# GHANA NATIONAL FRAMEWORK FOR CLIMATE SERVICES

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# List of acronyms

| | |
|---|---|
| DFID | Department of International Development |
| ECOWAS | Economic Community of West African States |
| FAO | Food and Agriculture Organization of the United Nations |
| GFCS | Global Framework for Climate Services |
| Gh-NDC | Ghana Nationally Determined Contribution |
| GIZ | German Development Cooperation |
| GMet | Ghana Meteorological Agency |
| MOFA | Ministry of Food and Agriculture |
| NADMO | National Disaster Management Organization |
| NCCP | National Climate Change Policy |
| NC3 | Third National Communication |
| NDPC | National Development Planning Commission |
| NGOs | Non-Governmental Organizations |
| NMHS | National Meteorological and Hydrological Service |
| UNFCCC | United Nations Framework Convention on Climate Change |
| UNICEF | United Nations Children's Fund |
| USAID | United States Agency for International Development |
| WASCAL | West Africa Science Service Centre on Climate Change and Landuse |
| WHO | World Health Organization |
| WMO | World Meteorological Organization |

# Executive Summary

Climate Service is the generation and provision of a wide range of information on past, present and future climate and its impacts on natural and human systems. It involves the acquisition, processing, packaging, and dissemination of weather and climate variables to a range of users at different levels. This is intended to support climate-resilient development and climate-informed policy and decision making. Considering the increasing demand for climate information and a long value chain of climate services, meeting the demand by various users is beyond the capacity of the Ghana Meteorological Agency and the coordinated effort of other institutions will enhance efficient service delivery. It therefore calls for a comprehensive framework to guide the implementation of climate information services in Ghana.

In Ghana, the climate-dependent sectors have policies that seek to contribute to sustainable development. Achieving the sustainable development under the erratic and changing climate is dependent on the successful implementation of a comprehensive National Framework for Climate Services.

The National Framework for Climate Services provides background information on the climate outlook in Ghana and sets the scene for the need for the framework for the GFCS priority sectors. The Framework will provide enabling capacity for the development and application of Climate Services in the planning and implementation of risk management in all climate-sensitive sectors of the economy. It will guide the improvement of knowledge on Climate Services in all sectors and the provision of efficient climate information services for sustainable socio-economic development.

The Ghana NFCS (NFCS-Gh) was prepared through a wide consultation of stakeholders including users, public, private and development partners. The draft framework was subjected to stakeholders at all levels for consultations for review to ensure that their interests are taken into account. The stakeholder analysis and the user needs assessment were done to provide the landscape of users of Climate Services in category, description, and use of the services. Capacity and infrastructure need assessments is done for the strengths and weaknesses in climate services providers in Ghana for informed improvements. Ghana's commitment to fight climate change impacts along with the existing legislative frameworks and various supporting policies towards climate change adaptation

and mitigation are outlined. Recommendations for improvement of the commitment are provided to include the institutional structure and financial plan from unprecedented collaboration among institutions across sectors, international and private boundaries. The implementation plan is provided to guide the efficient and timely delivery of services.

Priority activities and estimated costs recommended for the gaps identified are classified in the short term operationalization of the NFCS-Gh and long term activities for the priority sectors. Among the priority activities identified, the prime objectives are to facilitate and pass the bill on climate services and advocate for the effective and sustainable implementation of the action plan, determine a sustainable source of funding for NFCS-Gh activities, procure state-of-the-art equipment and tools for processing data, and improve the technical capabilities of actors, observation networks, and forecasting and information systems as well as the infrastructural development of the network of stations and the improvement of data collection mechanisms to support weather and climate. An adequate communication network and strategy is also proposed, in order to promote better access and greater synergy with existing climate platforms and databases for the well function of the NFCS-Gh.

It is expected that NFCS-Gh will guide and strengthen institutional capacity in the provision of efficient Climate Services to promote climate risk management for the impacts of climate variability and change. It is also expected to create the awareness of the impacts of climate change and variability for mainstreaming in the various sectors to build resilience.

A Scientific and Technical Committee (STC) and a Steering Committee under the supervision of the Inter-ministerial Committee, comprising of some government departments and the private sector described in chapter 2 are proposed to provide leadership for the NFCS-Gh. This will be the operational legal and institutional framework for the large-scale production, processing and extension of climate services for sectors and communities vulnerable to climate variability and change in Ghana.

The NFCS-Gh will therefore ensure a strong cooperation of all actors to guarantee a successful implementation of climate services in Ghana by a development of the knowledge, a mobilization of the capacities and necessary resources, and improvement of an advocacy and communication system.

# INTRODUCTION

Climate change is a challenge to sustainable development as it directly impacts many sectors in Ghana (Government of Ghana [GoG], 2020). It is probably the most challenging environmental subject the world has ever known. Evidence of the changing climate is manifesting in frequent droughts and floods, warmer and more frequent hot days and nights over most land areas (IPCC, 2018; Meehl et al., 2007). Floods and droughts have been more frequent and brought more severe consequences in recent times in Ghana (Amoako and Boamah, 2015; Ansah et al., 2020). Ghana generally experiences occasional reduction in crop yields, crop damage, increased pest outbreaks, rampant soil erosion and land degradation, wildfires, and waterlogging. Unpredictable drying and flooding of waterbodies usually affect water levels and consequently hydro energy generation, household and industrial use. Health systems in Ghana have not been spared from the impact of the changing climate manifesting in floods and extreme temperatures (Klutse et al., 2014).

Climate information is a tool to reduce the effect of climate risk in all sectors of the economy and has the potential to improve the resilience to climatic shocks. It can be used to help manage current climate risks and build resilience to future climate interventions. Climate Service involves the acquisition, processing, packaging, and delivery of weather and climate variables to a range of users at different levels to support climate-resilient development and climate-informed policy and decision making. It has therefore become important to improve the understanding of climate variability and climate predictions and how climate data and information is analyzed and provided to serve the needs of diverse stakeholders (list of stakeholders are presented in annex 1). This includes improving Ghana's weather and climate forecasting and prediction capabilities, services and applications to manage climate risks.

To achieve an efficient and timely Climate Services for every country, the Third World Conference of Ministers and Heads of State of the World Meteorological Organization (WMO) held in 2009 launched the process of creating a Global Framework for Climate Services (GFCS) that was adopted by the World Meteorological Organization. WMO Special Congress 2012 also established an Intergovernmental Council on Climate Services to oversee the implementation of the framework.

The aim of the GFCS is to support vulnerable governments and communities to build their resilience and adaptive capacity to better manage the risks associated with climate variability and change. Based on this, WMO Member States are challenged to develop national frameworks to guide the implementation of Climate Information Services in their respective countries.

