CLIMATE RISK COUNTRY PROFILE

GHANA

WORLD BANK GROUP

COPYRIGHT

1818 H Street NW, Washington, DC 20433
Telephone: 202-473-1000; Internet: www.worldbank.org

RIGHTS AND PERMISSIONS

Graphic Design: Circle Graphics, Reisterstown, MD.

ACKNOWLEDGEMENTS

This profile is part of a series of Climate Risk Country Profiles developed by the World Bank Group (WBG). The country profile synthesizes most relevant data and information on climate change, disaster risk reduction, and adaptation actions and policies at the country level. The country profile series are designed as a quick reference source for development practitioners to better integrate climate resilience in development planning and policy making. This effort is managed and led by Veronique Morin (Senior Climate Change Specialist, WBG) and Ana E. Bucher (Senior Climate Change Specialist, WBG).

This profile was written by MacKenzie Dove (Senior Climate Change Consultant, WBG). Additional support was provided by Yunziyi Lang (Climate Change Analyst, WBG), Fernanda Zermoglio (Senior Climate Change Consultant, WBG) and Jason Johnston (Operations Analyst, WBG).

Climate and climate-related information is largely drawn from the Climate Change Knowledge Portal (CCKP), a WBG online platform with available global climate data and analysis based on the latest Intergovernmental Panel on Climate Change (IPCC) reports and datasets. The team is grateful for all comments and suggestions received from the sector, regional, and country development specialists, as well as climate research scientists and institutions for their advice and guidance on use of climate related datasets.

CONTENTS

FOREWORD

Climate change is a major risk to good development outcomes, and the World Bank Group is committed to playing an important role in helping countries integrate climate action into their core development agendas. The World Bank Group is committed to supporting client countries to invest in and build a low-carbon, climate-resilient future, helping them to be better prepared to adapt to current and future climate impacts.

The World Bank Group is investing in incorporating and systematically managing climate risks in development operations through its individual corporate commitments.

A key aspect of the World Bank Group's Action Plan on Adaptation and Resilience (2019) is to help countries shift from addressing adaptation as an incremental cost and isolated investment to systematically incorporating climate risks and opportunities at every phase of policy planning, investment design, implementation and evaluation of development outcomes. For all IDA and IBRD operations, climate and disaster risk screening is one of the mandatory corporate climate commitments. This is supported by the Bank Group's Climate and Disaster Risk Screening Tool which enables all Bank staff to assess short- and long-term climate and disaster risks in operations and national or sectoral planning processes. This screening tool draws up-to-date and relevant information from the World Bank's Climate Change Knowledge Portal, a comprehensive online 'one-stop shop' for global, regional, and country data related to climate change and development.

Recognizing the value of consistent, easy-to-use technical resources for client countries as well as to support respective internal climate risk assessment and adaptation planning processes, the World Bank Group's Climate Change Group has developed this content. Standardizing and pooling expertise facilitates the World Bank Group in conducting initial assessments of climate risks and opportunities across sectors within a country, within institutional portfolios across regions, and acts as a global resource for development practitioners.

For developing countries, the climate risk profiles are intended to serve as public goods to facilitate upstream country diagnostics, policy dialogue, and strategic planning by providing comprehensive overviews of trends and projected changes in key climate parameters, sector-specific implications, relevant policies and programs, adaptation priorities and opportunities for further actions.

It is my hope that these efforts will spur deepening of long-term risk management in developing countries and our engagement in supporting climate change adaptation planning at operational levels.

Bernice Van Bronkhorst
Global Director
Climate Change Group (CCG)
The World Bank Group (WBG)

COUNTRY OVERVIEW

Ghana, located along the south-central coast of West Africa, shares borders with the Republic of Togo to the east, Burkina Faso to the north and Cote d'Ivoire to the west. Ghana has an area of 239,460 km^2 and its territorial coastal waters extends 200 nautical miles off the coast. Ghana's territory has many water bodies, which include the Lakes Volta and Bosomtwe, which occupy 3,275 km^2, as well as other seasonally flooded lakes that occupy another 23,350 km^2.[1] The country has two broad ecological zones: forest zone, which cover 30% of the southern region and the Northern Savannah Ecological Zone, which covers the remaining, drier, 70%. More than 70% of the country's land area is dedicated to agriculture.[2] **Figure 1** shows the topography and elevation for Ghana.

FIGURE 1. Relief map of Ghana[3]

Ghana is a lower middle-income, developing country with a stable and democratic government. In 2019, the country's population was 30.4 million people with an annual population growth rate of 2.2%. Projections suggest that the population will increase to 37.3 million people by 2030 and 51.2 million people by 2050. Over 55% of Ghanaians reside in urban areas, which are expected to experience considerable growth, with 63% and 73% of the population residing in urban areas by 2030 and 2050.[4] The country has a Gross Domestic Product (GDP) of US$66.9 billion (2019) and had an annual growth rate of 6.5%.[5] The impacts of climate change on Ghana's overall economic growth are predominantly negative (**Table 1**). Since 2010, economic growth has been fueled by high commodity prices and newly developed offshore oil resources. Despite a recent transition to an industry and services-oriented economy, 45%of the workforce still relies on work dependent upon rainfed agriculture. The fisheries sector contributes 4.5% to GDP and is another important source of income and nutrition, providing livelihoods for as many as 2.2 million people. Ghana's Northern Savannah Ecological Zone, where agricultural production is centered and where poverty rates are most severe, will see increasing risks as the climate changes.[6] The risks posed by climate change in Ghana include risks for the health and agriculture sectors, primarily due to altered rainfall patterns and coastal area flooding.[7]

---

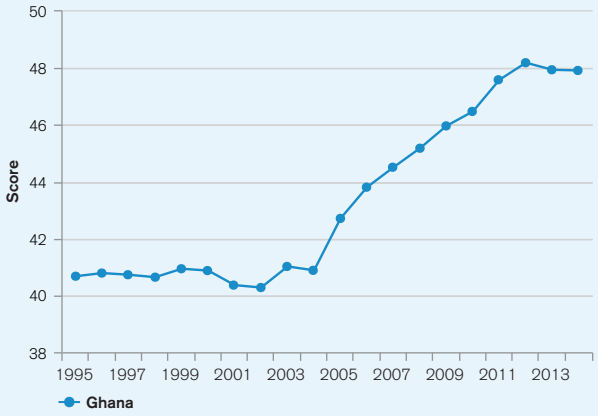
1 UNDP (2019). Climate Change Adaptation Profile – Ghana. URL: https://www.adaptation-undp.org/explore/western-africa/ghana
2 Republic of Ghana (2015). Ghana's Third National Communication to the UNFCCC. URL: https://unfccc.int/resource/docs/natc/ghanc3.pdf
3 World Bank (2019). Internal Climate Migration Profile – Ghana.
4 World Bank Open Data, Data Retrieved March 2021. Data Bank: Population Estimates and Projections, Ghana. URL: https://databank.worldbank.org/data/reports.aspx?source=health-nutrition-and-population-statistics:-population-estimates-and-projections
5 World Bank Open Data, Data Retrieved March 2021. Data Bank: World Development Indicators, Ghana. URL: https://databank.worldbank.org/data/reports.aspx?source=2&country
6 USAID (2017). Climate Change Risk Profile – Ghana. URL: https://www.climatelinks.org/sites/default/files/asset/document/2017_USAID_Climate%20Change%20Risk%20Profile%20-%20Ghana.pdf
7 UNDP (2019). Climate Change Adaptation Profile – Ghana. URL: https://www.adaptation-undp.org/explore/western-africa/ghana

TABLE 1. Data snapshot: Key development indicators[8]

Indicator	
Life Expectancy at Birth, Total (Years) (2019)	64.1
Population Density (People per sq. km Land Area) (2018)	130.8
% of Population with Access to Electricity (2018)	82.4%
GDP per Capita (Current US$) (2019)	$2,202.10

The ND-GAIN Index[9] ranks 181 countries using a score which calculates a country's vulnerability to climate change and other global challenges as well as their readiness to improve resilience. This Index aims to help businesses and the public sector better identify vulnerability and readiness in order to better prioritize investment for more efficient responses to global challenges. Due to a combination of political, geographic, and social factors, Ghana is recognized as vulnerable to climate change impacts, ranked 109 out of 181 countries in the 2020 ND-GAIN Index. The more vulnerable a country is the lower their score, while the more ready a country is to improve its resilience the higher it will be. Norway has the highest score and is ranked 1st. **Figure 2** is a time-series plot of the ND-GAIN Index showing Ghana's progress.

FIGURE 2. ND-GAIN Index for Ghana



Ghana submitted its Nationally-Determined Contribution to the UNFCCC in 2016, in support of the country's efforts to realize its development goals and increase its resilience to climate change. Ghana also published its Fourth National Communication to the UNCCC in 2020. Ghana is particularly focused on increasing its resilience through the development of sustainable land use practices, including food security, climate-proof infrastructure, energy security, sustainable forest management and urban waste management. Key sectoral focus is on energy, industry, waste and forestry sectors to reduce the country's carbon footprint.[10]

[8] World Bank (2021). DataBank – World Development Indicators. URL: https://databank.worldbank.org/source/world-development-indicators

[9] University of Notre Dame (2020). Notre Dame Global Adaptation Initiative. URL: https://gain.nd.edu/our-work/country-index/

[10] Republic of Ghana (2016). Nationally-Determined Contributions. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Ghana%20First/GH_INDC_2392015.pdf

Green, Inclusive and Resilient Recovery

The coronavirus disease (COVID-19) pandemic has led to unprecedented adverse social and economic impacts. Further, the pandemic has demonstrated the compounding impacts of adding yet another shock on top of the multiple challenges that vulnerable populations already face in day-to-day life, with the potential to create devastating health, social, economic and environmental crises that can leave a deep, long-lasting mark. However, as governments take urgent action and lay the foundations for their financial, economic, and social recovery, they have a unique opportunity to create economies that are more sustainable, inclusive and resilient. Short and long-term recovery efforts should prioritize investments that boost jobs and economic activity; have positive impacts on human, social and natural capital; protect biodiversity and ecosystems services; boost resilience; and advance the decarbonization of economies.

