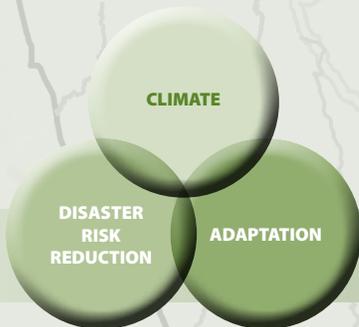




# Vulnerability, Risk Reduction, and Adaptation to Climate Change

## GHANA



**GFDRR**  
Global Facility for Disaster Reduction and Recovery

CLIMATE  
INVESTMENT FUNDS



## COUNTRY OVERVIEW

Ghana is located in West Africa and shares borders with Togo on the east, Burkina Faso to the north, La Cote D'Ivoire on the west and the Gulf of Guinea to the south. Ghana covers an area of 238,500 km<sup>2</sup>. The country is relatively well endowed with water: extensive water bodies, including Lake Volta and Bosomtwi, occupy 3,275 km<sup>2</sup>, while seasonal and perennial rivers occupy another 23,350 square kilometers.

Ghana's population is about 23.8 million (2009)<sup>1</sup> and is estimated to be increasing at a rate of 2.1% per annum. Life expectancy is 56 years and infant mortality rate is 69 per thousand life births. Ghana is classified as a developing country with a per capita income of US\$ 1098 (2009). Agriculture and livestock constitute the mainstay of Ghana's economy, accounting for 32% of GDP in 2009 and employing 55% of the economically active population<sup>2</sup>. Agriculture is predominantly rainfed, which exposes it to the effects of present climate variability and the risks of future climate change.

### Key Sectors

Agriculture/Food Security
Coastal Zones and Marine Ecosystems
Water Resources
Energy Production

Source: Adaptation Learning Mechanism

Increased climate variability is already affecting. The impacts are observable and place stress on the country's vulnerable sectors: agriculture, coastal zones/marine ecosystems, water resources, and energy production. Increased climate variability reflected in changing climate regimes is evident.<sup>3</sup> Climatic extremes, leading to periods of severe drought, decline in crop production and livestock herds, and the severe food shortages experienced in the country, especially in the early 1980's, point to potential future threats.<sup>4</sup> The adverse impacts of climate change on the natural

resources base and the sustainable livelihoods of rural communities can translate in increased poverty and limited economic development.

## CLIMATE BASELINE AND CLIMATE FUTURE

### CLIMATE BASELINE

Ghana has three hydro-climatic zones—the Volta basin system, the South-Western basin system, and the Coastal basin system. The South-Western system is the most humid part of the country, with mean annual rainfall between 1500 mm and 2000 mm. The Volta basin system, covering the northern part of the country, has mean annual rainfall of about 1000 mm in the savanna area and about 1500 mm to 2000 mm in the forest area. The Coastal basin system is the driest, with mean annual rainfall of about 900 mm. The rainfall is controlled by the movement of the tropical rain belt (also known as the Inter-Tropical Convergence Zone, ITCZ), which oscillates between the northern and southern tropics over the course of a year.

#### Major Climate Processes

El Niño Southern Oscillation (ENSO)

Inter-Tropical Convergence Zone (ITCZ) and West Africa monsoon

#### Impacts on Climate

*Brings Warmer and drier than average conditions in the south in December-March, wetter than average conditions in the north, particularly in November-May*

*Brings rains as it oscillates north-south. Creates a shift between the two opposing prevailing wind directions.*

<sup>1</sup> Statistics for population and GDP are from [http://ddp-ext.worldbank.org/ext/ddpreports/ViewSharedReport?REPORT\\_ID=9147&REQUEST\\_TYPE=VIEWADVANCED&DIMENSIONS=90](http://ddp-ext.worldbank.org/ext/ddpreports/ViewSharedReport?REPORT_ID=9147&REQUEST_TYPE=VIEWADVANCED&DIMENSIONS=90)

<sup>2</sup> <http://data.worldbank.org/indicator/NV.AGR.TOTL.ZS/countries>.

<sup>3</sup> Climate Change Adaptation in the 3 Northern Regions of Ghana. ALM.

<sup>4</sup> Ghana's First National Communication to the United Nations Framework Convention on Climate Change