For this reason, the Ghana Meteorological Agency in collaboration with WMO, and with funding support from the Economic Community of West African States (ECOWAS) organized a consultative workshop in June 2019 to establish a National Framework for Climate Services (NFCS) for Ghana. This framework will serve as a guide for the implementation of climate information services in Ghana.

The Ghana NFCS has been prepared following four key steps. The process commenced with institutional visits for consultation at the Ministry of Agriculture, Ministry of Communications and Digitalisation, Ministry of Fisheries, Academic Institutions, United Nations agencies (like FAO, WHO, UNICEF), International Organizations (GIZ) and Non-Governmental Organizations (NGOs). A desktop study was undertaken for reviews from literature including a review of the GFCS program. A stakeholder consultative workshop was participated by representatives from stakeholder institutions, (see report of the workshop in Annex 2), a team of Experts from Ghana Meteorological Agency, ECOWAS representatives, WMO Representatives, Academic and Research Institutions, Private Sector Organizations, and Non-Governmental Organizations.

This framework presents national policies and programs that demonstrate Ghana's commitment towards ensuring climate resilient communities. It also identifies the existing climate services initiatives for the priority sectors of the GFCS (Agriculture and Food Security, Water Resources, Disaster Risk Reduction, Health, Energy). Furthermore, the framework proposes action plans and identified needs for the implementation, and also an institutional arrangement and financial implementation guidelines for resources mobilization to sustain the operationalization of the NFCS in Ghana.

# CLIMATIC AND SOCIO-ECONOMIC CONTEXT AND DEVELOPMENT STRATEGY OF GHANA

## Country context

Ghana located in West Africa and bordered by Burkina Faso in the north, Togo in the east, Cote d'Ivoire in the west, and the Gulf of Guinea in the south. The land mass of Ghana spans 238,535 $km^2$ with a diverse geography and ecology that ranges from coastal savannahs to tropical rain forests. The Lake Volta with surface area of approximately 8,482 sq km is located in Ghana with the White Volta, Red Volta and Black Volta Rivers as its tributaries.

Ghana's climate is typically tropical with wet and dry seasons. Rainfall is highly variable on inter-annual and inter-decadal timescales with the annual average varying between 710 mm and 2030 mm. The southern part experiences a bimodal rainfall pattern and the northern part experiences a unimodal rainfall pattern. Ghana experiences dry, dusty, northeastern harmattan winds from December to March. More so, recurrent drought in the country severely affects agricultural activities.

Ghana's population is approximately 30 million according to the 2010 census. The population is concentrated in the southern half of the country, with the highest concentrations along the coast. Majority of the population are into subsistence rain-fed agriculture. Ghana is a lower-middle income developing nation and the economy relies strongly on the natural resources and an agricultural production base. However, the country faces challenges associated with rising population and changing climate which are impacting on the livelihoods and economic wellbeing of the people.

## Observed and projected trends in temperatures and rainfall

Temperature in Ghana is rising for both day and night. The average annual temperature has increased 1°C in the last 30 years since 1961 (Government of Ghana [GoG], 2015a, 2020) with minimum temperature increasing at a faster rate than the maximum temperature (Klutse et al., 2020). Moreover, according to Ghana's Third National Communication to UNFCC (Government of Ghana [GoG], 2015b) the average number of 'hot' days per year has increased by an additional 13.2% of days to 48 while the number of hot nights per year increased by an

extra 20% of nights to 73. The frequency of cold days per year has decreased by 3.3% of days to 12 and number of cold nights per year has reduced by 5.1% of days to 18.5. Downscaled information from General Circulation Models (GCMs) consistently indicate an increase in temperatures over the next 50 years across all regions of Ghana (De Pinto et al., 2012). Stanturf et al. (2011) reported a mean temperature increase in the dry season of between 1.5°C and about 3.0 °C by 2080 in most agro-ecological zones. According to Ghana's Fourth National Communication to the UNFCC (Government of Ghana [GoG], 2020), mean temperature is likely to increase by an average of 3$^{o}$C across all the agro-ecological zones by the year 2080. These projections are consistent with available projections for West Africa. The Northern Region is projected to experience a greater rate of warming than coastal areas of the country (Daron, 2014; McSweeney et al., 2010; World Bank, 2011). The months with the greatest temperature increase are expected to be December, January, and February (Christensen et al., 2013). In addition, the mean monthly maximum temperature is likely to increase by 4.2 $^{o}$C by 2040. Mean monthly maximum temperature is expected to record an increase of 3.2 $^{o}$C by the year 2080 while the mean monthly minimum temperature is likely to increase by 3 $^{o}$C by 2080.

Ghana has experienced declining rainfall totals during the 1980-2014 period (Government of Ghana [GoG], 2020). Ghana's Fourth National Communication estimates that rainfall is also predicted to decrease in all agro-ecological zones. The rainfall reduction is likely to be larger in the mid-future, whereas the far future would experience a marginal decline. The far future rainfall is likely to have a decadal increase with projected decadal variability for all the ecological zones until 2080. There is a consistent increase in decadal rainfall for sudan-savanna, deciduous and forest-savanna ecological zones compared to the transition zone where there is a high likelihood of a decline in rainfall in the near future in 2050. More specifically, Ashanti Region and the coastal areas of Volta, Eastern, Greater Accra, Central and Western Regions will continue to be the wettest parts of the country, while the northern and southern savannah zones will experience drier conditions (World Bank, 2011).

There are uncertainties in the rainfall patterns that vary across the different ecological zones in Ghana. Rainfall variability will continue to be higher in Ghana into the future towards 2080. This rainfall pattern impacts heavily on Ghana with a rainfed agricultural system as the climate change impacts manifest as droughts, dry spells, floods, delayed onset, and reduced length of growing period. A World Bank study for Ghana projects that a cyclical pattern of increased rainfall levels followed by drought will occur every decade between 2010 and 2050 (World

Bank, 2011). Changes in temperature patterns may have effects on river systems which may affect hydroelectric production (Markoff and Cullen, 2008).

- ## Impacts and vulnerabilities

Ghana is particularly vulnerable to Climate Change due to lack of capacity to undertake adaptive measures to address environmental problems and socio-economic costs. These include climate change associated health systems, flooding of coastal areas which are already undergoing erosion, and low operating water level of the Akosombo hydropower-generating dam in the country which produces 40% of the national electricity supply as a result of reduced levels of precipitation. Climate change is manifested in Ghana through rising temperatures, declining rainfall totals and increased variability, rising sea levels, and high incidence of weather extremes and disasters. The climate variations have unexpected impacts on the frequency and intensity of precipitation and temperature distributions.