CLIMATOLOGY

Climate Baseline

Overview

Ghana's generally tropical climate is strongly influenced by the West African monsoon winds, which varies slightly along with the country's varied topography. Across Ghana, annual rainfall ranges from 1,100mm in the north to approximately 2,100 mm in the southwest. The northern part of the country has one rainy season, which extends from May to September; the south has two rainy seasons: the first from April to July and the second from September to November. The dry season (December to March) brings the arid and dusty harmattan winds that blow from the Sahara Desert, and is marked by low humidity, hot days (T >25°C) and cool nights (T <20°C) Average annual temperatures are approximately 27°C, with higher temperatures generally exhibited in the north and during the country's dry season. The area between the forest in the southwest and the savanna in the north is vital for domestic food production, due to more reliable rains and an extended growing season.[11]

[11] USAID (2017). Climate Change Risk Profile – Ghana. URL: https://www.climatelinks.org/sites/default/files/asset/document/2017_USAID_Climate%20Change%20Risk%20Profile%20-%20Ghana.pdf

Ghana is highly vulnerable to climate variability and change, which continues to pose a threat to future growth and development. Rising sea levels, drought, higher temperatures and erratic rainfall negatively impacts infrastructure, hydropower production, food security and coastal and agricultural livelihoods. Approximately ¼ of the population lives along the coast in rapidly expanding urban areas like Accra, and are especially vulnerable to flooding and waterborne diseases. Drought and reduced rainfall threaten access to reliable power sources, already erratic and insufficient. The climate and socio-economic environment in semi-arid, coastal and wetland areas across Ghana make communities vulnerable to food insecurity and unstable livelihoods as well as leading to unsustainable agroecological systems, crop failure and unproductive rangelands.[12]

Analysis of data from the World Bank Group's Climate Change Knowledge Portal (CCKP) (**Table 2**) shows historical information for 1901–2020. Mean annual mean temperature for Ghana is 27.3°C, with average monthly temperatures ranging between 25°C–26°C (June to September) and 28°C–29°C (February to April). Mean annual precipitation is 1,189.9 mm, with highest rainfall occurring May to September, with extremely low precipitation falling between November to January, for the most recent climatology, 1991–2020 (**Figure 3**).[13] **Figure 4** shows the spatial representation of the average annual precipitation and temperature across Ghana.

TABLE 2. Data snapshot: Summary statistics

Climate Variables	1901–2020
Mean Annual Temperature (°C)	27.3°C
Mean Annual Precipitation (mm)	1,189.9 mm
Mean Maximum Annual Temperature (°C)	32.5°C
Mean Minimum Annual Temperature (°C)	22.1°C

[12] USAID (2017). Climate Change Risk Profile – Ghana. URL: https://www.climatelinks.org/sites/default/files/asset/document/2017_USAID_Climate%20Change%20Risk%20Profile%20-%20Ghana.pdf

[13] WBG Climate Change Knowledge Portal (CCKP, 2021). Ghana URL: https://climateknowledgeportal.worldbank.org/country/ghana/climate-data-historical

FIGURE 3. Average monthly temperature and rainfall for Ghana, 1991–2020[14]

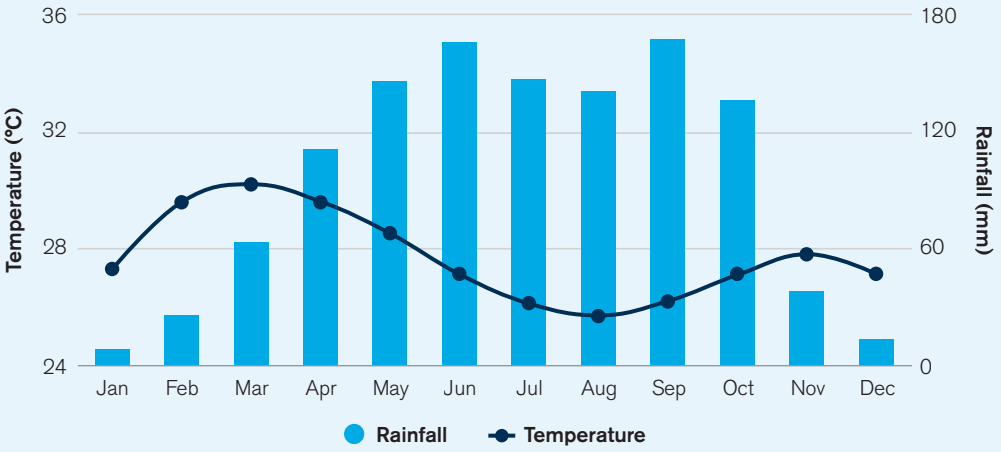
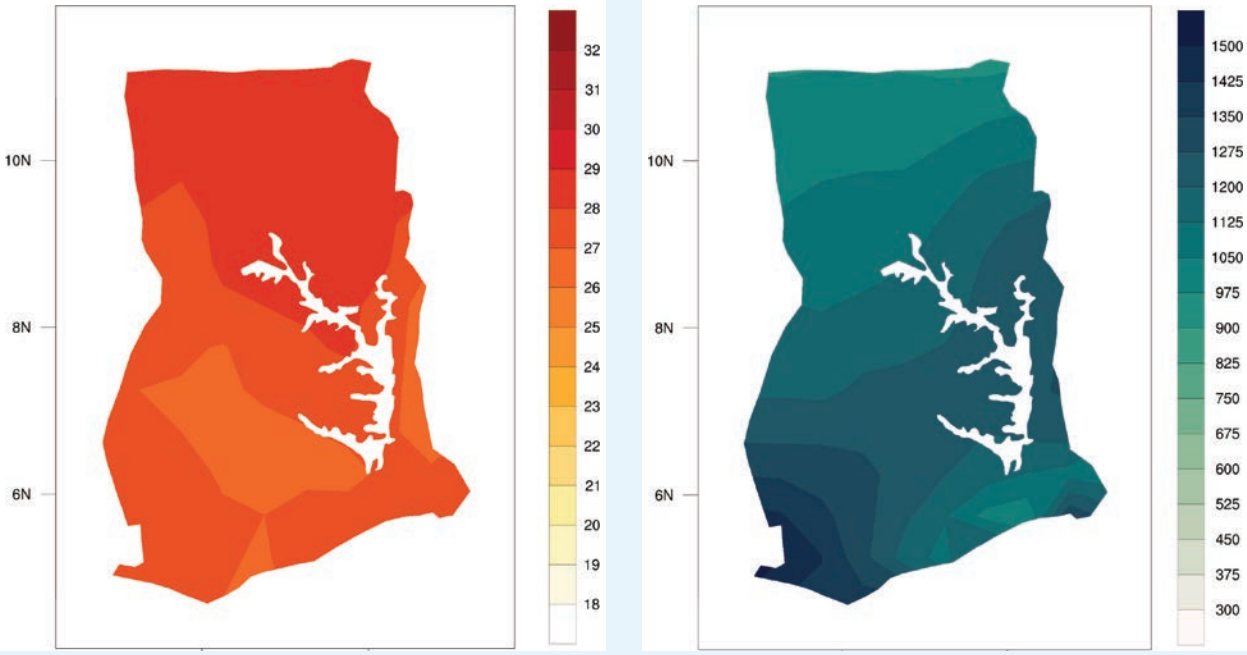


FIGURE 4. Map of average annual temperature (°C) (left); annual precipitation (mm) (right) of Ghana, 1991–2020[15]



[14] WBG Climate Change Knowledge Portal (CCKP, 2021). Ghana URL: https://climateknowledgeportal.worldbank.org/country/ghana/climate-data-historical

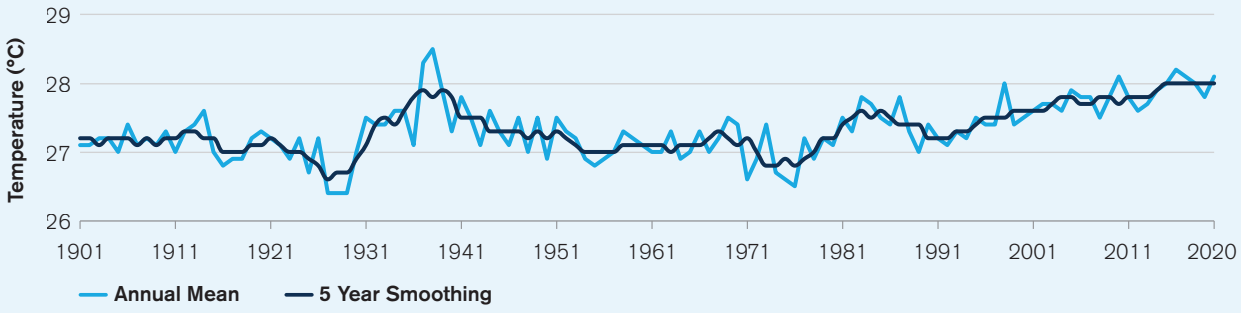
[15] WBG Climate Change Knowledge Portal (CCKP, 2021). Ghana. URL: https://climateknowledgeportal.worldbank.org/country/ghana

Key Trends

Temperature

Temperatures in Ghana have risen by approximately 1°C since the 1960s (an average increase of 0.21°C per decade) (**Figure 5**). The number of very hot days (Tmax >35°C) have increased by over 13% per year, and hot nights (Tmin >26°C) increasing by 20% per year; with the most pronounced increase occurring between September and November.[16] Overall, the rates of increase have been more rapid in the north of the country, and minimum temperatures in the southern regions (rainforest and coastal, agro-ecological areas) have increased. However, the rate of temperature rise for the middle and northern parts of Ghana (savannah zones) were +37%.[17]

FIGURE 5. Observed temperature for Ghana, 1901–2020[18]



[16] USAID (2017). Climate Change Risk Profile – Ghana. URL: https://www.climatelinks.org/sites/default/files/asset/document/2017_USAID_Climate%20Change%20Risk%20Profile%20-%20Ghana.pdf

[17] Republic of Ghana (2015). Ghana's Third National Communication to the UNFCCC. URL: https://unfccc.int/resource/docs/natc/ghanc3.pdf

[18] WB Climate Change Knowledge Portal (CCKP, 2021). Ghana URL: https://climateknowledgeportal.worldbank.org/country/ghana/climate-data-historical

Precipitation

Precipitation in Ghana, and the West Africa region, experience a high degree of interannual and interdecadal variability. However, since the 1960s, an overall reduction in cumulative rainfall of 2.4% per decade was observed.[19] Changes in decadal rainfall declined in the middle of the country, with more intense rainfall events occurring in both the north and south of the country, indicating an increase in the intensity of rainfall events and possibility of increased dry spell durations.[20]

Climate Future

Overview

The main data source for World Bank Group's Climate Change Knowledge Portal (CCKP) is the CMIP5 (Coupled Inter-comparison Project No.5) data ensemble, which is the resource database for the global climate change projections presented in the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC). Four Representative Concentration Pathways (i.e. RCP2.6, RCP4.5, RCP6.0, and RCP8.5) were modelled, defined by their total radiative forcing (cumulative measure of GHG emissions from all sources) pathway and level by 2100. The RCP2.6, for example, represents a very strong mitigation scenario, whereas the RCP8.5 assumes business-as-usual scenario where emissions will follow historical trends. For more information, please refer to the RCP Database. For simplification, these scenarios are referred to as a low (RCP2.6); a medium (RCP4.5) and a high (RCP8.5) emission scenario in this profile. **Table 3** provides CMIP5 projections for essential climate variables under high emission scenario (RCP8.5) over 4 different time horizons. **Figure 6** presents the multi-model (CMIP5) ensemble of 32 Global Circulation Models (GCMs) showing the projected changes in annual precipitation and temperature for the periods 2040–2059 and 2080–2099.