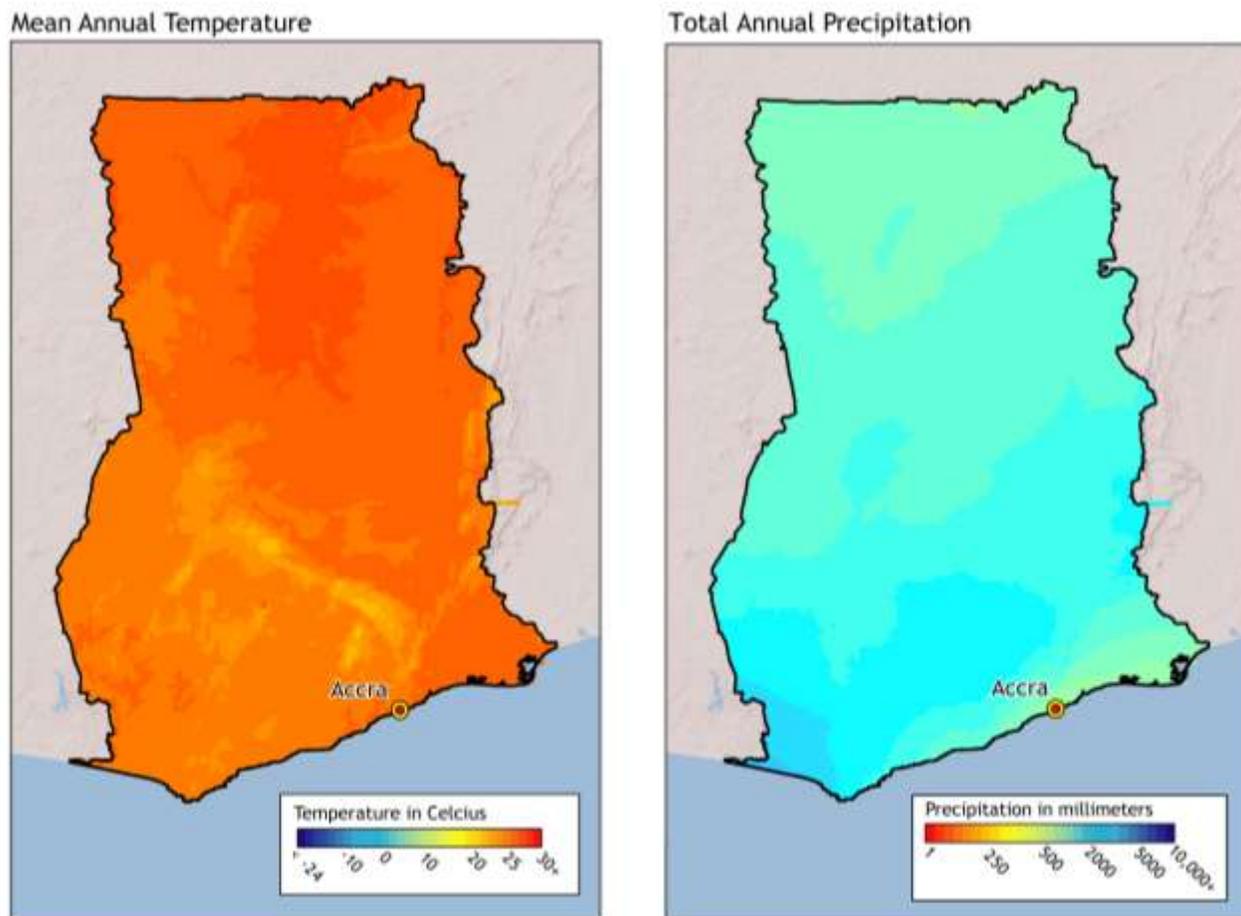


Figure 1: Climate Baseline for Ghana<sup>5</sup>

Ghana's climate is tropical and strongly influenced by the West African monsoon. Two main rainfall regimes are identified: a) the double maxima regime occurring south of latitude 8°30'N, with two maximum periods occurring from May to August and from September to October; and b) the single maximum regime found north of latitude 8°30'N, where there is only one rainy season from May to October, followed by a long dry season from November to May.

In northern Ghana, the wet season occurs between May and November, when the ITCZ is in its northern position and the prevailing wind is south-westerly, and the dry season occurs between December and March, when the 'Harmattan' wind blows north-easterly. The south-eastern coastal strip is dry and different from the north and the south.

The seasonal rainfall in the region varies considerably on inter-annual and inter-decadal timescales, due in part to variations in the movements and intensity of the ITCZ, and variations in timing and intensity of the West African monsoon. The most predictable cause of these variations is the El Niño Southern Oscillation (ENSO). El Niño events are associated with drier than average conditions in West Africa. Seasonal variations in temperature in Ghana are greatest in the north, with highest temperatures in the hot, dry season (April, May, and June) at 27-30°C; further south, temperatures are lower (June, August, September) at 22-25°C.

<sup>5</sup> Worldclim 1960-1990 Averages. Robert J. Hijmans, Susan Cameron, and Juan Parra, at The Museum Of Vertebrate Zoology, University Of California, Berkeley, in collaboration with Peter Jones And Andrew Jarvis (CIAT), and with Karen Richardson (Rainforest CRC). [www.worldclim.org/current](http://www.worldclim.org/current)

The major rainfall and temperatures patterns form the basis of the agro-climatic zones—namely, the Sudan Savanna zone, the Guinea Savanna zone, the Transition Zone, the semi-Deciduous Rainforest zone, and the High Rainforest Zone. Each zone is represented geo-climatically by Navrongo, Tamale, Wenchi, Kumasi, and Axim, respectively.<sup>6</sup>

The climate baseline trends for Ghana (since 1960) can be summarized as follows:<sup>7</sup>

- ➔ Mean annual temperature has increased by 1.0°C, at an average rate of 0.21°C per decade. The rate of increase has been higher in the northern regions of the country than in the south.
- ➔ The average number of 'hot' days<sup>8</sup> per year increased by 48 between 1960 and 2003.
- ➔ The average number of 'hot' nights per year increased by 73 in the same period.
- ➔ The average number of 'cold' days<sup>9</sup> per year decreased by 12 (3.3% of days) between 1960 and 2003.
- ➔ The average number of 'cold' nights per year decreased by 18.5 (5.1% of days) in the same period.
- ➔ Annual rainfall in Ghana is highly variable on inter-annual and inter-decadal timescales and long-term trends are difficult to identify.
- ➔ Rainfall over Ghana was particularly high in the 1960s, and decreased to particularly low levels in the late 1970s and early 1980s, producing an overall decreasing trend in the period 1960 to 2006, with an average precipitation of 2.3 mm per month (2.4%) per decade.
- ➔ There is no evidence of a trend in the proportion of rainfall that has occurred in 'heavy'<sup>10</sup> events since 1960.

## CLIMATE FUTURE

Generally, climate models cannot project changes in regionally driven climate phenomena, such as ENSO. Thus, for Ghana climate models show a wide range of projected changes in the amplitude of future El Niño type of events. As the climate in Ghana is strongly influenced by ENSO, this contributes to uncertainty in climate projections. Projections of precipitation changes for the Sahelian and Guinea coast regions of Africa are strongly divergent and most models fail to reproduce realistic inter-annual and inter-decadal rainfall variability in the Sahel in 20th century simulations. This adds to the uncertainty in the projected changes.

Several studies have been undertaken to reveal overall climate trends for Ghana in the future. These include the World Bank study of the Economics of Adaptation to Climate Change Study (looking at the 2010-2050 period) and the 2000 UNDP Climate Profile of Ghana (looking at the 2060-2090 period). Among their findings are the following:

- ➔ The mean annual temperature is projected to increase by 1.0 to 3.0°C by the 2060s, and 1.5 to 5.2°C by the 2090s. The projected rate of warming is most rapid in the northern inland regions of Ghana.
- ➔ Under the Ghana Dry climate scenario, temperatures in the three regions of the North are projected to increase by 2.1–2.4°C, in the western, western-central, and Volta regions by 1.7–2.0°C, and in the Brong Ahafo region by 1.3–1.6°C.
- ➔ All projections indicate substantial increases in the frequency of days and nights that are considered 'hot' in current climate, but the range of projections between different models is large.
- ➔ Total annual rainfall is projected to decline by 1.1%, and 20.5% in 2020 and 2080, respectively.
- ➔ Seasonality is projected to change, with early termination of rainfall in the transitional zone, and is likely to convert the current bi-modal regime to a uni-modal one.