- ## Temperature and rainfall risks

The Government of Ghana ([GoG], 2015) based on a 1981-2010 baseline study concludes that the climate in Ghana in the next few decades is projected to be hotter, with a gradual increase in the average minimum and maximum temperature in all agro-ecological zones of the country. Temperatures are projected to increase between 1 °C and 7 °C by 2080 compared with the observed temperatures from 1980-2010. There is evidence of statistical change in prevailing weather conditions in the country. The spread of change is more intense towards northern Ghana than the south for both temperature and rainfall. The observed changes in a decade for minimum temperatures are 0.54%, 0.31% and 20% for southern, middle and northern parts of Ghana respectively. Similarly, maximum temperature has higher decadal change of 0.8%, 0.6% and 29.6% for southern, middle and northern parts of Ghana respectively.

The mean annual rainfall in all agro-ecological zones is projected to reduce by about 10%. Rainfall in the major rainfall seasons are also likely to see a decrease of more than 10% in all agro-ecological zones but will increase in the other months by less than 10% in the next 10 to 60 years till 2080.

- **Sea level rise risks**

Ghana has a shoreline of about 540 km and 50% of this length is vulnerable to sea level rise (Boateng et al., 2016). Ghana has experienced a sea-level rise of 2.1 mm per year over the last 30 years. It is projected to rise further by 16.5 cm in 2050 and by 34.5 cm in 2080. Coastal erosion is a major challenge in the Coastal agro-ecological zone and the east coast of Ghana is the most affected with whole communities in Ada, Keta, Ningo and Prampram at risk of losing their houses and other infrastructure from very high erosion rates between 3.4 and 3.9 m/yr (Boateng, 2012).

- **Socio-economic Sector**

Ghana's NC3 confirmed that Ghana's major economic sectors continue to be sensitive to the impacts of climate change, particularly with the projected rising temperatures, erratic rainfall, floods and more extreme weather events.

Ghana is primarily an agrarian economy, with most of the population earning their livelihoods as smallholder farmers who rely on traditional technologies and so crop yields are low and rural poverty is high. Agriculture underpins Ghana's economy and it is the biggest contributor to Ghana's Gross Domestic Product (GDP). However, its share to the total GDP is declining. Over the last decade, the sector's contribution has declined from 51 % to 36 % of GDP, with the sector experiencing its lowest growth (0.8%) in more than two decades in 2011. In 2018, the agricultural sector contributed 18.3% of Ghana's GDP (World Bank, 2020).

An increase in temperature, decrease in rainfall, and its unpredictability jeopardize the employment of about 60% of the active population of Ghana, the majority of whom are small scale rural farmers. Agriculture and food security are interrelated and thus Climate Change induced unsustainable livelihoods will result in negative consequences on food security, poverty, health, education, gender equality and environmental degradation.

The use of irrigation to counter poor rainfall is particularly low across the country. For instance, the World Bank (2020) reports that the agricultural irrigated land was 0.22% of the total agricultural land in 2014. This figure translates into 40,000 hectares of the areas under irrigation in the country with potential irrigable lands of 500,000 hectares.

Tourism is a major contributor to employment creation and a viable tool for conservation of environment and local cultures in the country. In 2015, the industry employed an estimated 393,000 people directly and indirectly from hotels, restaurants, travel trade, entertainment, recreational, tourist site managers, etc. Because environmental conditions are critical resource for tourism, a wide range of climate induced environmental changes have profound effects on tourism in the country. These may include, changes in water availability, altered agricultural production (e.g., agro-based tourism, Cocoa Trail Tourism), increased natural hazards especially bush fires and destruction of eco-tourism sites, bio-diversity loss - flora (mangroves) and fauna (sea turtles, manatees), reduced landscape aesthetics through erosion and landslides, coastal erosion and inundation of beach resorts and historical sites, increasing incidence of vector borne diseases particularly malaria which poses threats to tourism.

Water, in its various occurrences, management and uses, is an essential component of human development and is a crosscutting factor in current development priorities driving Ghana's goal of sustainable development[1]. The ever-rising demand for water, planned future growth in housing, hydro-power needs and the uncertainties of Climate Change, raise difficult issues for sustainable water resource management for irrigation, hydropower generation, health, nutrition, infrastructure and energy-based industries[2].

Electricity is a key determinant of the country's continued economic growth, but the country has recently struggled to keep up with demand by the expanding and high value industries near the coastal capital city, Accra[3]. Ghana's economy is growing rapidly, with most of the country's expanding and higher-value industries located in or near to the coastal capital city, Accra. Despite planned diversification, hydropower is expected to remain a major energy source over the coming decades, and this raises concerns about the effect of climate change on river flows and generation capacity. Currently, Ghana's power is fueled by crude oil, natural gas and diesel, solar and imports from La Cote d'Iviore. Ghana also exports power to Togo, Benin and Burkina Faso. The current installed capacity for existing plants is 4,132MW

[1] Ghana National Water Policy, 2007

[2] Resource Centre Network Ghana report 2020

[3] Ministry of Energy report, 2017

consisting of 38% Hydro, Thermal 61% and Solar less than 1%[4]. Wood fuel consumption accounts for over 60% of the total energy used in Ghana. Wood fuel include firewood and charcoal, and are used for cooking (in both the urban and rural areas) and providing the bulk of the energy requirements of most informal enterprises (such as bread-baking, processing of palm oil, brewing of local drinks, tobacco curing, traditional textiles (tie and dye, batik), traditional soap making and fish smoking).

Provision of infrastructure and all modes of transportation are dominated by the State. Except in road and air transport, the public sector has been heavily involved in all modes and has monopoly in rail and inland water transport[5]. Most urban transportation is by road and is provided by taxis, minibuses for residents commuting to work, schools and other socio-economic activities. A rail network connects the main agricultural and mining regions to the ports of Tema and Takoradi for haulage of minerals, cocoa, timber and other solid and liquid bulk cargo; while private sector airlines operate flights between Accra and five inland airports; and a fleet of tugs and barges carry passengers and cargo on the inland Volta lake, from the Akosombo port to and from ports in the middle belt and northern parts of the country.

Climate change affects the usability of rural and urban roads, including highways and related civil works – bridges, culverts and flyovers – are often either permanently or temporarily made unusable by severe floods. Though unrecorded, it is likely that recent torrential rains, which occurred nationwide, may have caused some degree of damages to telecommunication infrastructure, above ground facilities such as cell phone masts, aerial telephone cables, internet hubs and transformers which were vulnerable to destruction from falling trees, and storms. Ghana has a large infrastructure deficit, particularly roads in the rural areas, and many households have poor access to markets and public services. Ten percent of the government's budget is already allocated to maintaining roads, and so if climate change damages road surfaces it could further widen the infrastructure gap.