TABLE 3. Data snapshot: CMIP5 ensemble projection

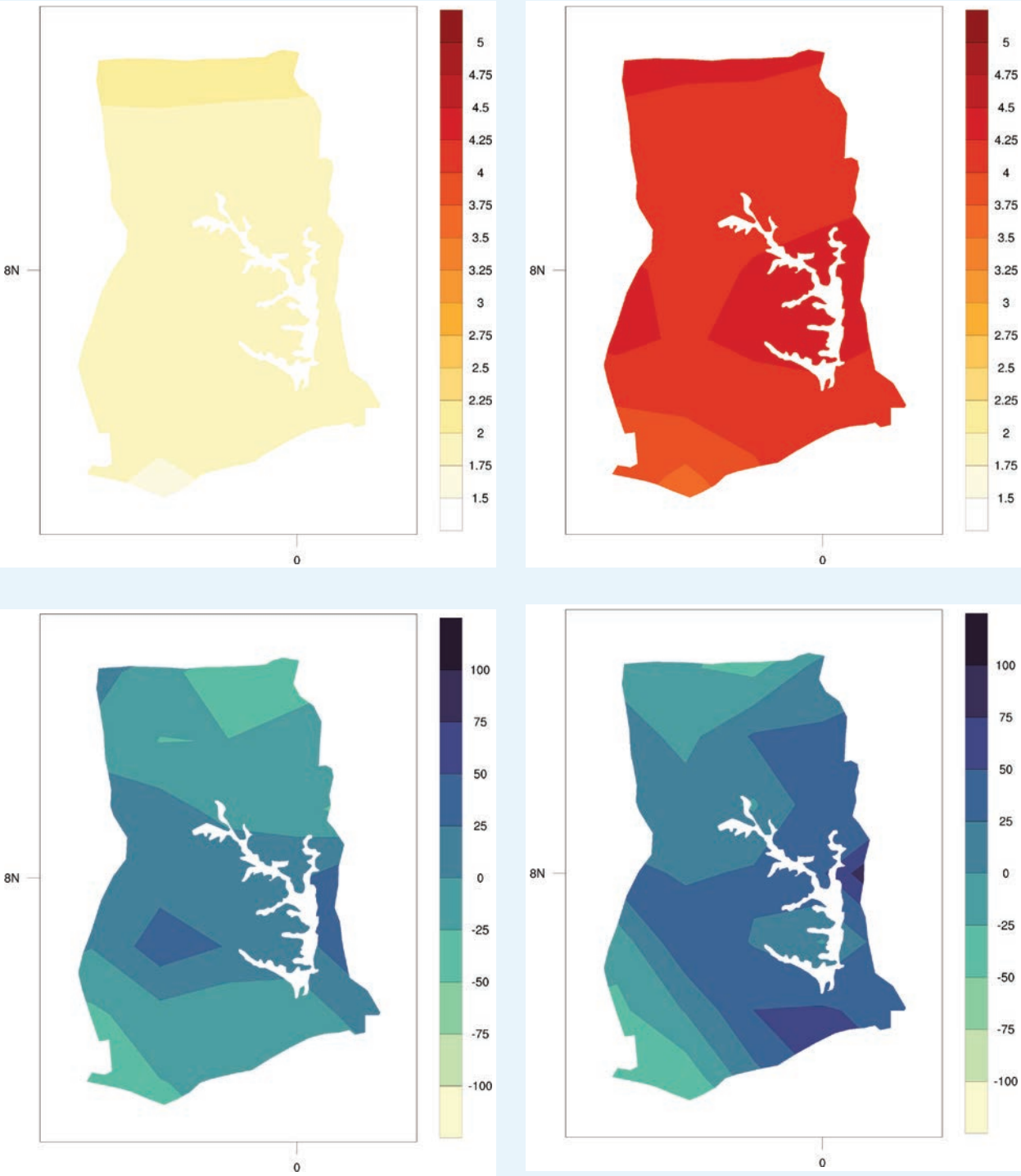
Cmip5 Ensemble Projection	2020–2039	2040–2059	2060–2079	2080–2099
Annual Temperature Anomaly (°C)	**+0.6 to +1.5** (+0.9°C)	**+1.2 to +2.7** (+1.7°C)	**+1.7 to +3.8** (+2.7°C)	**+2.3 to +5.3** (+3.6°C)
Annual Precipitation Anomaly (mm)	**–16.7 to +22.0** (+0.9 mm)	**–22.2 to +30.4** (+0.3 mm)	**–22.9 to +38.9** (+2.9 mm)	**–29.7 to +45.2** (+1.6 mm)

Note: The table shows CMIP5 ensemble projection under RCP8.5. Bold value is the range (10th–90th Percentile) and values in parentheses show the median (or 50th Percentile).

[19] USAID (2017). Climate Change Risk Profile – Ghana. URL: https://www.climatelinks.org/sites/default/files/asset/document/2017_USAID_Climate%20Change%20Risk%20Profile%20-%20Ghana.pdf

[20] Republic of Ghana (2015). Ghana's Third National Communication to the UNFCCC. URL: https://unfccc.int/resource/docs/natc/ghanc3.pdf

FIGURE 6. CMIP5 ensemble projected change (32 GCMs) in annual temperature (top) and precipitation (bottom) by 2040–2059 (left) and by 2080–2099 (right), relative to 1986–2005 baseline under RCP8.5[21]



[21] WBG Climate Change Knowledge Portal (CCKP, 2021). Ghana Projected Future Climate. URL: https://climateknowledgeportal.worldbank.org/country/ghana/climate-data-projections

Key Trends

Temperature

Ghana will continue to get warmer with mean temperatures projected to increase by 1.0°C to 3.0°C, by mid-century and by 2.3°C to 5.3°C by end of the century. Projected warming will likely occur more rapidly in the norther and inland areas that the coastal regions.[22] In addition to rising temperatures, substantial increases are expected in the frequency of days and nights that are considered 'hot', with an expected increase of 18–59% by mid-century. This is coupled with a general decrease in the number of days considered 'cold.[23]

Across all emission scenarios, temperatures will continue to rise within Ghana through the end of the century. As seen in **Figure 7**, under a high-emission scenario, average temperatures will increase rapidly by mid-century. Across the seasonal cycle (**Figure 8**), temperature rise will likely be most significantly in July and August, this will be especially felt in the northern areas. Increased heat and extreme heat conditions will result in significant implications for human and animal health, agriculture, water resources, and ecosystems.

FIGURE 7. Historical and projected average temperature for Ghana from 1986 to 2099 (Reference Period, 1986–2005)[24]

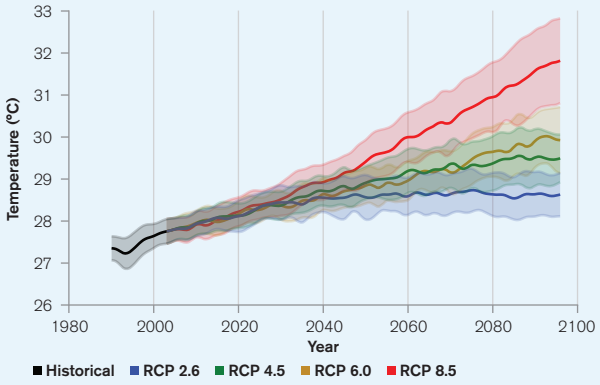
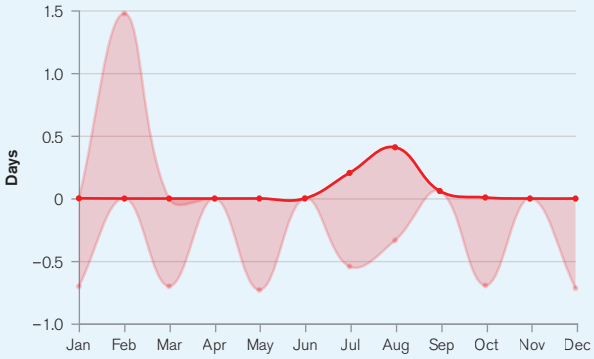


FIGURE 8. Projected change in Summer Days (Tmax >25°C) (RCP8.5, Reference Period, 1986–2005)[25]



[22] IFPRI (2012). Ghana – Strategy Support Program, climate change, agriculture, and foodcrop production in Ghana. URL: http://ebrary.ifpri.org/utils/getfile/collection/p15738coll2/id/127134/filename/127345.pdf

[23] Republic of Ghana (2015). Ghana's Third National Communication to the UNFCCC. URL: https://unfccc.int/resource/docs/natc/ghanc3.pdf

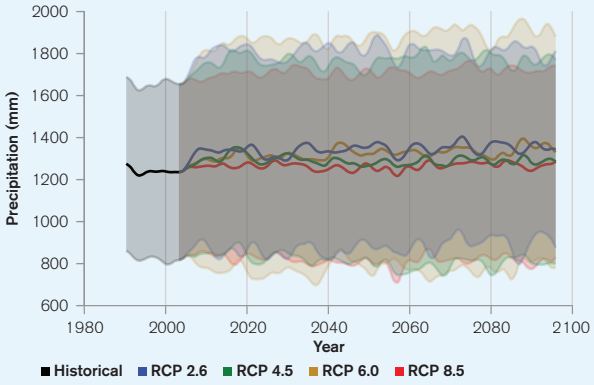
[24] WBG Climate Change Knowledge Portal (CCKP, 2021). Climate Indicator Dashboard – Agriculture. Ghana. URL https://climatedata.worldbank.org/CRMePortal/web/agriculture/crops-and-land-management?country=GHA&period=2080-2099

[25] WBG Climate Change Knowledge Portal (CCKP, 2021). Interactive Climate Indicator Dashboard – Agriculture. Ghana. URL https://climatedata.worldbank.org/CRMePortal/web/agriculture/crops-and-land-management?country=GHA&period=2080-2099

Precipitation

Rainfall in Ghana is highly variable and will continue to be so throughout the century. However, heavy rainfall events are expected to increase. Additionally, changes in 1 to 5-day rainfall maxima trends will likely increase in some areas, but are expected to decrease in others.[26] More erratic and intense rainfall during the wet season is expected, along with lower precipitation levels during the dry season; larger decreases in the southern regions. Intense rainfall events are also likely to result in flooding and flash floods, as well as river bank erosion.[27] **Figure 9** below, shows the change in the projected annual average precipitation for Ghana.[28] As seen below, at an aggregate national scale, overall, annual precipitation in Ghana is expected to largely remain the same by the of the century under a high emissions scenario of RCP8.5; however coastal zones are expected to receive higher rainfall than central or northern areas.