<sup>6</sup> Ghana National Communication to the United Nations Framework for Climate Change.

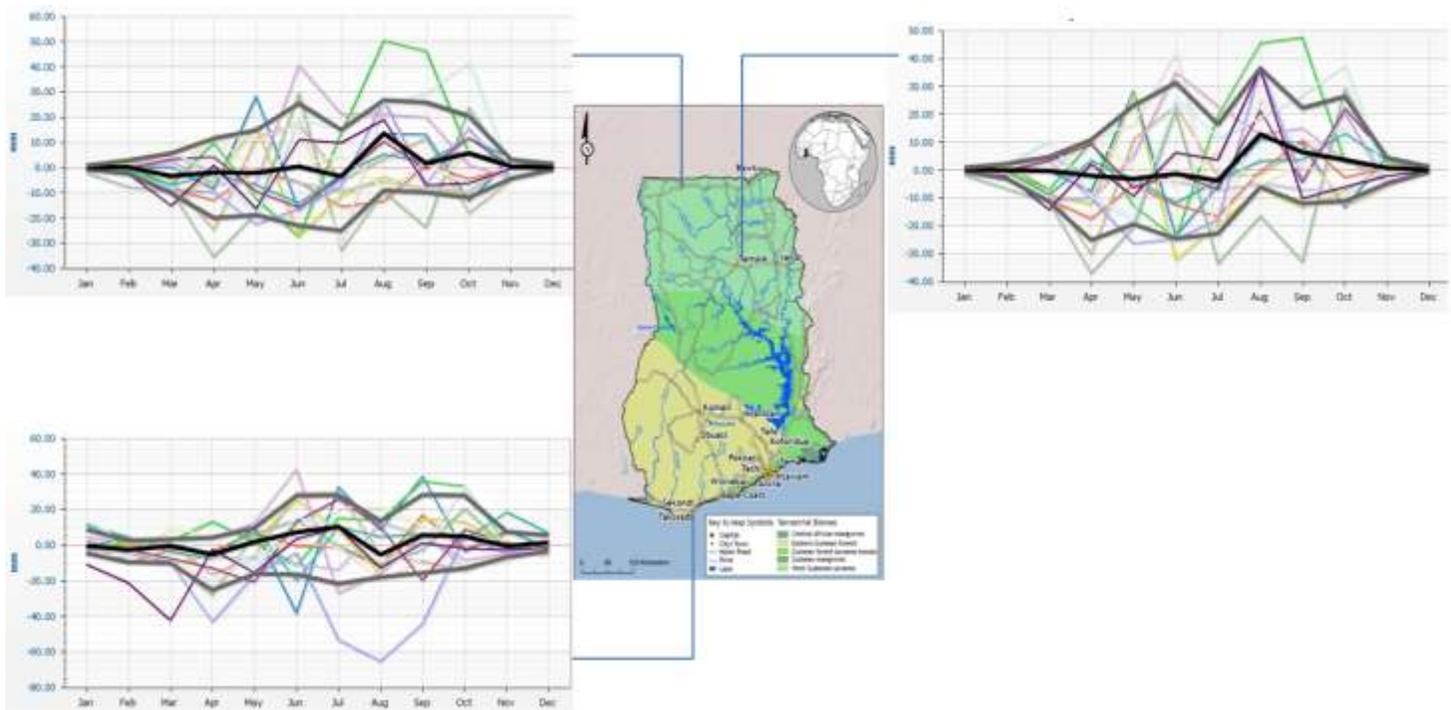
<sup>7</sup> IPCC 4<sup>th</sup> Assessment Report and UNDP Climate Profiles.

<sup>8</sup> 'Hot' days or nights are defined as the temperature above which 10% of days or nights are recorded in current climate of that region/season.

<sup>9</sup> 'Cold' days or night are defined as the temperature below which 10% of days or nights are recorded in current climate of that region/season.

<sup>10</sup> A 'heavy' event is defined as a daily rainfall total that exceeds the threshold above which 5% of rainy days in the current climate have been recorded for that region and season.

- ➔ The projections for precipitation indicate a cyclical pattern over the period 2010–2050 for all regions, with high rainfall levels followed by a drought every decade or so. The wettest parts of the country are expected to be the Tropical and Moist Deciduous Rainforest zone (in the Ashanti and Western regions) and Coastal zone (Volta, Eastern, Central, and Greater Accra regions). The northern and southern Savannah zones are projected to be relatively dry.
- ➔ The proportion of total annual rainfall that falls in ‘heavy’ events tends toward increases and there is a trend in the projections toward a decrease in January-June rainfall (dry season), and increases in July-August rainfall (wet season), suggesting that the wet seasons are projected to get wetter and the dry seasons drier.
- ➔ Projected changes in 1- and 5-day rainfall maxima tend toward increases, but projections vary a great deal.
- ➔ Sea level rise is projected at 5.8 cm, 16.5 cm and 34.5 cm by 2020, 2050, and 2080, respectively.



**Figure 2: Projected changes in rainfall for 2020-2039 as compared to between 1970-1990<sup>11</sup>**  
 (Note the wide disagreement across models, particularly from October to April.)

Overall, Ghana is projected to become hotter and wetter during the wet season and drier during the dry season, with increased sea level rise and storm surges.