[4] Ministry of Energy report, 2019

[5] Ghana Investment Promotion Centre (GIPC) Report 2019

# OBJECTIVES AND EXPECTED RESULTS OF GHANA NFCS

## Main objective

The objective of the NFCS is the provision of timely and sector relevant climate services for climate risk management and adaptation to the impacts of climate variability and change for socio-economic development.

## Specific objectives

The specific objectives of the NFCS are to:

i. Understand the impact of climate change and the risks it poses.
ii. Understand the vulnerability of the various sectors, particularly the five relevant sectors (agriculture and food security, water resources, energy, health, disaster risk reduction).
iii. Enhance capacity in observations and monitoring of climate systems.
iv. Improve the provision of climate services at the national and local levels.
v. Guide the mainstreaming of climate information in development planning and decision-making.
vi. Guide the capacity in developing, packaging and communicating weather and climate information.
vii. Enhance the capacity of users in understanding and application of climate information and services.
viii. Improve climate-related research, modeling, and prediction of weather and climate.

## Expected results

The NFCS is expected to guide and strengthen institutional capacity in the provision of efficient climate services to promote climate risk management for the impacts of climate variability and change. It is also expected to guide climate change and variability mainstreaming in the various sector to build resilience in Ghana.

# SECTION I: STATE OF CLIMATE SERVICES IN GHANA

This section reviews the current state of climate services for the five main sectors in Ghana whilst justifying the need for the implementation of the national framework for climate services in Ghana. For each sector, the strengths, weaknesses, opportunities and threats (SWOT) in their operations are identified. The national priorities that are aligned to the objectives of the NFCS and the institutions responsible are highlighted. The potential role by the institutions in the implementation of the NFCS are also provided.

## 1.1 NFCS Sectoral priorities of Ghana

The NFCS is expected to provide the needed benefits for its stakeholders - both climate service providers and users within these sectors. The framework will provide an enabling capacity for the development and application of climate services for five climate-sensitive sectors in line with the GFCS. The climate-sensitive sectors that are taken into consideration in the NFCS are the priority areas of GFCS and suggested during the National Consultation Workshop towards the establishment of a National Framework for Climate Services (NFCS) in July 2019. The priority area are Agriculture and food security, Water resources, Energy, Health and Disaster risk reduction.

### 1.1.1 Agriculture and Food Security

Agriculture in Ghana is predominantly smallholder, traditional and rain-fed (SRID-MoFA, 2011) and about 80 % of Ghanaians rely on subsistence agriculture. Smallholder farmers are living at a subsistence level and are easily trapped in poverty because they cannot recover from climate shocks like changes in planting dates, erratic rainfall patterns, disease emergence and pest infestation. The smallholder farmers are key to food security in sub-Saharan Africa (Dayamba et al., 2018; Enfors et al., 2008). These farmers grow most of the country's maize and produce significant quantities of potatoes, beans, peas, sorghum, cassava, banana, oilseeds, vegetables, tree fruits, etc. However, these farmers are faced with several challenges including the impact of climate change, lack of farm inputs and support from the government on product sale and preservation. Meeting these challenges is vital to sustained livelihoods and reduction of poverty in Ghana. The changes in the climatic conditions have exacerbated the vulnerability of rural population to poverty. Furthermore, investments in agriculture are becoming

expensive, risky and less profitable. Timely provision and access to weather and climate information like changes in planting seasons and possible extreme events can help reduce these impacts through preparedness and planning. The Ministry of Food and Agriculture, and the Ministry of Fisheries and Aquaculture Development are responsible for all agricultural activities in Ghana and help interpret this climate information to farmers. The institutions work with farmers through the Agric extension officers and farmer groups. Table 1 provides the strengths, weaknesses, opportunities and treats (SWOT) analysis of the Agriculture and Food security sector managed by the ministries.

Table 1: SWOT of Food and Agriculture sector

| Strengths | Opportunities |
|---|---|
| • Has two ministries responsible - Ministry of Food and Agriculture, and the Ministry of Fisheries and Aquaculture Development<br>• GMet has a good collaboration with farmers<br>• Database of farmers groups<br>• Good collaboration with GMet enhancing access to weather and climate information including seasonal forecasts<br>• Provider of specific weather and climate information related to agriculture<br>• Strong willingness to share climate services with farmers<br>• Agric Extension Officers on the field working with farmers | • Support for national climate change adaptation efforts<br>• Cooperation with international and national organizations to support service delivery<br>• Value added product provider in the value chain of climate service<br>• Knowledge sharing with stakeholders<br>• Adaptation of existing practices to improve service delivery to users<br>• Building capacity of stakeholders in information use |
| **Weaknesses** | **Threats** |
| • Inadequate communication facilities with stakeholders<br>• Do not receive tailored weather and climate information for relevant agricultural practices<br>• Lack of seasonal forecast for dry season farming<br>• No documentation of the capacity of research expertise in climate applications<br>• Limited Agriculture extension officers to deliver on the specific climate services products and applications | • Availability of financial resources to implement projects and programs<br>• Data availability at all needed timescales<br>• The low literacy of climate services and products among stakeholders<br>• Staff attrition |

### 1.1.2 Water Resources

Water is a critical sector and supports the agriculture sector as well as input into industrial production. Climate change has increased pressure on water resources through droughts and floods (Parry et al., 2007) thereby endangering access to quality and quantity of water in Ghana. Additionally, industries such as mining companies have polluted the water bodies in Ghana and have affected the biological diversity and the main source of supply for farmers to water crops. Climate services which provide information on water levels and quality, stream flows, and projection of future heavy rainfall or decreased rainfall are key components in effective and sustainable water resources management towards achieving sustainable development. The third national communication on climate change to the UNFCCC confirmed that Ghana's major economic sectors continue to be sensitive to the impacts of climate change, particularly with the projected rising temperatures, erratic rainfall, floods and more extreme weather events.

Drought persists to be a major disaster causing vast impairment to humanity, the environment, and the economy (Mishra and Singh, 2010). Drought monitoring, forecasting, and mitigation is a complex phenomenon, which varies every time in terms of its onset, intensity, duration, and geographical coverage. The impacts of the rising temperatures are contributing to the drying of water bodies in the dry season and frequent events of drought which cause low levels of water that affect the hydropower generation, for instance, across the country (Kasei, 2009; Kunstmann and Jung, 2005). On the other hand, where there are heavy rainfall so much that the soil cannot absorb and cannot drain as quickly as it rains, floods are experienced. Since heavy rainfall and floods are also amplified by global warming, information on the impact of global warming on water bodies is needed in the water sector planning effective and sustainable water resources management. The Ministry of Sanitation and Water Resource and its associated institutions disseminate customized climate information to users. The SWOT of the Ministry is given in Table 2.