FIGURE 9. Annual average precipitation in Ghana for 1986 to 2099 (Reference Period, 1986–2005)[29]



CLIMATE RELATED NATURAL HAZARDS

Overview

Ghana is vulnerable to increasing aridity, droughts and extreme rainfall events and flooding,[30] and faces significant challenges from a changing climate change to its ecology, economy, and society. In addition, Ghana has a high degree of risk to natural hazards and disasters. The country is exposed to risks from multiple weather-related hazards, primary those due to floods and droughts in the Northern Savannah belt. There are also risks related to coastal resources, including storm surges and coastal erosion as well as landslides, earthquakes, pest infestations, and wildfires. Between 1991 and 2011 the country experienced seven major floods. In 2010, floods in the White Volta River Basin affected hundreds of thousands of people and destroyed many of their livelihoods. Urban floods also regularly impact major cities. Current development dynamics and demographic changes in Ghana further compound the risk of disasters. These dynamics are related to rural poverty, rapid urbanization, and environmental

[26] Republic of Ghana (2015). Ghana's Third National Communication to the UNFCCC. URL: https://unfccc.int/resource/docs/natc/ghanc3.pdf
[27] UNISDR (2018). Disaster Risk Profile – Ghana. URL: http://africa.cimafoundation.org/documents/869
[28] WBG Climate Change Knowledge Portal (CCKP, 2021). Ghana Water Dashboard. Data Description. URL: https://climateknowledgeportal.worldbank.org/country/ghana/climate-sector-water
[29] WBG Climate Change Knowledge Portal (CCKP, 2021). Climate Data-Projections. Ghana. URL: https://climateknowledgeportal.worldbank.org/country/ghana/climate-sector-water
[30] Republic of Ghana (2015). Ghana's Third National Communication to the UNFCCC. URL: https://unfccc.int/resource/docs/natc/ghanc3.pdf

degradation. Agriculture and livestock, two sectors most impacted by weather-related hazards, constitute the foundation of Ghana's economy and employ 55% of the economically active population.[31] Climate change and variability are already affecting Ghana's water resources damage and flood exposure is projected to result in $160 million annually, due to flooding.[32]

Data from the Emergency Event Database: EM-Dat database, presented in **Table 4**, shows the country has endured various natural hazards, including floods, landslides, epidemic diseases, and storms.

TABLE 4. Natural disasters in Ghana, 1900–2020[33]

Natural Hazard 1900–2020	Subtype	Events Count	Total Deaths	Total Affected	Total Damage ('000 USD)
Drought	Drought	3	0	12,512,000	100
Earthquake	Ground Movement	1	17	0	0
Epidemic	Bacterial Disease	18	1,118	89,735	0
	Viral Disease	3	150	1,031	0
Flood	Riverine Flood	16	409	3,859,990	33,500
	Flash Flood	1	13	0	0
Wildfire Storm	Land Fire (Brush, Bush, Pasture)	1	4	1,500	0
Storm	Convective Storm	1	20	12	0

Key Trends

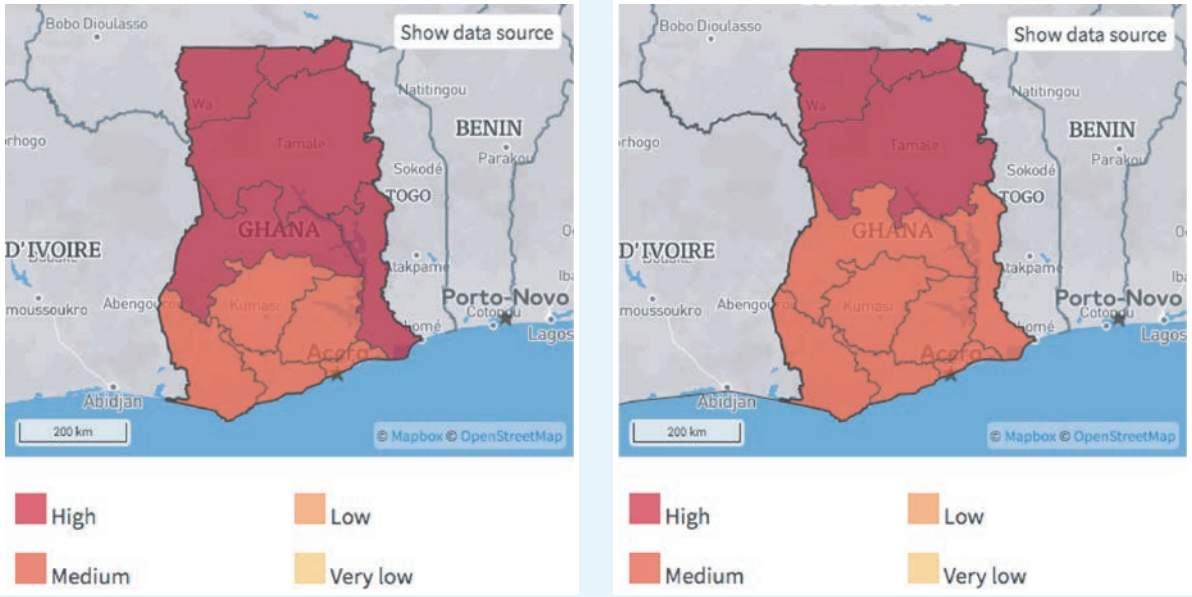
Climate change is expected to increase the risk and intensity of water scarcity and drought across the country. The primary sectors affected are water, agriculture and forestry, and human health. As extreme rainfall events become more common, river bank over flow and flash flooding is likely. This may also result in soil erosion and water logging of crops, thus decreasing yields with the potential to increase food insecurity; particularly for subsistence farmers. The frequency and complexity of some of these disaster events are also increasing, especially flooding. The country has been impacted by seven major floods in the last two decades. In 2007, floods caused damage to infrastructure and livelihoods in excess of $130 million and affected more than 265,000 people in the three northern regions, with nearly 100,000 requiring assistance in various forms to cope and restore their livelihoods. Additionally, these floods were preceded by a period of drought that destroyed most food crops.[34] Higher temperatures coupled with increased aridity may also lead to livestock stress and reduced crop yields.[35] This is likely to result in economic

[31] GFDRR (2019). Ghana, Country Context. URL: https://www.gfdrr.org/en/ghana
[32] UNISDR (2018). Disaster Risk Profile – Ghana. URL: http://africa.cimafoundation.org/documents/869
[33] EM-DAT: The Emergency Events Database - Universite catholique de Louvain (UCL) - CRED, D. Guha-Sapir, Brussels, Belgium. URL: http://emdat.be/emdat_db/
[34] UNDP (2017). Advocacy and Capacity Building for Disaster Risk Reduction and Preparedness in Ghana Project. Final Project Report. URL: https://www.undp.org/content/dam/ghana/docs/Doc/Susdev/Final%20Project%20Report.pdf
[35] USAID (2017). Climate Change Risk Profile – Ghana. URL: https://www.climatelinks.org/sites/default/files/asset/document/2017_USAID_Climate%20Change%20Risk%20Profile%20-%20Ghana.pdf

losses, damage to agricultural lands as well as critical infrastructure and human casualties. Furthermore, land degradation and soil erosion, exacerbated by recurrent flood and drought adversely impact agricultural production, further affecting the livelihoods of the rural poor. Small rural farmers, are more sensitive to impacts of disasters (floods, dry periods) because they have limited resources with which confront these risks.[36]

As temperatures rise and the impacts of climate change come into view, this will likely (i)exacerbate existing tensions between agricultural and human population needs for water, especially during the dry seasons, (ii) alter the quality of available water from surface water and groundwater, and (iii) increase pressure on urban zones.[37] Changing rainfall patterns are expected to play a significant role in agricultural production and harvest seasons, with later onsets expected to impact crop productivity as well as livestock health. Droughts have remained one of the key drivers of food insecurity for the country, with increased aridity and drought resulting in crop damage, loss of pasture and water sources, loss of animals, hunger, disease outbreaks, asset depletions, malnutrition and migration.[38] Increased temperatures and degraded agricultural conditions are expected to adversely affect 'working days', impacting livelihoods and economic resilience of vulnerable groups. **Figure 10** present the risk of extreme heat and water scarcity for Ghana.