## CLIMATE CHANGE IMPACTS ON NATURAL HAZARD VULNERABILITY

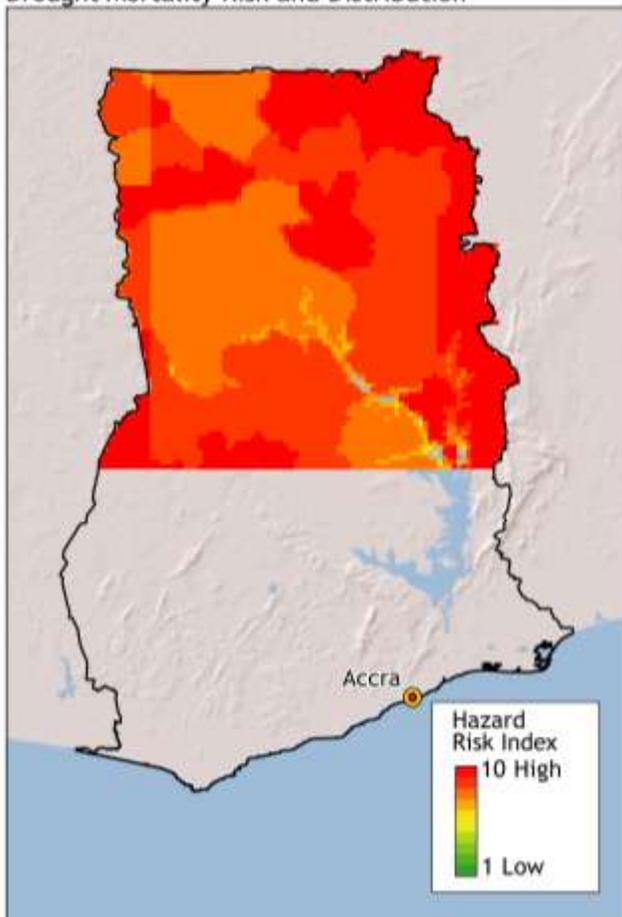
- ➔ **Floods and landslides-** Ghana is exposed to floods, particularly in the northern Savannah belt, and faces associated risks of landslides. Extreme rainfall events have increased over the 1986-1995 period, including a high number of 24-hour maximum rainfall events—a trend that has continued in the last decade. The parallel increases in temperature across all river basins suggest that the observed intensification in flood

<sup>11</sup> The World Bank's Climate Change Knowledge Portal, Data from IPCC CMIP3 Archive.

frequency may not be just a cyclical variability. Thus, the recurrence of both floods and droughts in the northern Savannas is becoming a common phenomenon, often associated with high temperatures and intense heat.

- ➔ **Coastal erosion**- Already affected by coastal erosion, especially along the eastern coastline, the coastal regions of Ghana are likely to be affected by further sea level rise and storm surges by the end of this century.<sup>12</sup> Additionally, areas around Accra, including the Akosombo Dam, are exposed to seismic hazards.<sup>13</sup>

Drought Mortality Risk and Distribution



Flood Mortality Risk and Distribution

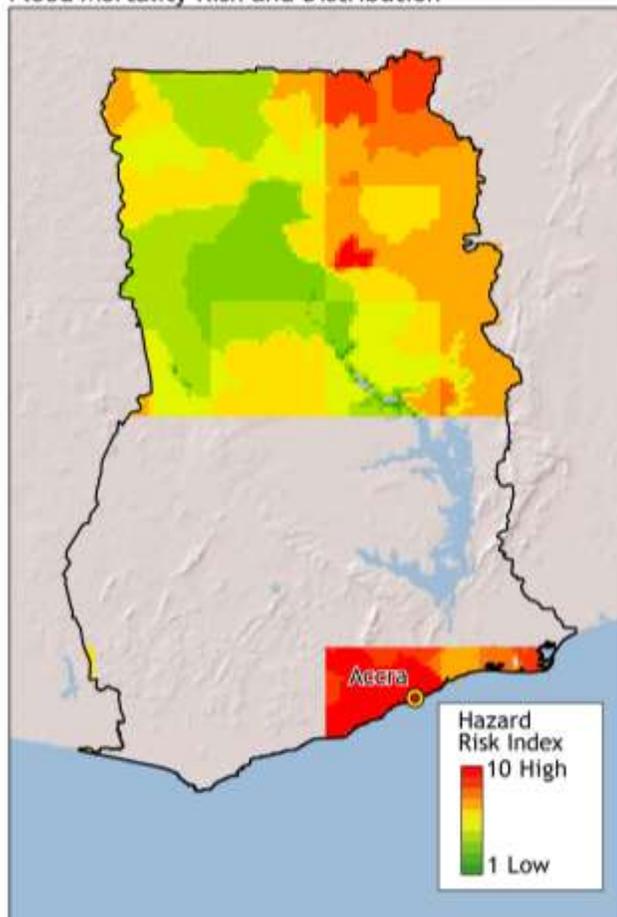


Figure 3: Exposure to climate-related hazards across Ghana illustrating drought- and flood-related mortality risks<sup>14</sup>

- ➔ **Droughts**- Climate extremes amplify food security threats and can severely affect economic development. Insufficient rainfall during the major cropping season during the last major severe drought in 1982-1983, affected more than 12 million people<sup>15</sup>. More recently, the 2007 catastrophic floods in north Ghana occurred immediately after a period of drought and damaged the initial maize harvest.

<sup>12</sup> IPCC Working group I (*The Physical Science Basis*): Chapter 10 (Global Climate Projections) (Meehl *et al.*, 2007). Regional sea-level projections are estimated by applying regional adjustments to projected global mean sea-level rise from 14 AR4 models.

<sup>13</sup> Ghana Country Program for Disaster Risk Management and Climate Adaptation, GFDRR, <http://gfdrr.org/ctrydrmnnotes/Ghana.pdf>

<sup>14</sup> UNEP'S Global Risk Data Platform, Columbia University Center for Hazards and Risk Research (CHRR), and Columbia University Center for International Earth Science Information Network (CIESIN).

<sup>15</sup> "EM-DAT: The OFDA/ CRED International Disaster Database

Current development dynamics and demographic changes in Ghana put more people at risk from disasters as a result of increasing rural poverty, rapid urbanization, growth of informal settlements, poor urban governance, and declining ecosystem and land conditions. With more than 60% of Ghana's 20 million people depending directly on agriculture, the impacts of localized disasters are likely to have even greater accumulated impacts on rural livelihoods over time as a consequence of climate change. These impacts are likely to be more obvious in the north, where soil erosion is more pronounced and poverty among crop farmers is high. Overall, the impacts of climate risks are likely to magnify the uneven social and spatial distribution of risk in Ghana, and possibly amplify poverty in the north.

