCL) - CRED, D. Guha-Sapir, Brussels, Belgium

⁴ND-Gain: ND-GAIN Country Index: Zimbabwe

⁵R. Davis and R. Hirji (2014). Climate Change and Water Resources Planning, Development and Management in Zimbabwe