*Table 2: SWOT of Ministry of Sanitation and Water Resource*

| Strengths | Opportunities |
|---|---|
| • Availability of expertise in data analysis and research in climate applications in the water sector<br>• Good collaboration with stakeholders<br>• Strong willingness to implement climate adaptation services | • Support for national climate change adaptation efforts<br>• Value addition of climate data<br>• Cooperation with international and national organizations for service delivery<br>• Adaptation of existing practices to improve service delivery to users<br>• Developing the capacity of users of weather and climate products |
| **Weaknesses** | **Threats** |
| • Limited human resource development<br>• Lack of data on water levels and quality, stream flows. | • Products and services from external service providers (foreign competition)<br>• The low literacy rate among the users of climate services<br>• Unavailable Database of stakeholders |

### 1.1.3 Energy

Energy is essential for socio-economic growth and sustainable development. However, changes in weather and climate extremes have significant impacts on the energy sector, particularly in developing countries. Extreme events such as storms, floods, drought, and extreme temperature significantly affect energy production, transmission, and supply (Deressa, 2014). Ghana's power generation has been affected heavily by drought and flood events. The Akosombo hydro dam is located at the south of the lake Volta and provides about 40% of Ghana's electricity. When the level of the dam goes down because of the effect of climate change, it leads to power rationing in Ghana and a typical one happened in 2006. This trend poses a threat to the future energy security of the country. The protection of the energy sector from the variable weather and climate is a priority for the sector and therefore requires accurate rainfall intensity and frequency as well as future changes in these variables and number of expected dry and wet days under global warming for taking appropriate decisions. Currently GMet provides seasonal forecasts of rainfall intensity, and temperature for the sector. Other

needed variables like future changes in these variables, number of expected dry and wet days in the future, water level forecasts are not provided by the GMet. Future changes in these variables and number of expected dry and wet days under global warming are done in Academic and Research Institutions. The SWOT analysis of the Ministry of Energy, which is the main institution to ensure the use of the climate information is presented in Table 3.

*Table 3: SWOT analysis for Ministry of Energy*

| Strengths | Opportunities |
|---|---|
| • Availability of expertise at upstream<br>• Database of consumers<br>• Experience in PPPs<br>• Proliferation of fossil fuel thermal plants<br>• Adequate Solar irradiance<br>• Solar power panels demonstrated for renewable energy<br>• Energy efficiency promotion programs<br>• Renewable Energy Act<br>• Ghana Nuclear Regulatory Act | • Support for national climate change adaptation efforts<br>• Discovery of fossil fuel<br>• Plans for nuclear power infrastructure<br>• Introduction of energy generation mix through the development of renewable energy sources |
| **Weaknesses** | **Threats** |
| • High electricity tariffs<br>• Poor tariff structure<br>• Over-dependence on thermal and hydro sources for electricity generation<br>• High carbon emission<br>• Low renewable energy usage<br>• Downstream fossil fuel processing is inadequate<br>• Limited human resource development downstream<br>• Impact of climate variability on hydropower | • Fossil fuel is susceptible to petroleum price instability<br>• Running out of rivers to develop dams for hydropower.<br>• Impact of climate variability on hydropower<br>• Increasing energy demand |

### 1.1.4 Disaster Risk Reduction

Many disasters are caused by weather and climate-related hazards such as floods, strong winds, extreme temperatures, landslides, and wildfires. The Intergovernmental Panel on Climate Change (IPCC) Special Report on Managing the Risks of Extreme Events and Disasters (Murray and Ebi, 2012) reports that climate variability and change will impact all sectors of the economy. In Ghana, droughts, dry spells, unreliable rainfall and excess runoff, including floods, pose potential threats to sectors such as energy, health, agriculture and food security, forestry, housing and settlement, and transport. Development of early warning systems will help minimize high future economic and financial cost, and human insecurity and proactively plan their resource allocation for water, food, and other core services. Climate services will contribute to the availability and the accessibility to early warning disaster risk management. Currently, the National Disaster Management Organization (NADMO) is responsible for the management of disasters as well as other emergencies in Ghana. The institution collaborates with the Ghana Meteorological Agency for weather and climate information for preparedness and accounts for vulnerable areas in Ghana. The SWOT analysis of NADMO is provided in Table 4.

*Table 4: SWOT of National Disaster Management Organization (NADMO)*

| Strengths | Opportunities |
|---|---|
| • Existing collaboration with GMet<br>• Database of vulnerable areas<br>• Easy data procurement by users<br>• Strong willingness to improve services | • Support for national climate change adaptation efforts<br>• Capacity to develop early warning systems<br>• Cooperation with international and national organizations<br>• Implementation of internationally recognized quality control and data rescue in the region<br>• Adaptation of existing practices to improve service delivery to users<br>• Building critical mass in research<br>• Developing the capacity of users |
| **Weaknesses** | **Threats** |
| • Limited information on emerging vulnerable areas.<br>• Limited tailored future climate products<br>• Lack of timely weather information | • Availability of financial resources to implement projects and programs<br>• Data availability |

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| • The low capacity of research expertise in climate applications<br>• The limited human capacity to develop early warning systems<br>• Lack of coordination of climate service providers<br>• Limited sensitization on the role of NADMO<br>• The low levels of awareness on climate related disasters among the population. | • The low literacy rate among the users of climate services |

### 1.1.5 Health

The Government of Ghana spends about 18 % of its budget on health annually to combat diseases (e.g., diarrheal disease, malaria, and meningitis, among others), which are influenced by climatic factors like changes in temperature and rainfall. Ghana has two distinct temperatures ranges. The lower temperature range is recorded at the southern half and the higher in the northern half of Ghana motivating geographically localized diseases. For example, Meningitis is prevalent among the people of the northern half of Ghana whiles cholera and diarrhea are prevalent among the people in the coastal areas. However, Malaria affects people in every part of Ghana.

Infectious diseases with seasonal cycles are influenced by changes in spatial and temporal variations in the climate. The seasonality of the diseases is driven by changes in weather and climate elements such as rainfall, temperature, and humidity (Klutse et al., 2014). For example, patterns of malaria transmission may change as a result of climate change (Lindsay and Martens, 1998; Peterson et al., 2009; Tanser et al., 2003). Timely provision of rainfall, temperature, and humidity forecasts and future changes in these variables is crucial for planning intervention measures and taking appropriate decisions to reduce climate risks on health. The Ministry of Health has integrated climate change risks into health policies and programmes at national and local levels and within vulnerable sectors and population groups in Ghana. A SWOT analysis of the ministry of presented in Table 5.