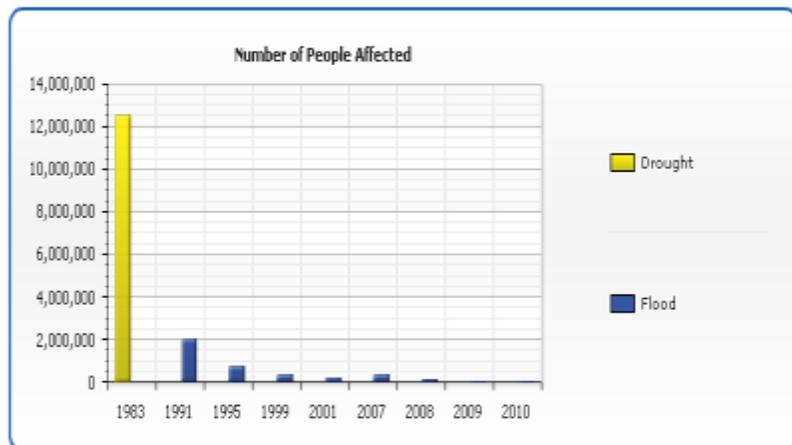


Figure 5. Annual average frequency of natural hazards

In response, the Government of Ghana has initiated actions to develop strategies and strengthen institutional capacity in disaster risk management with increasing donor support, including for a country-wide hazard mapping covering the broad geographical distribution of disaster exposed areas for key hazards. Such efforts come both as a response to the 2007 floods and out of concerns over projected increased in frequency and intensity of extreme climatic events. They are aimed at strengthening Ghana's adaptive capacity and building social and ecosystem resilience to absorb current and future climate change impacts.<sup>16</sup>

### Implications for Disaster Risk Management

- ➔ Climate change could produce disruption of agricultural systems and food security and seriously impact health. The impacts of droughts and floods might have economy-wide implications due to widespread crop failure/loss, outbreaks of human and animal diseases, forced migration of human populations, destruction of property and infrastructure, and loss of livelihoods.<sup>17</sup>
- ➔ Decreases in agricultural productivity might become more pronounced over time<sup>18</sup> (see below).
- ➔ Projected increase of flooding in low and coastal areas, which are already eroding, might severely impact marine ecosystems and coastal livelihoods.
- ➔ Reduced levels of precipitation are a major concern for the operation of the only hydro-generating dam in the country.
- ➔ The increased construction of immovable structures near the shoreline zone prone to inundation may need to be reconsidered, along with the need to avoid development in areas subject to liquefaction during earthquakes. The emerging peri-urban slum areas present a major challenge in this respect.

<sup>16</sup> CC DARE: Climate Change Development-Adapting to by Reducing Vulnerability. A joint UNEP/UNDP Program for Sub-Saharan Africa. National Climate Change Adaptation Strategy

<sup>17</sup> Ibid.

<sup>18</sup> Economics of Adaptation to Climate Change: Ghana Country Case. World Bank, 2010.

[http://climatechange.worldbank.org/sites/default/files/documents/EACC\\_Ghana.pdf](http://climatechange.worldbank.org/sites/default/files/documents/EACC_Ghana.pdf)

## SECTORAL CLIMATE RISK REDUCTION RECOMMENDATIONS

### AGRICULTURE

Agriculture in Ghana is predominantly on a small-holder basis. About 67% of the farmers use maize as a cash crop in addition to feeding their households. The country also has some large farms and plantations, particularly for cocoa (1,200,000 ha), oil palm (285,000 ha), seed cotton (62,000 ha), tobacco (1,600 ha), and coconut, bananas, and kola (1,502,500 ha). In the 1970s, Ghana was virtually self-sufficient in the production of maize, cocoyam, cassava, and plantain. Since then the agriculture sector has suffered many setbacks. Poor performance in food production can be attributed in part to external economic conditions, physical conditions (e.g., the drought and bushfires of 1982-1983), deficient agricultural policies, low priority given to food production in the past, inadequate support for the agricultural sector, and an emphasis on capital-intensive agriculture and industry to the neglect of the larger traditional farming sector.<sup>19</sup>

Climate change is likely to further exacerbate such trends according to analysis of projected climate change impact on cereal production. While drought-tolerant crops like millet may not be affected, cereals that are non-tolerant to drought will reduce their yields.<sup>20</sup>

### WATER RESOURCES

Water is vital to Ghana's socio-economic growth and improvement. Impacts of climate change on water resources are likely to affect sectors such as energy, agriculture, and the budding industry. Based on domestic, industrial, and irrigation water demands relative to socio-economic indicators for the year 2020- 2050 and using GCM projections and CROPWAT model for precipitation and evapotranspiration, the following impacts are expected as a result of increasing climate variability<sup>21</sup>:

- ➔ Reductions in rainfall and runoff of about 20 and 30%, respectively, with an observed increase in temperatures of about 1°C over a 30 year period.
- ➔ Sensitive changes to runoffs or discharges in all the representative basins relative to precipitation and temperature. A 10% change in precipitation or a 1°C rise in temperature can cause a reduction in runoff of about 10%, although this varies according to the terrain and soil types.
- ➔ Likely reduction in river flows between 15-20% and 30-40% for the years 2020 and 2050, respectively, in all the basins.
- ➔ Climate change can cause reduction in groundwater recharge between 5 and 22% by the year 2020. Reductions for the year 2050 are projected to be between 30 and 40%.
- ➔ Irrigation water demand and hydropower generation could be affected considerably by climate change.

### COASTAL ECOSYSTEMS

The coast of Ghana comprises 565 km of relatively low and straight shoreline. On the west and the east the coast is dominated by sandy beaches, while the central part is taken by rock shores. Based on the last census, 25% of Ghana's population resides in the coastal zone, which accounts for about 7% of the country's land area. Close to 60% of this population resides on the East Coast, below the 30-m contour.