FIGURE 10. Risk of extreme heat (left)[39]; risks of water scarcity (right)[40]



[36] Republic of Ghana (2015). Ghana's Third National Communication to the UNFCCC. URL: https://unfccc.int/resource/docs/natc/ghanc3.pdf
[37] USAID (2018). Climate Risk Profile – West Africa. URL: https://www.climatelinks.org/sites/default/files/asset/document/West_Africa_CRP_Final.pdf
[38] IFPRI (2012). Ghana – Strategy Support Program, climate change, agriculture, and foodcrop production in Ghana. URL: http://ebrary.ifpri.org/utils/getfile/collection/p15738coll2/id/127134/filename/127345.pdf
[39] ThinkHazard! (2020). Ghana – Extreme Heat. URL: http://thinkhazard.org/en/report/94-ghana/EH
[40] ThinkHazard! (2020). Ghana – Water Scarcity. URL: http://thinkhazard.org/en/report/94-ghana/DG

Implications for DRM

Over the past decade, Ghana has taken significant steps toward a more proactive approach to reducing its disaster risks and increase its resilience. The *Ghana Plan of Action for Disaster Risk Reduction and Climate Change Adaptation (2012)* outlines support for disaster risk management (DRM) from the government and its development partners.[41] The country's *National Disaster Risk Reduction Policy (2011–2015)* was adopted by disaster management stakeholders to ensure that all public institutions and non-governmental organizations factor DRM into their organizational planning, budgeting, and operations. In support of this implementation, the Ghanaian Government is integrating DRM planning into its urban and land use planning. It is also in the process of establishing mechanisms and strategies to further integrate DRM into national and local development policies. Key focus is to address flood risks in major urban areas and to make more coastal communities more resilient to sea level rise, storm surges and flooding.[42]

CLIMATE CHANGE IMPACTS TO KEY SECTORS

Ghana is projected to become hotter and drier in the future, and the country will continue to experience temperature increases, extreme events like droughts and floods and the increase in frequency and duration of heat waves. Rainfall will remain variable, with increased rainfall in some areas and decreased rainfall in others. The onset of the rainy season will occur later in the spring, and heavy rainfall events will increase in frequency and intensity.[43] This is likely to result in adverse environmental impacts such as soil erosion, deforestation, recurrent droughts, desertification, land degradation, and the loss of biodiversity including wildlife. Key sectors such as agriculture, forestry, health, water resources, and tourism are vulnerable.[44] Water scarcity and drought conditions are expected to increase risks of food insecurity and may exacerbate conflict situations over scarce resources and population movements. Additionally, sea level rise may impact much of the country's coastline.[45]

Ghana faces additional challenges due to the country's high rate of urbanization and relatively large population migrations from rural agricultural livelihoods to urban centers. These challenges are compounded by climate stressors such as floods and droughts that are increasingly putting pressure on service delivery, adaptation needs and financing.[46] Environmental degradation, impacted water resources, and loss of biodiversity and ecosystem services constitute serious obstacles to the country's continued development and poverty reduction efforts, it increases vulnerability to risks and hazards as well as increases the importance for sustainable adaptation and resilience measures.[47]

---

[41] UNDP (2019). Climate Change Adaptation Profile – Ghana. URL: https://www.adaptation-undp.org/explore/western-africa/ghana
[42] GFDRR (2019). Ghana, Country Context. URL: https://www.gfdrr.org/en/ghana
[43] USAID (2018). Climate Risk Profile – West Africa. URL: https://www.climatelinks.org/sites/default/files/asset/document/West_Africa_CRP_Final.pdf
[44] USAID (2017). Climate Change Risk Profile – Ghana. URL: https://www.climatelinks.org/sites/default/files/asset/document/2017_USAID_Climate%20Change%20Risk%20Profile%20-%20Ghana.pdf
[45] USAID (2017). Climate Change Risk Profile – Ghana. URL: https://www.climatelinks.org/sites/default/files/asset/document/2017_USAID_Climate%20Change%20Risk%20Profile%20-%20Ghana.pdf
[46] UNDP (2019). Climate Change Adaptation Profile – Ghana. URL: https://www.adaptation-undp.org/explore/western-africa/ghana
[47] Republic of Ghana (2015). Ghana's Third National Communication to the UNFCCC. URL: https://unfccc.int/resource/docs/natc/ghanc3.pdf

Gender

An increasing body of research has shown that climate-related disasters have impacted human populations in many areas including agricultural production, food security, water management and public health. The level of impacts and coping strategies of populations depends heavily on their socio-economic status, socio-cultural norms, access to resources, poverty as well as gender. Research has also provided more evidence that the effects are not gender neutral, as women and children are among the highest risk groups. Key factors that account for the differences between women's and men's vulnerability to climate change risks include: gender-based differences in time use; access to assets and credit, treatment by formal institutions, which can constrain women's opportunities, limited access to policy discussions and decision making, and a lack of sex-disaggregated data for policy change.[48]

Agriculture

Overview

Agriculture is a key sector for Ghana's economy, household livelihoods and food security. The sector employs more than half the population on a formal and informal basis, and accounts for almost 20% of GDP and almost half of export earnings. The sector is the main source of livelihood for the majority of the country's poorest households. Two-thirds of non-oil manufacturing depends on agriculture for raw materials, and accounts for a major share of all economic activities and livelihoods among smallholder farmers. Ghana produces variety of crops in various climatic zones which range from dry savanna to wet forest and which run in east west bands across the country. Ghana's agriculture sector is made up of crops, livestock, fisheries and forestry. The crops sub-sector includes industrial crops (e.g. cocoa, rubber, oil palm, coconut, cotton), starchy and cereal staples (e.g. cassava, yam, maize, rice, plantain), and fruits and vegetables (e.g. pineapple, banana, cashew, citrus, mango).

The agriculture sector of Ghana is highly vulnerable to climate variability and change as the sector is primarily dependent on rainfall. As a result, the sector is characterized by low productivity levels. Erratic precipitation patterns have severe consequences for productivity as only 2% of the country's irrigation potential is in use; the majority of Ghana's agriculture remains reliant on ran-fed production. Rising temperatures are projected to lower yields in major staple crops (cassava, yams, plantains, maize and rice). Cassava yields, for example, are projected to fall by 29.6% by 2080 and maize yields by 7% by 2050. Cases of total crop failure are projected to occur approximately once every five years in Ghana's northern region due to delayed or diminished rainfall. Cocoa, a major cash crop and the country's second leading foreign exchange earner, is sensitive to rising temperatures as well as drought. Suitable areas for cocoa production, mainly along the coast, are also decreasing due to temperature increase, floods, soil salinization and continued coastal erosion.[49]

[48] World Bank Group (2016). Gender Equality, Poverty Reduction, and Inclusive Growth. URL: http://documents1.worldbank.org/curated/en/820851467992505410/pdf/102114-REVISED-PUBLIC-WBG-Gender-Strategy.pdf

[49] USAID (2017). Climate Change Risk Profile – Ghana. URL: https://www.climatelinks.org/sites/default/files/asset/document/2017_USAID_Climate%20Change%20Risk%20Profile%20-%20Ghana.pdf

Climate Change Impacts

Yield losses may additionally become more severe as interannual rainfall variability increases and the length of growing seasons shorten. Rising temperatures are likely to increase presence of pests and diseases leading potentially to crop failure and reduced yields, especially for cassava, a key food staple. Reduced rainfall will shorten growing seasons and the desertification of agricultural land brought about by unsustainable farming practices, such as limited crop rotation and poor soil management, will further inhibit production.[50] Ghana's fisheries sector is also a major part of local industries, the Ghanaian diet and economy. The fisheries sector includes marine finishing and some inland and freshwater fisheries in Lake Volta, Botsumtwi and other reservoirs. Rising sea surface temperatures will continue to alter the migratory patterns and reproductive cycles of key species such as anchovies, sardines, tilapia and catfish, all staples in the Ghanaian diet and economy. A decline in the fisheries sector productivity as a result of climate variability (along with overfishing) has forced Ghana to spend over $200 million annually on seafood imports to satisfy local demand.[51]

Figure 11 shows the projected change in the number of consecutive Dry Days in Ghana through the end of the century and the projected change in days with a heat index >35°C. A 'Dry Day' refers to a day without any meaningful rainfall (less than 0.1mm/day), impacting soil moisture and thus crop growth. This is an important indicator for agriculture and especially for Ghana as the majority of the country's agriculture production is rain-fed. The increased likelihood of droughts and prolonged dry periods are expected to further soil erosion and exacerbate land degradation. Rising temperatures, particularly the increase in very hot days (TMax >35°C) is likely to increase the presence of pests and increase risks of fires. As extreme rainfall events become more frequent and more intense, critical 'regulating services' such as soil water maintenance, base flows and filtration will likely suffer.[52] **Figure 12** shows the average daily max-temperature across seasonal cycles. These higher temperatures have implications for impacts to soil moisture and crop growth and as seen below, temperature increases will be experienced all year round.

[50] IFPRI (2012). Ghana – Strategy Support Program, climate change, agriculture, and foodcrop production in Ghana. URL: http://ebrary.ifpri.org/utils/getfile/collection/p15738coll2/id/127134/filename/127345.pdf

[51] USAID (2017). Climate Change Risk Profile – Ghana. URL: https://www.climatelinks.org/sites/default/files/asset/document/2017_USAID_Climate%20Change%20Risk%20Profile%20-%20Ghana.pdf

[52] Republic of Ghana (2015). Ghana's Third National Communication to the UNFCCC. URL: https://unfccc.int/resource/docs/natc/ghanc3.pdf

FIGURE 11. Projected change in the number of consecutive dry days (Reference Period, 1986–2005)[53]

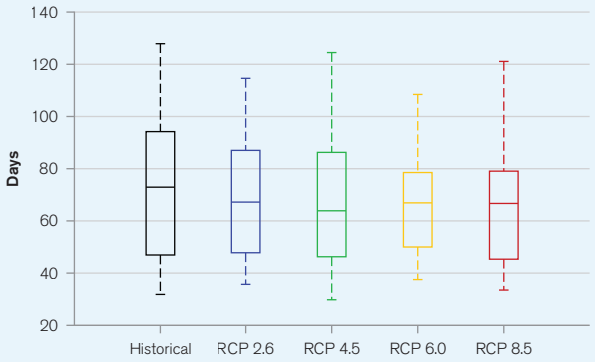
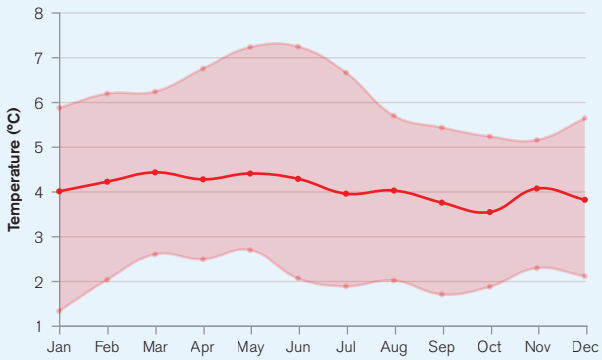


FIGURE 12. Average daily max temperature for Ghana (RCP8.5, Reference Period, 1986–2005)[54]