*Table 5: SWOT of Ministry of Health*

| Strengths | Opportunities |
|---|---|
| ● Existing user interface of health and climate change<br>● Good collaboration with GMet<br>● Database of stakeholder institutions<br>● Climate change is mainstreamed into health policy<br>● Strong willingness to use climate services | ● Support for national climate change adaptation efforts<br>● Cooperation with international and national organizations<br>● Adaptation of existing practices to improve service delivery to users<br>● Developing the capacity of users and professionals |
| **Weaknesses** | **Threats** |
| ● The limited human capacity to deliver on the specialized climate services, products, and applications.<br>● The low level of awareness on climate change impact on health among the population.<br>● Limited knowledge by decision-makers on the importance of climate service providers. | ● Availability of financial resources to implement projects and programs<br>● Data availability<br>● Products and services from external service providers (foreign competition)<br>● The low literacy rate among the users of climate services |

## 1.2 Selected national priorities aligned to the Ghana NFCS

Ghana felt the critical importance to explore the challenges and opportunities inherent in the inevitable climate change process and has demonstrated its commitment to mitigate and adapt to climate change issues. The National Development Planning Commission (NDPC), NADMO, and in collaboration with a host of ministries, has commissioned a set of 12 Policy Advice Series on the impact of Climate Change based on Climate Change and National Development Planning; Agriculture and Food Security; Disaster Risk Management; Coastal Zones and Resources; Education; Energy; Forestry and Bio-diversity; Health; Human Settlement; Tourism; Transport; and Water Resources. Furthermore, towards sustainable development, Ghana prepared a National Climate Change Policy, the National Climate Change Master Plan; the National Adaptation Plan, National Five-Year Development Plan 2016-2020. Table 6 provides the details of the national plans and programmes along with their potential roles in the NFCS. These are existing platforms necessary for the vehicle for the implementation of the NFCS.

Table 6: Selected national priorities aligned to the NFCS

| Policy/Strategy/Plan | Lead Institution | Objectives and links to Ghana NFCS | Potential role in Ghana NFCS |
|---|---|---|---|
| National Climate Change Policy and National Climate Change Master Plan | EPA/MESTI | Partnership with stakeholders | Policy guidance to implementers and regulators |
| National Adaptation Plan, National Five-Year Development Plan 2016-2020 | The National Development Planning Commission | Eradication of poverty and reduction of inequalities in the rural and deprived communities. | Ensure the implementation of adaptation and development plan<br><br>Ensure developments confirm with development strategy |
| Ghana Nationally Determined Contribution (Gh-NDC) | EPA/MESTI | The goal is to lower Ghana's greenhouse gas emissions by 15 percent relative to a business as usual scenario emission.<br><br>Ghana's adaptation goal is to increase climate resilience and decrease vulnerability for enhanced sustainable development. | Mobilizing capacity support for climate mitigation and adaption<br><br>Coordinating activities of sector actors<br><br>Climate related data management strategies<br><br>Sector Gh-NDCs planning, implementation and reporting<br><br>Awareness and engagement on climate related issues |
| 12 Policy Advice Series on the impact of Climate Change based on Climate Change and National Development Planning | National Development Planning Commission<br><br>MMDAs | Improve national climate smart development.<br><br>Regulate climate friendly infrastructure.<br><br>Ensure domestic and industrial climate project compliance. | Inter-agency coordination and global, regional and national land framework coordination |
| National Disaster Risk Reduction and Management Policy | NADMO<br><br>National Commission for Civic Education | Direct people to be more prepared and participate in the prevention of disasters and disaster risk management. | Provide emergency relief for people in distress.<br><br>Create awareness in disaster prone areas. |
| Energy<br><br>Renewable Energy Master Plan<br><br>National Low Carbon Growth Strategy | Energy Commission<br><br>Ministry of Energy<br><br>MESTI | Improve sustainable land use and infrastructure, which is climate proof and smart technology to expand food security.<br><br>Zero emission hydro electrified and solar | Inter-agency coordination and global, regional and national land framework coordination. |

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| | | powered transportation systems. | |
| Agriculture and Food Security Forest Development Master Plan (2016-2036)<br><br>The Forest Plantation Strategy: 2016-2040 | Ministry of Lands and Natural Resources<br><br>Ministry of Food and Agriculture<br><br>The Forestry Commission | The forest development master plan recognizes community forestry as a means to achieve technology-led forestry management systems that will rehabilitate and restore all degraded forest and savannah landscapes. | Inter-agency coordination and global, regional and national land framework coordination.<br><br>Ensure greater community awareness, participation and involvement in the sector.<br><br>Ensure quality engagement of local communities in efforts to reduce deforestation and forest degradation and land management.<br><br>Ensure appropriate planting, harvesting to and storage to expand food security. |
| National Water Policy<br><br>National Integrated Water Resource Management<br><br>National Drinking Water Quality Management Framework for Ghana | Water Resource Commission<br><br>Ghana Water Company Limited | Improve access to water resources knowledge base to facilitate water resources planning and decision making. | The strategic outcome of this objective is to improve data and information management for water resources management.<br><br>Implement communication strategies for sustained public and stakeholder awareness of Integrated Water Resource Management (IWRM). |

## 1.3 SECTORAL POLICIES AND LEGISLATIVE FRAMEWORKS

### 1.3.1 Ghana's commitment to climate change

Ghana has ratified international conventions on climate change (a list of the conventions is in annex 4) through the adoption of a more holistic approach by integrating them into its national policies and programs. Particularly, Ghana is a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) and committed to it through the ratification of the convention in September 1995. As a party to the convention, Ghana has actively implemented various domestic policies to address climate change while continuing to advance national economic development. Ghana also reports to the UNFCCC her national circumstances, national greenhouse gas inventory, greenhouse gas mitigation assessment, vulnerability and impacts assessment, climate change education, training and awareness, constraints, gaps and

related financial, technical and capacity needs and has done four National Communications since 2001.

Ghana has prepared 31 mitigation and adaptation actions in its Nationally Determined Contribution (Gh-NDC) to the UNFCCC in response to the Lima Call for Action (annex 5 is the NDC of Ghana). The Gh-NDC is to be updated in October 2020. The National Development Policy Framework (2017-2024) affirms Ghana's commitment to the Gh-NDC under the Paris Agreement. The Gh-NDC is also aligned with priority areas in the National Climate Change Policy (NCCP). The coordinated climate actions have been articulated in the NCCP which was officially launched by the President of the Republic of Ghana in 2014. The policy is anchored on the Ghana Shared Growth Development Agenda and seeks to provide medium-term strategy the country and its partners will follow. Details of some national priorities including the Ghana NDC and NCCP aligned to the NFCS are provided in Table 6.

The NFCS is a necessary step to enhance Ghana's commitments and capacity for climate change adaptation and mitigation. The NFCS will deliver the commitments through structured and coordinated provision of climate information services involving all stakeholders along the value chain.