<sup>19</sup> Samuel Nii Ardey Codjoe(xxx).Population growth and agricultural land use in two agro-ecological zones of Ghana,1960-2010.Regional Institute for Population Studies, University of Ghana,

<sup>20</sup> Ghana's First national Communication to the United Nations Framework Conference on Climate Change

<sup>21</sup> Ibid.

Sea level rise is projected to exacerbate shoreline recession, particularly on sandy shores, inundating low-lying coastal areas, and increasing the salinity of estuaries and aquifers. These physical changes can have significant impacts on socio-economic activities within the coastal zone.<sup>22</sup> Coastal habitats will be lost, biodiversity could be adversely affected, and livelihood impacted especially in areas inhabited predominantly by fishermen and farmers. Sea level rise, along with projected increase in extreme weather events, make the choice of location of new construction and key infrastructure of critical importance to both urban planners and decision-makers.

**Table 1: Coastal Zone Vulnerabilities in Ghana**

Socio-economic activities in the coastal zone	Vulnerability to sea-level rise
Fishery and Fishery Activities	
Fishery in open water	High
Fishing villages with vessels and canoes in number > 50	High
Fishing villages with vessels and canoes in number < 50	Medium
Coast used for intensive beach seine fishery (villages having > 5nets)	Very high
Coast used for intensive beach seine fishery (villages having < 5nets)	High
Coast with lagoon fishing and/or aquaculture	Low-to-High
Industrial and Agriculture Activities	
Coast with salt production utilizing marine water	Low-to-High
Coast with major port	High
Coast with industrial plant relying on marine water intake	Low-to-High
Coastal farming (e.g. shallot cropping)	High
Tourism and recreational activities	
Coast with tourist hotels at the water front having > 20 rooms	High
Coast with tourist hotels at the water front having < 20 rooms	Medium
Coast used for recreational purpose	Medium
Historical Monuments and Amenities	
Coast with historical monuments (forts/castles) near waterfront	High

## ENERGY

Ghana's energy sector has already shown signs of susceptibility to climate variability, particularly the effect of highly variable precipitation patterns on hydropower production. About two-thirds of electricity generation in the country is from hydropower and the remainder is mostly from petroleum-fired thermal generation<sup>23</sup>. There is a small contribution (of less than 1 percent) from small-scale solar systems. The drought of the early 1980s (1980 to 1983) not only affected export earnings through crop losses, but also called into question the nation's continued dependence on hydroelectric power.

## ADAPTATION

To address the critical issue of climate change and its impacts on the environment and society, the Government of Ghana focuses on building climate resilience through mainstreaming adaptation in development projects and programs, with active support from regional (ECOWAS) and multilateral development agencies (UNDP, UNEP, FAO, WHO, WMO, IPCC, UNFCCC), bilateral donors (DFID, CIDA, JICA, GTZ, etc.), and through South-South cooperation with China, South Africa, Bangladesh, and Malaysia<sup>24</sup>. A recently completed Economics of Adaptation to Climate Change Study has synthesized key adaptation measures and their associated costs in order to provide information and assist policy makers in planning for climate resilient actions.<sup>25</sup>

<sup>22</sup> Ghana National Communication to the UNFCCC.

<sup>23</sup> Ghana Energy Commission 2006

<sup>24</sup> CC DARE: Climate Change Development-Adapting to by Reducing Vulnerability. A joint UNEP/UNDP Program for Sun Saharan Africa. National Climate Change Adaptation Strategy.

<sup>25</sup> Economics of Adaptation to Climate Change: Ghana Country Case. World Bank, 2010.  
[http://climatechange.worldbank.org/sites/default/files/documents/EACC\\_Ghana.pdf](http://climatechange.worldbank.org/sites/default/files/documents/EACC_Ghana.pdf)

A number of vulnerability and adaptation assessments indicate that the country is highly vulnerable to climate change and present evidence that the coastal zone, agriculture (including fisheries, cocoa, cereals, and root crops), water resource sector, as well as human health, economic security, and women's livelihoods are all threatened by increasing climate variability and change. In response, the Government of Ghana has developed a national climate change adaptation policy framework<sup>26</sup>, recognizing that adaptation policies at the national level must take into account the diverse socio-ecological settings within the country, while devising area-specific interventions that can support the livelihoods of vulnerable populations. Building on efforts such as the National Climate Change Adaptation Strategy and the Netherlands Climate Change Studies Assistance Program (NACP), this climate change adaptation policy framework examines the linkages between poverty and climate change, including mainstreaming measures targeting both district and national development plans.

The UNDP Africa Adaptation Program, of which Ghana is one of the participating twenty-one countries, also supports direct country assistance to develop integrated adaptation actions and resilience plans<sup>27</sup>. The Program targets five general outputs, including:

- ➔ Introduction of a dynamic, long-term planning mechanism to manage the inherent uncertainties of climate change;
- ➔ Strengthening leadership capacities and institutional frameworks to manage climate change risks and opportunities in an integrated manner at the local and national levels;
- ➔ Implementing climate-resilient policies and measures in priority sectors;
- ➔ Expanding financing options to meet national adaptation costs at the local, national, sub-regional and regional levels; and
- ➔ Generating and sharing knowledge on adjusting national development processes to fully incorporate climate change risks and opportunities.

#### Priority Adaptation Projects

Increasing resilience to climate change impacts: identifying and enhancing early warning systems
Alternative livelihoods: minimizing impacts of climate change for the poor and vulnerable
Enhancing national capacity to adapt to climate change through improved land use management
Adapting to climate change through enhanced research and awareness creation
Development and implementation of environmental sanitation strategies to adapt to climate change
Managing water resources to enhance productivity and livelihoods
Minimizing climate change impacts on socio-economic development through agricultural diversification
Minimizing climate change impacts on human health through improved access to healthcare
Demand- and supply-side measures for adapting the national energy system to impacts of climate change
Adaptation to climate change: sustaining livelihoods through enhanced fisheries resource management

Source: National Climate Change Adaptation Strategy

In addition, the UNDP Africa Adaptation Program recognizes that adaptation options have to deal with the present "adaptation deficit" and also address the multiple stresses that affect major productive sectors. This implies the need for institutional strengthening, including through improved inter-sectoral coordination and collaboration.