Adaptation Options

Households in Ghana differ in terms of their adaptation responses to climate change and variability. These differences may be attributed to the households' livelihood group and asset holding level, and to some extent the ecological zone in which the household is located. Adaptation strategies for the agriculture sector in Ghana include investing in climate smart agriculture practices, improved water management, improved monitoring and early warning, the development of knowledge and decision-support systems, and the development of new crop varieties and technologies to support farming. Increased use of drought resistant varieties and improved integration of nutrient management can help to improve yields for staple crops, such as maize, rice, cassava.[55] The adaptation practices by households in the northern savannah zone for instance include expansion of area cultivated, dry season gardening, taking on more agricultural tasks by women, cultivation of early yielding and high value crops, diversification into livestock rearing, increasing fertilizer use among others. Irrigation infrastructure and access to reliable water for agriculture would make substantial difference for the country's resilience as well as boost production opportunities and thus livelihoods for smallholder farmers. To address increased demand and combat the reduction of Ghana's fisheries productivity, aquaculture development, more formal restocking of fingerlings, and improved extension services can be implemented to build resilience in the sector.[56] Ghana has developed the Climate Smart Agriculture Investment Plan (CSAIP) which identifies interventions that will help the agriculture sector better able to deal with climate change. The CSAIP produced evidence of climate-smart agriculture (CSA) technologies that can offer the greatest potential to Ghana's agriculture sector to increase productivity and enhance household incomes under a changing climate. It also provides opportunity for building the agricultural system's resilience, and in so doing

[53] WBG Climate Change Knowledge Portal (CCKP, 2020). Ghana Agriculture. Dashboard URL: https://climatedata.worldbank.org/CRMePortal/web/agriculture/crops-and-land-management?country=GHA&period=2080-2099

[54] WBG Climate Change Knowledge Portal (CCKP, 2020). Ghana Agriculture. Dashboard URL: https://climatedata.worldbank.org/CRMePortal/web/agriculture/crops-and-land-management?country=GHA&period=2080-2099

[55] IFPRI (2012). Ghana – Strategy Support Program, climate change, agriculture, and food crop production in Ghana. URL: http://ebrary.ifpri.org/utils/getfile/collection/p15738coll2/id/127134/filename/127345.pdf

[56] Republic of Ghana (2015). Ghana's Third National Communication to the UNFCCC. URL: https://unfccc.int/resource/docs/natc/ghanc3.pdf

ensures that future agriculture practices do not follow a path that could threaten environmental integrity through green-house gas emissions, pollution of water systems or destruction of ecological systems. The CSAIPs is an outcome of the stakeholder engagement process that identified and prioritized CSA technologies that have proved to be most suitable and impactful in Ghana's agriculture. These include:

1. Cereal-legume integration
2. Climate-smart cocoa production
3. Poultry feed improvement and genetic resource enhancement
4. Climate resilient ruminant production and genetic resource conservation
5. Sustainable fisheries and aquaculture
6. Diversified tree crop production
7. Roots-tubers-livestock integration
8. Knowledge system and advisory services
9. Water harvesting technologies and irrigation management

Water

Overview

The development and management of its water resources plays a key role for resilient and sustainable development of Ghana. Freshwater covers nearly 5% of the total land areas in Ghana, these are primarily made of the Volta, South Western and Coastal river systems. Neary half of the water used in Ghana originates from three international rivers (Volta, Bia, Tano), which flow into the country from outside of Ghana's borders, putting the country at risk of water insecurity and political tensions should water availability decline. Currently, tensions already exist between Ghana and Burkina Faso due to Burkina Faso's decision to withdraw its water from the Volta Basin; reducing water levels and impacting hydropower generation in Ghana.[57]

Climate Change Impacts

The Volta Basin flows could be reduced by as much as 24% by mid-century and by as much as 45% by end of the century due to reduced rainfall and increased evaporation.[58] Clean water and sanitation are a challenge for some areas and communities in Ghana, where approximately 25% of the population lacks access to clean water. Declining rainfall, increased levels of drought and rising temperatures in addition to increased pressures from a growing population, urbanization, and industrialization are likely to further compound this issue. The reduced quantity and quality of water will be a significant challenge for human consumption as well as use in the agriculture, industry and hydropower sectors. Rising sea levels are already increasing salinization in coastal water sources and wells.[59]

[57] Republic of Ghana (2015). Ghana's Third National Communication to the UNFCCC. URL: https://unfccc.int/resource/docs/natc/ghanc3.pdf

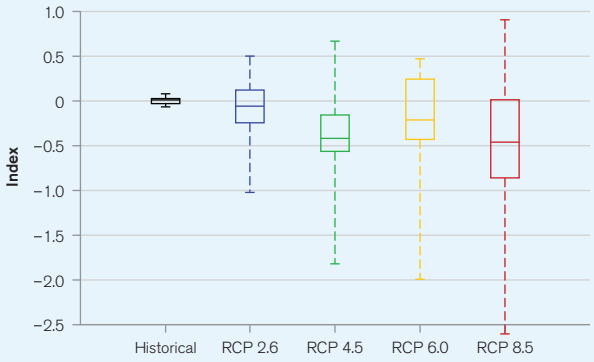
[58] USAID (2017). Climate Change Risk Profile – Ghana. URL: https://www.climatelinks.org/sites/default/files/asset/document/2017_USAID_Climate%20Change%20Risk%20Profile%20-%20Ghana.pdf

[59] Republic of Ghana (2015). Ghana's Third National Communication to the UNFCCC. URL: https://unfccc.int/resource/docs/natc/ghanc3.pdf

Poor areas in the country (especially the northern part) disproportionally suffer from droughts, floods and soil erosion that are adversely affecting agricultural production; newer challenges in flood management due to urbanization; and flooding exacerbated by poor land use and limited mitigation infrastructure.[60,61] Rainfall and evaporation changes also impact rates of surface water infiltration and recharge rates for groundwater, which, when coupled with low-water storage capacity, increases the country's vulnerability to unreliable rainfall patterns. This has the potential for further decreased reliability of unimproved groundwater sources and surface water sources during droughts or prolonged dry seasons. Additionally, increased strain on pump mechanisms may lead to breakdowns if maintenance is neglected and the potential for falling water levels in the immediate vicinity of wells or boreholes and in areas of high demand.[62] Rising temperatures could further soil moisture deficits even under conditions of increasing rainfall.

The Standardized Precipitation Evapotranspiration Index (SPEI) represents the measure of the given water deficit in a specific location, accounting for contributions of temperature-dependent evapotranspiration and providing insight into increasing or decreasing pressure on water resources. Negative values for SPEI represent dry conditions, with negative values indicating increased likelihood of increased aridity and drought conditions, likewise positive values indicate increased wet conditions. This is an important understanding for the water sector in regards to quantity and quality of supply for human consumption and agriculture use as well as for the energy sector as reductions in water availability impacts river flow and the hydropower generating capabilities. Ghana is projected to experience heightened dry conditions and increased pressure on water resources by mid-century and by end of the century is likely to be experience severe drought conditions and water scarcity (**Figure 13**).

FIGURE 13. Annual SPEI Drought Index in Ghana for the period, 1986 to 2099 (Reference Period, 1986–2005)[63]



Adaptation Options

The policy paper[64] on Ghana's Water Resources Development released in 2012 by the World Bank found that available surface water resources were adequate to meet projected demand through to 2025 but significant investments across the water-using sectors (e.g. irrigation, water supply, sanitation, and electricity) were required, if Ghana's mid-term and long term objectives in the water sector were to be met. The recent Ghana Systematic Country Diagnostics report (2018)[65] also re-emphasized the criticality of effective water resources management

[60] Yeleliere, E. et al (2018). "Review of Ghana's water resources: the quality and management with particular focus on freshwater resources". Applied Water Science. https://doi.org/10.1007/s13201-018-0736-4

[61] Obuobie, E. et al (2012) "Assessment of vulnerability of river basins in Ghana to water stress conditions under climate change". Journal of Water and Climate Change, 03.4. DOI: https://doi.org/10.2166/wcc.2012.030

[62] USAID (2018). Climate Risk Profile – West Africa. URL: https://www.climatelinks.org/sites/default/files/asset/document/West_Africa_CRP_Final.pdf

[63] WBG Climate Change Knowledge Portal (CCKP, 2021). Ghana Water Sector Dashboard. URL: https://climatedata.worldbank.org/CRMePortal/web/water/land-use-/-watershed-management?country=GHA&period=2080-2099

[64] World Bank (2012). Ghana: Water Resources Development – Policy Paper.

[65] World Bank Group (2018). Ghana Priorities for Ending Poverty and Boosting Shared Prosperity : Systematic Country Diagnostic. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/30974 License: CC BY 3.0 IGO.

for Ghana's resilience and sustainability. One of the Government's vision of the water sector as stipulated in the Water Sector Strategic Development Plan (2012–2025) is to promote water security and resilience to climate change. The National Irrigation Policy objectives also list, among others, increasing irrigated surfaces, improving their management, and increasing climate change resilience as a result of sustainable irrigation service delivery.

Sustainable and reliable development, storage and proper use of the water resources in Ghana is a high priority and should be led through a water resources management policy that promotes the efficient, equitable and optimum utilization of available water resources. Water harvesting and improved rainwater collection and storage (at a household or community level) is a critical intervention proposed by the Ghanaian Government.[66] Flood retention development is ongoing in areas of Upper East and Central regions. Additional dam construction and rehabilitation as well as the de-silting of dams can make water access effective and efficient. Planning and adaptation strategies for water resources should also be included within development strategies for agriculture, infrastructure, and energy sectors.[67]

Energy

Overview

Ghana's energy is largely sourced from hydropower. The Akosombo, Kpong, and Bui dams provide approximately 54% of national generation capacity. The Volta River Authority is responsible for Ghana's state-owned hydro-thermal plants which also manages water levels in Lake Volta in response to increased evapotranspiration and unpredictable rainfall. Despite Ghana's hydropower capabilities, frequent power outages are common, with large sections of rural communities having little access to electricity. Given expected reductions in national and regional rainfall, hydropower capacities are expected to perform at 50% of current capacity by mid-century.[68] As Ghana continues to develop, greater demands are expected to be placed on its energy sector.