### 1.3.2 Existing legislative frameworks

GMet was established by ACT 682(2004) of Parliament of Ghana to provide accurate weather forecast and climate services. This is the key institution in Ghana with such a mandate. There are other programmes and institutions aligned to climate adaptation and mitigation actions listed in Table 6. The legislative frameworks that relate directly or indirectly to the issues of climate change in Ghana are as follows:

**a. National Climate Change Policy (NCCP)**

The National Climate Change Policy launched in 2014 is an overarching framework intended to respond to climate change for a sustainable climate-resilient society. The policy demonstrates government commitments to tackle climate change through effective adaptation to the low carbon growth and social development objectives. The NCCP has five priority areas: (i) Agriculture and Food Security; (ii) Disaster Preparedness and Response; (iii) Natural

Resource Management; (iv) Equitable Social Development; (v) Energy, Industrial and Infrastructural Development.

### b. The Ghana Irrigation Policy (2011)

The National Irrigation Policy, Strategies and Regulatory Measures Irrigation Policy was formulated in 2011. The goal of the policy is to achieve sustainable growth and enhanced performance of irrigation while contributing fully to the goals of the Ghanaian agriculture sector". The policy is complemented with a strategic framework called National Irrigation Development Master Plan (NIDMAP) to specify how the strategies in the policy document will be implemented with the aim to put an area of 500,000 hectares under irrigation in the medium to long term. The policy has four objectives namely: i) accelerating the performance and growth in Ghana's agricultural land under irrigation; ii) removing current constraints on land and water resources to promote balanced socio-economic engagement in the water sector; iii) raising the environmental performance of all types of irrigation and related agricultural practices; and iv) enhancing services which extend cost-effective, demand-driven irrigation services to public and private irrigation practitioners through a series of economic incentives for farmer participation.

### c. The National Water Policy

The National Water Policy provides a framework for the sustainable development of water resources in Ghana and includes water use and water management within the central Governmental and decentralized (district assemblies) structures, Non-Governmental Organizations and International agencies. The policy also recognizes cross-sectoral issues related to water-use and the relationship with other relevant sectoral policies such as those on sanitation, agriculture, transport, energy etc.

### d. The National Adaptation Plan

This National Adaptation Plan (NAP) was launched in 2018 to focus more on sector-based approach to climate change adaptation planning in Ghana. The Environmental Protection Agency (EPA) of Ghana coordinates the development of an overarching NAP, and with adaptation priorities identified for key sectors such as agriculture, forestry, water, energy, gender and health, and multiple sectors and agencies, working at national and sub-national

levels to foster stronger collaboration and coordination among the different Institutions and Ministries. The NAP has a mandate to: i) addressing capacity gaps and weaknesses; ii) identifying and appraising adaptation options at the sectoral, subnational and national levels; iii) creating an enabling environment for effective institutional functioning and capacities for adaptation; iv) designing a coherent approach to fund mobilization for effective climate change adaptation; v) developing innovative approaches for engaging the private sector; and, vi) developing an effective monitoring and evaluation scheme to facilitate implementation.

### e. National Energy Policy / Energy Sector Strategy and Development Plan

The National Energy Policy of Ghana which came into force in 2010, states that "the goal of the renewable sub-sector is to increase the proportion of renewable energy, particularly solar, wind, mini hydro and waste-to-energy in the national energy supply mix and to contribute to the mitigation of climate change (Government of Ghana, 2010)" The vision of the energy sector is stated in the Energy Sector Strategy and Development Plan, 2010 as "to guarantee the availability of an adequate level of energy supply to meet the country's internal demands and ensure universal access to modern energy by 2020 as well as provide surplus energy for export (Government of Ghana, 2010)". The increase and expansion of the renewable energy production and supply is a key effort by Government of Ghana to address the challenges posed by climate change.

### f. Food and Agriculture Sector Development Policy

The current Food and Agriculture Sector Development Policy (FASDEP II) was developed in 2007 by the Ministry of Food and Agriculture in 2007, as a follow-up of FASDEP I that was developed in 2002. The FASDEP II mentions energy availability and costs among the crosscutting constraints in the food and agriculture sector, together with gender inequality and discrimination against women as well as access to land and finance. The policy document indicates that the cost and demand for energy (fossil fuel and electricity) in all sectors of the economy is growing rapidly, with dire consequences for agricultural production and processing. The policy indicates that the potential of alternative energy sources (particularly renewable energy) in the sector is largely unexplored due to inadequate research and knowledge. The policy objective for irrigation development is to enhance production potential of existing schemes by raising productivity of irrigation water from 30% to 80% in a ten-year

period (by 2018). The strategies to be pursued include the development of alternative ways of water delivery for irrigation schemes to reduce operational cost associated with energy.

### g. Health Policy

The Health Policy was formulated in 2006, with the ultimate goal "to ensure a healthy and productive population that reproduces itself safely". The policy seeks to address the objectives, concerns and challenges in the health sector through simultaneous action in priority areas, including: i) Promoting healthy lifestyles and healthy environments; ii) Providing health, population and nutrition services; and iii) Promoting the use of Information for planning and management of the health sector. The priority areas of "providing health, population and nutrition services" and "promoting the use of Information for planning and management of the health sector," in particular, could be enhanced with improved access to modern energy services to rural communities. In 2015, the Ministry of Health integrated climate change risks into health policies and programmes at national and local levels and within vulnerable sectors and population groups in Ghana.

# SECTION 2: ANALYSIS AND EVALUATION OF CAPACITY

For successful implementation of the NFCS, partnership, collaboration and cooperation among and between stakeholders from various sectors are required. Table 7 presents the mandates of institutions that have relationships with the GMet and their potential involvement in the current NFCS process. Partners who support climate services along the value chain include: Policy and Decision-Makers; MMDAs; Academic Institutions; Media; Private Sector; Civil Societies Organizations (CSOs); and Development Partners such as International, Multilateral and United Nations Agencies. These stakeholders have important roles in enhancing access and the use of climate services to reduce climate and weather risks. The private and development partners are essential in resource mobilization. They can enhance cooperation with national and international stakeholders to enable adequate delivery of climate services.