In this context, Ghana is already working to broaden and improve its institutional capacity and financing mechanisms for addressing climate risks. This also includes linking disaster risk reduction and climate change through specific measures such as the implementation of early warning systems. The matrix below includes a menu of adaptation options considered under various assessments and national reports.

<sup>26</sup> Ghana's National Capacity Self-assessment report: Capacity Needs for Global Environmental Management. UNDP/GEF

<sup>27</sup> UNDP: Africa Adaptation Strategy. <http://www.undp-adaptation.org/africaprogramme/>

## Adaptation Options by Sector

Sectors	Adaptation Options
<b>Agriculture/Food Security</b>	<p>Educational &amp; outreach activities to change management practices to those suited to climate change</p> <p>Switch to different cultivars</p> <p>Improve pest and disease forecast and control</p> <p>Development of drought tolerant varieties</p> <p>Breeding of early or extra early maturing genotypes.</p> <p>Educating farmers to plant in low population densities so as to reduce competition for scarce or limited soil moisture.</p> <p>Educating farmers on effective low input soil and water competition practices such as conservation tillage.</p> <p>Shifts in national production centers for cereal production to areas where comparative advantage in production can be obtained.</p> <p>Farm level adaptations such as shift in planting dates and modifying the amount and timing of fertilizer application may be adopted. Changing cropping sequences may be useful.</p> <p>Economic adaptive measures such as plans to change national production of rice and other cereals</p> <p>Rural roads provision to enhance both national agricultural marketing and exports of cash crops</p>
<b>Water Resources</b>	<p>Increase water supply, e.g. by using groundwater, building reservoirs, improving or stabilizing watershed management, desalination</p> <p>Decrease water demands, e.g. by increasing efficiency, reducing water losses, water recycling, changing irrigation practices</p> <p>Improve or develop water management. For surface water supply, increased water transfer from the Volta basin —identified as a high priority in order to meet the needs of the growing urban population.</p> <p>Develop and introduce flood and drought monitoring and control systems</p> <p>Develop efficient irrigation drainage systems to increase returns flows</p> <p>Promotion of afforestation to enhance dry season flows in basins (high priority); increased rainfall harvesting at domestic level (medium priority); and improved land use practices such as avoidance of uncontrolled deforestation, protection of river courses, and de-sedimentation of reservoirs (high priority)</p> <p>Develop Integrated Coastal Zone Management</p>
<b>Coastal Resources and Marine Ecosystems</b>	<p>Increase sea dikes; create and enhance construction of river dikes to protect ports and harbors; beach nourishment; coastal mangrove protection (ecosystem-based adaptation) and management.</p> <p>Shoreline accommodation options include promoting flood-proof building construction</p>

**Social Dimensions of Adaptation:**<sup>28</sup> Vulnerability has also been discovered to be influenced by other factors such as physical geography, economic geography/regional development levels, socioeconomic status, and social differentiation (which also includes migrant status and gender). Due to the extent and varying degree at which these factor impact different communities, adaptation practices by households also vary according to livelihood group and asset holding level.

To better support efforts of community-focused group adaptation plans, robust state-implemented adaptation practices to argument community efforts needs to be put in place, including the following:

- ➔ Developing drought-resistant short gestation crops;
- ➔ Developing small-scale irrigation systems;
- ➔ Improving farmer knowledge and supporting integrated farming approaches;

<sup>28</sup> Ghana, Economics of Adaptation to Climate Change

- ➔ Promoting woodlots and mangrove regeneration with incentives;
- ➔ Research into appropriate, less-expensive building technology;
- ➔ Enhancing mechanization of agriculture and encouraging productivity using agrochemicals;
- ➔ Refining arrangements for access to land;
- ➔ Providing microcredit and skills for diversified livelihoods;
- ➔ Encouraging aquaculture, restocking rivers and lakes with fingerlings;
- ➔ Providing community social and economic infrastructure, including insurance;
- ➔ Providing early warning information; and
- ➔ Targeting the poorest households with starter packs and access channels for livelihood diversification.

### EXISTING ADAPTATION FRAMEWORK/STRATEGY/POLICY AND INSTITUTIONAL SET-UP<sup>29</sup>

In an effort to manage climate change and adapt effectively, Ghana has developed a national climate change adaptation strategy through a series of sectoral studies. This was borne out of the recognition that the key to catalyzing the implementation of climate change adaptation and disaster reduction is to mainstream it into the wider national development process. Ghana's holistic approach engenders ownership at the national, regional, district, and community levels, with active inclusion of both governmental and non-governmental agencies including the private sector and civil society organizations.

Projects on adaptation and disaster risk management cut across all the vulnerable sector with collaborative efforts and/or partnerships with neighboring countries, multilateral and international agencies (UNDP, UNEP, FAO, WHO, WMO, IPCC, UNFCCC), bilateral collaboration (Netherlands Climate Assistance Program; Danish Government, Switzerland, DFID, CIDA, JICA, GTZ, and Australia) and South-South assistance from countries such as China, South Africa, Bangladesh, Malaysia, etc.<sup>30</sup>

#### Ongoing Efforts - At a Glance

<i>Vulnerability Reduction</i>	<i>Agency or Donor</i>
Policy, institutional capacity, and consensus building	NADMO, ECOWAS
Integration of disaster risk management in development strategies	NADMO
Strengthening knowledge and capacity enhancement for DRM	NADMO, UNDP, WB
Supporting integrated and comprehensive approaches to climate change adaptation in Africa	UNDP, Local assembly authorities
Reducing underlying risk factors and integration across sectors	NGOs, Local communities
Integrating and strengthening disaster preparedness and recovery	Community volunteers, zonal offices of NADMO, district assembly representatives
<i>GFDRR Interventions</i>	<i>Agency or Donor</i>
Strengthening national disaster risk management strategies and institutions	UNDP, ISDR, NREG, ECOWAS
Developing risk and vulnerability assessments, early warning and contingency planning and financing	UNDP, WFP, Met Station
Community co-management for disaster risk management of marine resources in West Africa	GFDRR, WB
Increasing and sustaining public awareness, education, and capacity building	UNDP, NGOs, UNICEF, ISDR
Reducing underlying risk and vulnerability factors	UNDP, WFP, ISDR, ECOWAS, Terrafrica