Climate Change Impacts

While rainfall is overall expected to decline in the future across Ghana, the high variability across the country pose a significant challenge to hydro power generation. Additionally, a large proportion of the population relies on biomass for cooking, which continues to cause large scale and widespread deforestation. Rising temperatures are also likely to have an impact on cooling capacities of power generating stations, also likely to impact generation and transmission. Rising temperatures resulting in seasonal changes are also likely to alter demand for electricity with increased demand for peak loads during projected hotter summers leading to increased production costs, which are likely to increase the costs for consumers. Climate projections are also expected to increase costs of maintenance and repairing of power and energy infrastructure as well as disrupt power supply.[69] Ghana has high potential for renewable energy generation through solar power sources, but the sector needs to continue to develop.

---

[66] IFPRI (2012). Ghana – Strategy Support Program, climate change, agriculture, and food crop production in Ghana. URL: http://ebrary.ifpri.org/utils/getfile/collection/p15738coll2/id/127134/filename/127345.pdf

[67] Republic of Ghana (2015). Ghana's Third National Communication to the UNFCCC. URL: https://unfccc.int/resource/docs/natc/ghanc3.pdf

[68] USAID (2017). Climate Change Risk Profile – Ghana. URL: https://www.climatelinks.org/sites/default/files/asset/document/2017_USAID_Climate%20Change%20Risk%20Profile%20-%20Ghana.pdf

[69] USAID (2018). Climate Risk Profile – West Africa. URL: https://www.climatelinks.org/sites/default/files/asset/document/West_Africa_CRP_Final.pdf

Cooling Degree Days show the relationship between daily heat and cooling demand, typically sourced through a form of active cooling or an evaporative process. The change in cooling degree days provides insight into the potential for extended seasons of power demand or periods in which cooling demand (power demands) might increase. As seen in **Figure 14**, seasonal increases for cooling demands are expected to increase throughout the year. The Warm Spell Duration Index represents the number of days in a sequence of at least six days in which the daily maximum temperature is greater than the 90th percentile of daily maximum temperature. As shown in **Figure 15**, warm spells are expected to sharply increase in the second half of the century.

FIGURE 14. Projected change in Cooling Degree Days (65°F) in Ghana for the period 2040–2059 (Reference Period, 1986–2005)[70]

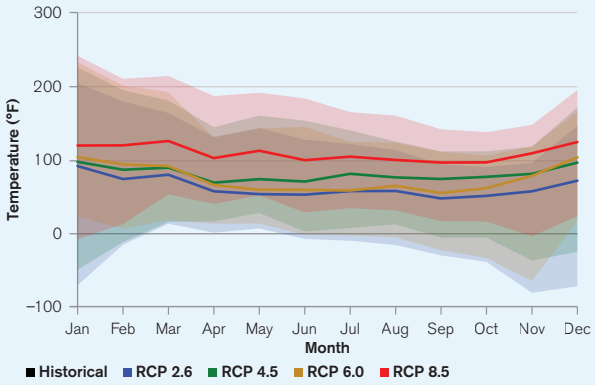
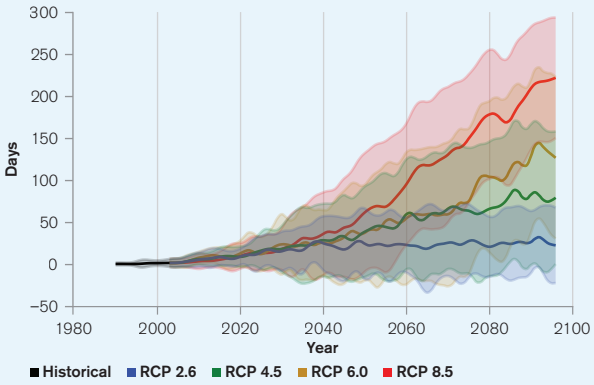


FIGURE 15. Warm Spell Duration Index in Ghana for the period 1986 to 2099 (Reference Period, 1986–2005)[71]



Adaptation Options

Efficient energy generation, transmission and expanded use is critical to the country's overall development agenda and economic growth. The country is investing heavily in transforming its energy sector through a transition to a low-carbon energy sector, and to increase its use of renewable energy generation in hydro as well as solar.[72] Additional adaptation strategies can be implemented at a household level by investing in efficient cookstoves, Using liquid petroleum gas for cooking as well installing mini solar grids for household use. Improved forestry management practices can also be implemented to reduce illegal deforestation and to encourage the sustainable use of biomass through short rotation forestry efforts.[73]

[70] WBG Climate Change Knowledge Portal (CCKP, 2021). Ghana – Energy. URL: https://climateknowledgeportal.worldbank.org/country/ghana/climate-sector-energy

[71] WBG Climate Change Knowledge Portal (CCKP, 2021). Ghana Energy Sector Dashboard. URL: https://climatedata.worldbank.org/CRMePortal/web/energy/oil-gas-and-coal-mining?country=GHA&period=2080-2099

[72] UNDP (2019). Climate Change Adaptation Profile – Ghana. URL: https://www.adaptation-undp.org/explore/western-africa/ghana

[73] Republic of Ghana (2015). Ghana's Third National Communication to the UNFCCC. URL: https://unfccc.int/resource/docs/natc/ghanc3.pdf

Health

Overview

Ghana is highly vulnerable to the adverse health implications from climate change. Projected marked temperature increases across the country, alongside more variable rainfall, rising sea levels, and more frequent extreme weather events are expected to impact food and water security, human settlements, infrastructure and ecosystems, as well increase the prevalence and geographic extent of vector and waterborne diseases that are already widespread in Ghana. Increased disease prevalence will be particularly significant in the densely populated urban areas where temporary settlements lack access to clean water and sanitation. Access to improved sanitation is low overall (20% of urban and 9% of rural populations). Flooding commonly leads to cholera outbreaks across the country. Malaria remains a significant challenge, and is likely to increase as temperatures rise and flooding becomes more common, particularly in coastal and urban zones.[74]

Climate Change Impacts

The health of Ghana's population is expected to be aggravated by heat stress, other vector-borne diseases sucha as dengue fever and yellow fever, air pollution, communicable diseases such as HIV/AIDS, cholera and TB, and other respiratory disease. Higher temperatures, land and water scarcity, flooding, drought and displacement, will all impact agricultural productivity and can contribute to breakdowns in food systems. This disproportionally affects those most vulnerable to hunger and can lead to food insecurity. Vulnerable groups risk further deterioration into a food and nutrition crises if exposed to extreme weather events Without considerable efforts made to improve climate resilience, the risk of hunger and malnutrition globally could increase by up to 20% by 2050. In Ghana, the prevalence of child malnutrition in children under age five is 13.4%.[75]

Rising temperatures along with water scarcity are an increasing concern for Ghana. Under a high emissions scenario for heat-related death in the elderly (65+ years) are projected to increase to 70 deaths per 100,000 by 2080 compared to the estimated baseline of approximately 2 deaths per 100,000 annually between 1961 and 1990.[76] The annual distribution of days with a high-heat index provides insight into the health hazard of heat. The annual distribution of days with a high-heat index provides insight into the health hazard of heat. **Figure 16** shows the expected Number of Days with a Heat Index >35°C; showing a sharp increase in mid-century and continuing to increase under a high-emission scenario by end of the century. Tropical Nights (**Figure 17**) represents the projected increase in tropical nights (>20°C) across different emission scenarios, which are expected to rapidly increase in a high-emission scenario. Under a high emission scenario, for Ghana, it is projected that every night will be above 20°C by the end of the century.

[74] USAID (2017). Climate Change Risk Profile – Ghana. URL: https://www.climatelinks.org/sites/default/files/asset/document/2017_USAID_Climate%20Change%20Risk%20Profile%20-%20Ghana.pdf

[75] WHO (2015). Climate and Health Country Profile – Ghana. URL: https://apps.who.int/iris/bitstream/handle/10665/208862/WHO_FWC_PHE_EPE_15.08_eng.pdf?sequence=1

[76] WHO (2015). Climate and Health Country Profile – Ghana. URL: https://apps.who.int/iris/bitstream/handle/10665/208862/WHO_FWC_PHE_EPE_15.08_eng.pdf?sequence=1

FIGURE 16. Days with a Heat Index >35°C (Reference Period, 1986–2005)[77]

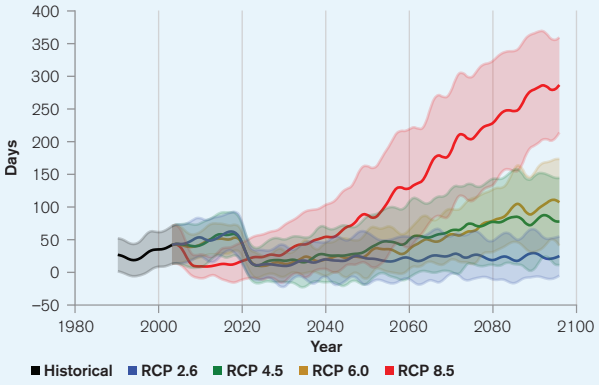
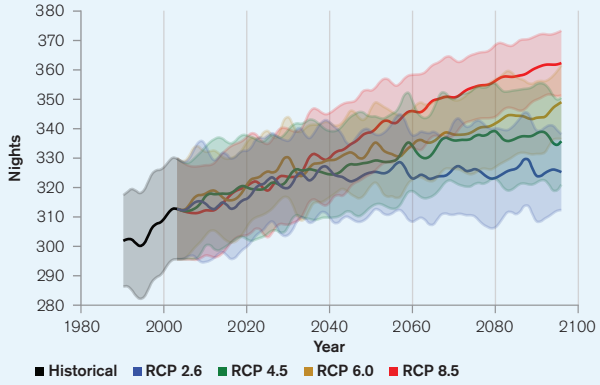


FIGURE 17. Number of Tropical Nights (Tmin >20°C) (Reference Period, 1986–2005)[78]



Adaptation Options

Investments should build resilience to climate socks in Ghana's health-care infrastructure. Capacity needs to be built to support the adaptation to extreme weather events and the necessary response capacities. Health care system personnel should receive additional training to increase awareness the relationship between climate variability and change and health impacts. Investing in training and capacity can improve the level of knowledge and skills to prevent diseases connected with climatic factors, though this knowledge remains relatively limited among the general population. Additionally, improved monitoring and surveillance systems are not conducted at scales necessary to establish adequate early warning systems for climate sensitive diseases. A targeted climate-health-adaptation research agenda can support the identification and analysis of trends and associations between diseases and weather, and develop indicators to improve health sector capacity to react. The development of Health Early Warning systems is needed, specifically for heat waves and flooding.[79]