<sup>29</sup> Ghana: GFDRR Profile

<sup>30</sup> Ghana National Climate Change Adaptation Strategy

## RESEARCH, DATA, AND INFORMATION GAPS

As an agrarian-based economy, dependent on food and cash crops, Ghana is greatly vulnerable to the impacts of climate change. This is further augmented by its inability to effectively monitor and manage associated systems for the extrapolation of probability of extreme events or the assessment of possible changes in weather patterns. Hence, the development of both long- and short-term disaster plans is hampered. Thorough assessment studies are required for any intervention plan to be undertaken or formulated. These challenges are outlined below.

Like other countries in the region, the quality and coverage of available information varies in Ghana, both in terms of hydro-metrological data and in respect to the analysis of biophysical and socioeconomic implications. However, Ghana is highly recognized for its comparatively strong education system and independent think tanks. It has institutions conducting research in various areas, but currently lacks any educational programs that directly address DRM. Therefore, a strategic methodology is required for the inclusion of disaster risk management and climate change in school curricula, with a corresponding approach to the training of teachers. Research needs in these areas include:<sup>31</sup>

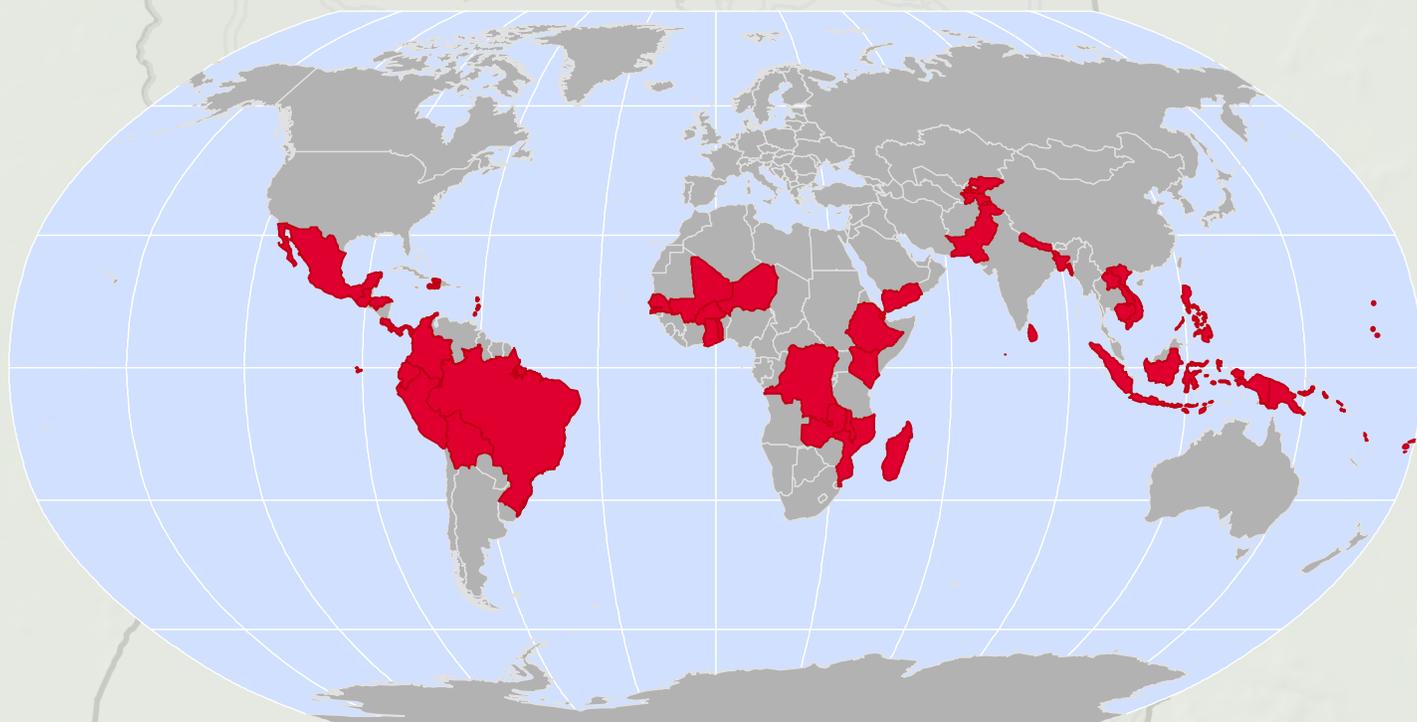
- ➔ Approaches with special focus on institutional support to integrating CC and DRR into national development plans;
- ➔ Appropriate model for DRM integration into key planning documents on climate change planning programs;
- ➔ Appropriate model for an efficient, decentralized multi-hazard early warning system, which incorporates a “how to design” , linked to monitoring, information analysis, communication, and outreach;
- ➔ Models that offer protection to key investments and natural resources
- ➔ Research of appropriate infrastructure design standards that meet higher requirements against extreme weather related natural hazard events.
- ➔ Disaster risk assessment, vulnerability assessment, monitoring, and early warning for effective hazard mapping relative to climate predictions linked to hazard exposure and vulnerability;

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<sup>31</sup>Ibid.

# Climate Risk and Adaptation Country Profile

This Country Profile (<http://countryadaptationprofiles.gfdr.org>) is part of a series of 49 priority country briefs developed by the Global Facility for Disaster Reduction and Recovery (GFDRR) and the Global Support Program of the Climate Investment Funds (CIF). The profile synthesizes most relevant data and information for Disaster Risk Reduction and Adaptation to Climate Change and is designed as a quick reference source for development practitioners to better integrate climate resilience in development planning and operations. Sources on climate and climate-related information are linked through the country profile's online dashboard, which is periodically updated to reflect the most recent publicly available climate analysis.



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