Ghana has approved a national health adaptation strategy and is currently implementing projects to adapt the health sector to address climate risks. In addition, Ghana is taking action to build institutional and technical capacities to work on climate change and health and to increase the climate resilience of health infrastructure. Need remains for a comprehensive national assessment of climate change impacts, vulnerability and adaptation for the health sector to be undertaken, including an estimate the costs of implementing health resilience to climate change.[80]

[77] WBG Climate Change Knowledge Portal (CCKP, 2021). Ghana Health Sector Dashboard. URL: https://climatedata.worldbank.org/CRMePortal/web/health/systems-and-service?country=GHA&period=2080-2099

[78] WBG Climate Change Knowledge Portal (CCKP, 2021). Ghana Health Sector. URL: https://climateknowledgeportal.worldbank.org/country/ghana/climate-sector-health

[79] Republic of Ghana (2015). Ghana's Third National Communication to the UNFCCC. URL: https://unfccc.int/resource/docs/natc/ghanc3.pdf

[80] Republic of Ghana (2015). Ghana's Third National Communication to the UNFCCC. URL: https://unfccc.int/resource/docs/natc/ghanc3.pdf

Forests and Natural Resources

Overview

Natural resources have been key drivers of economic growth in Ghana; however, the country faces environmental challenges roughly corresponding to its rural, urban, and coastal landscapes. The country's continued growth, economic development and urbanization is expected to further deplete its natural capital, complicating existing environmental, climate, and natural resource management challenges. Additionally, the livelihood of much of the rural population depends on access to natural resources. Currently, a substantial share of jobs is still based in renewable natural resources. In rural areas, approximately 71% of people are employed in agriculture, forestry, and fishing and the sector is a primary source of employment for the 300,000–350,000 new workers who enter the labor force each year. Environmental degradation in Ghana occurs due to water pollution, agricultural land degradation, deforestation, illegal mining, overfishing, coastal erosion, and flooding. The cost of deforestation, on average, is about US$0.4 billion, equivalent to 0.67% of GDP. Forests in Ghana cover about 5.7 million ha. Deforestation is a widely recognized problem, mainly due to cocoa expansion, slash and burn agriculture, and illegal logging. However, available estimates differ considerably, but it is estimated that deforestation leads to an annual loss of forest benefits of about US$90/ha.[81]

Climate Change Impacts

Ghana is a net emitter of CO2 emissions, primarily from its oil and gas industry, but deforestation and forest degradation contribute. The average annual emissions in Ghana from deforestation and forest degradation from 2001–2015 was estimated at 61.2 million tCO2e yr-1 and average removals were 569,300 tCO2e/yr-1. Deforestation, defined by the Government of Ghana, as human-induced forest loss, was the largest contributor to emissions. For deforestation alone, the annual average emissions over a 15-year period (2001–2015) were 40,295,807 tCO2e, with a significant increase between 2010 and 2015. Overall, emissions were highest from the moist evergreen forests of the HFZ, accounting for 28% of the national total.[82]

Climate change is one of the major driver of habitat destruction and biodiversity loss as a result of frequent bush fires due to high temperatures and prolong droughts. The problem is compounded by bush fires, illegal and unsustainable logging and hunting practices. Continued degradation of forest reserves will result in significant biodiversity loss, including the extinction of many species and the associated loss of ecosystem services provision.[83] Increased temperatures and shifts in rainfall seasonality is expected to impact not only Ghana's biodiversity and forest ecosystems, but may also impact reforestation and afforestation efforts.

[81] World Bank (2020). Ghana Country Environmental Analysis. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/33726 License: CC BY 3.0 IGO.

[82] World Bank (2020). Ghana Country Environmental Analysis. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/33726 License: CC BY 3.0 IGO.

[83] Boon, E. and Ahenkan, A. (2012). Assessing Climate Change Impacts on Ecosystem Services and Livelihoods in Ghana: Case Study of Communities around Sui Forest Reserve. Journal of Ecosystem and Ecology S3:001. DOI: 0.4172/2157-7625.S3-001

Adaptation Options

Cocoa-forest mosaics play an important role in climate change adaptation and mitigation strategies—as articulated by Ghana's shift to climate-smart cocoa production—through micro-climate generation of rainfall, temperature moderation, hosting of pollinators, enhancement of soil and air moisture, and carbon sequestration, among other services. To catalyze these gains, Ghana is participating in performance-based payments through the signing of an Emission Reductions Purchase Agreement with the World Bank's Forest Carbon Partnership Facility Carbon Fund. From 2018–2024, Ghana will be in a position to generate US$50 million in emission reduction results-based payments. The long-term value of reducing (a conservatively estimated) 240 million tons of CO2 emissions from deforestation and forest degradation in the HFZ over a 20-year period is estimated at US$1.2 billion. Emerging signals that the sector's revenue sources and funding are shifting from a timber-centric to a non-extractive model that values the standing forest are encouraging.

Forest and forestry plantation mitigation options include reducing emissions from deforestation and forest degradation, enhancing carbon sequestration rate in existing and new plantations, providing fuel from wood as a substitute for fossil fuels, and providing wood products (as renewable energy) for more energy-intensive materials. When properly designed and implemented, plantation adaptation and mitigation options will have substantial co-benefits with respect to employment and income generation prospects, biodiversity and watershed conservation, provision of timber and fiber, as well as aesthetic and recreational services.[84]

Forest plantation programs should focus on equitable benefit sharing, which can ultimately help to improve ecosystem services and mitigate the impacts of climate change. Community-based action plans should be prepared on a yearly basis so that local people could initiate environmentally friendly activities and by planting trees in their farms. Forest restoration through re-forestation can help to remove greenhouse gasses from the atmosphere (carbon sequestration) and also promote poverty alleviation, biodiversity conservation and improvement of ecosystem services provision.[85]

ADAPTATION

Institutional Framework for Adaptation

Ghana's Environmental Protection Agency is responsible for coordinating the country's national climate change strategy. Strategy leadership is conducted in partnership with the Ministry of Environment, Science, Technology and Innovation. Climate change is recognized as a cross-cutting issue in Ghana and policies and implementation include cross-sector efforts and coordination including the National Development Planning, Forestry, and Energy Commissions and the Ministries of food and Agriculture, Lands and Natural Resources, and Power.[86]

---

[84] World Bank (2020). Ghana Country Environmental Analysis. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/33726 License: CC BY 3.0 IGO.

[85] Boon, E. and Ahenkan, A. (2012). Assessing Climate Change Impacts on Ecosystem Services and Livelihoods in Ghana: Case Study of Communities around Sui Forest Reserve. Journal of Ecosystem and Ecology S3:001. DOI: 0.4172/2157-7625.S3-001

[86] Republic of Ghana (2015). Ghana's Third National Communication to the UNFCCC. URL: https://unfccc.int/resource/docs/natc/ghanc3.pdf

Policy Framework for Adaptation

Implementation of climate change activities has been relatively slow; however the Ghanaian Government continues to make concerted efforts to integrate climate change objectives and priorities into sector-specific development plans in agriculture, transportation and energy to mainstream climate change strategies.[87] Ghana submitted its Third National Communication to the UNFCCC in 2015, its Second Biennial Update Report in 2018, and its Nationally-Determined Contributions to the UNFCCC in 2016. These documents, in conjunction with its National Climate Change Adaptation Strategy (2015) provide the guidance and platform to integrate responsible environmental management with climate change adaptation strategies, in line with the country's social and economic development targets.[88] These strategies focus on the preparation and strengthening of institutional frameworks for improved management of climate change effects and to make available the necessary resources to support strategic adaptation activities and to advance low emission and climate resilient development.[89]

National Frameworks and Plans

- Fourth National Communication (2020)
- Second Biennial Update Report (2018)
- Nationally-Determined Contribution (2016)
- Ghana REDD+ Strategy (2016)
- Third National Communication to the UNFCCC (2015)
- National Climate Change Master Plan Action Programs for Implementation: 2015–2020 (2015)
- National Climate Change Adaptation Strategy, (2012)
- Second National Communication to the UNFCCC (2011)

Recommendations

Research Gaps

- Gain a better understanding of the timing and magnitude of incidence of several important indicators of climate change in the future, as well as the key vulnerabilities, development impact, and possible adaptation responses
- Widen the participation of the public, scientific institutions, women and local communities in planning and management, accounting for approaches and methods of gender equity
- Strengthen environmental monitoring capabilities for strengthened and more effective environmental management
- Additional investment in weather stations to expand the country's national hydro-meteorological monitoring system
- Strengthen the technical capacity to integrate Ghana's climate-smart agriculture and climate change risk management into farmer's and the wider agricultural sector[90]
- Conduct a comprehensive national assessment of climate change impacts and existing vulnerabilities for Ghana's population health and the health sector's capability to respond and adapt to climate change impacts

[87] USAID (2017). Climate Change Risk Profile – Ghana. URL: https://www.climatelinks.org/sites/default/files/asset/document/2017_USAID_Climate%20Change%20Risk%20Profile%20-%20Ghana.pdf
[88] UNDP (2019). Climate Change Adaptation Profile – Ghana. URL: https://www.adaptation-undp.org/explore/western-africa/ghana
[89] Republic of Ghana (2016). Nationally-Determined Contributions. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Ghana%20First/GH_INDC_2392015.pdf
[90] IFPRI (2012). Ghana – Strategy Support Program, climate change, agriculture, and foodcrop production in Ghana. URL: http://ebrary.ifpri.org/utils/getfile/collection/p15738coll2/id/127134/filename/127345.pdf

Data and Information Gaps

- Develop early warning systems about dangerous hydrometeorological phenomena and climate risk management
- Ensure that nation-wide climate change and atmosphere monitoring systems are maintained and enhanced where necessary, including through monitoring networks at appropriate spatial density and frequency[91]

Institutional Gaps

- Ensure integration of National Environmental Strategy goals are developed within sectoral and regional plans[92]
- 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

[91] Republic of Ghana (2015). Ghana's Third National Communication to the UNFCCC. URL: https://unfccc.int/resource/docs/natc/ghanc3.pdf

[92] Republic of Ghana (2015). Ghana's Third National Communication to the UNFCCC. URL: https://unfccc.int/resource/docs/natc/ghanc3.pdf

CLIMATE RISK COUNTRY PROFILE

GHANA

WORLD BANK GROUP