*Table 7: Role of partner institutions in the provision of climate service*

| Name of the institution | Mandate | Current interventions in the field of climate services | Potential role in the national chain for climate services |
|---|---|---|---|
| Ghana Meteorological Agency | To provide Meteorological Services | • Measurement of climatic parameters<br><br>• Archiving of data<br><br>• Production of weather and climate information at different scales (temporal and spatial)<br><br>• Evaluation | • Climate Service Provider<br><br>• Communication |
| Ghana Hydrological Services Department | | • Production of hydrological bulletins<br><br>• Technical notes | • Climate Service Provider<br><br>• Communication |
| Ministry of Energy | Promotion of renewable energy, energy efficiency and domestic fuels | • Promotion and development of rural electrification<br><br>• Domestic fuel promotion, forest resource management | End users |
| Ministry of Health | Management and monitoring of health policy | Epidemiological monitoring bulletin | End users |
| Water Resources Commission | Regulate and manage Ghana's Water Resources<br><br>Co-ordinate government policies in relation to their resources. | Promoting adaptive and coping strategies for water resources use and management | • End users<br><br>• Public education |
| Ministry of Agriculture | • Management and monitoring of agricultural policies<br><br>• Monitoring of the cropping season | • Provision of seasonal calendar according to the seasonal forecast<br><br>• Scaling up of Climate Smart Agriculture<br><br>• Climate change and NAP process<br><br>• Crop Monitoring and extension services<br><br>• Capacity building of users | • End users<br><br>• Sector technical partner<br><br>• Provider of sector specific information |

| | | | |
|---|---|---|---|
| Ministry of Fisheries and aquaculture development | Development of climate resilient marine and inland fisheries and food systems | • Dissemination of weather information<br>• Capacity building of users | • End users<br>• Sector technical partner<br>• Provider of sector specific information |
| Environmental Protection Agency | Management and monitoring of the environment | • Climate change and NAPs process<br>• Environmental management | • End user<br>• Provider climate information |
| Media | Communication | • Dissemination of information (Press, written, National TV, community radios)<br>• Reporting of meteorological events<br>• Outreach and awareness programs on climate change (Press, National TV, community radio) | Information relay |
| Research and Academic Institutions | Human Resource development<br>Research and development | Research and development | • Provider of climate information<br>• Publications of climate research results |
| Private practitioners /NGO/CSO | Community sensitization | Dissemination of information | • End user<br>• Information relay<br>• Resource mobilization |
| Development Partners | • Poverty eradicate while protecting the planet.<br>• Support countries develop policies, skills, partnerships and institutions. | • Research support<br>• Granting access to information<br>• Expertise for peer review<br>• Support on policies | Adequate delivery of climate services |

The intent of this Framework is to enhance climate services to support the implementation of climate change adaptation measures. In particular, it will involve all stakeholders along the value chain of climate information services from the provision of climate and weather information through value addition to application and use of information. The objectives of the framework will be achieved through the implementation of climate information services at both national and sub-national levels to drive the process in a manner that addresses national needs

and priorities in climate services development and utilization. Hence the establishment of the Ghana National Framework for Climate Services (Ghana NFCS) which is led by Ghana Meteorological Agency (GMet); a Government Agency under the Ministry of Communications and Digitalisation.

## 2.1 Capacity Assessment for Climate Services

Climate change and sustainable development are challenges to a society that require climate services at local, national, and global scales. The national framework for climate services is to help address the challenges. The Ghana Meteorological Agency is the institution mandated for the provision of weather and climate services in Ghana. However, there is a range of other institutions that contribute to the observation, generation, and application of weather and climate information. Table 8 provides a list of institutions leading national plans and international programmes and how they contribute to weather and climate service.

*Table 8: Institutions and summary of climate change activities relating to their mandates. Source: Third National Communication*

| Sector/Institution | Strategic Focus |
|---|---|
| National Development Planning Commission | Ensure integration of climate change issues into national planning and Budgeting processes. |
| Ministry of Environment Science Technology and Innovation | Integrate broader climate related environmental issues |
| Environmental Protection Agency | Evaluate and promote relevant climate related technologies. |
| Ministry of Finance | Assess implications of climate on economy, growth and budgets.<br><br>Track and capture additional financing from climate funds. |
| Ministry of Food & Agriculture | Achieve a "climate-proof" green revolution. (Climate Smart Agriculture).<br>Create and promote sustainable low-carbon land use. |
| Ministry of Lands and natural resources | Stop deforestation and boost reforestation and afforestation.<br>Secure financial opportunities by REDD+ and Forest Investment Programme. |
| Ministry of Power and Energy Commission | Promote increased energy efficiency.<br><br>Achieve energy security including doubling renewables on the public grid. |
| Ministry of Transport | Introduce fuel-efficiency and biofuel requirements.<br><br>Reduce city traffic by promoting public transport. |
| Other partners | Build awareness and work to inform the public on climate issues.<br>Promote disaster risk reduction through early warning systems.<br>Support climate initiatives within ministries.<br>Effective spatial planning to support climate resilience. |

The National Disaster Management Organisation (NADMO) has established emergency operation centres for early warning and communication for priority hazards in 10 sites in Ghana. This is to benefit nearly 6 million people. In addition, NADMO led early warning/disaster risk reduction initiatives with details presented in Table 9.

*Table 9: Early warning/disaster risk reduction initiatives implemented in Ghana by NADMO. Source: Fourth National Communication to UNFCCC*

| Name of Initiative | Implementing organisation(s) | Time Frame | Sponsor of Initiative | Scope of Initiative | Objectives | Main Outcomes / Impacts | Main tools used | Beneficiaries | Supporting Adaptation Area |
|---|---|---|---|---|---|---|---|---|---|
| Flood recession agriculture for food security in the white Volta River Basin | HSD | June - December 2016 | International Water Management Institute | White Volta Basin in the Northern Region | Supervision of gauge readers.<br><br>Validate, digitise and transmit gauge values. | Monitored and transmitted accurate data during the 2016 flood season.<br><br>Trained and supervised gauge readers. | Training | Data collection professionals | Building resilience in the vulnerable landscape |
| Flood Hazard Assessment | WRC, UNDP, NADMO, HSD, and GMet | 2010 - 2012 | World Bank | White Volta Basin | Flood hazard assessment of the White Volta Basin | Flood Hazard maps | Hydrological models | Vulnerable communities within the basin | Early warning system |
| Disaster risk management | WRC, UNDP, NADMO, HSD and GMet | 2014 - 2016 | World Bank<br><br>Global facility for disaster | White Volta Basin | Development risk management procedure | Development of flood early warning system for | Training<br><br>Hydrological Models | Vulnerable communities | Early warning system |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | reduction and recovery | | and services for the White Volta | the white Volta.<br><br>Development of flood risk maps.<br><br>Flood forecasting model. | | | |
| OTI flood hazard assessment | WRC, UNDP, NADMO, HSD, and GMet | 2016 - 2017 | World Bank | OTI Basin | | Development of flood maps.<br><br>Flood Early Warning system developed | Hydrological models | Communities within the OTI Basin | Early warning system (flood) |
| Improved the resilience of crops to drought through strengthened early warning within Ghana. | WRC, GMet | 2016 - 2017 | Climate Technology Centre and Network (CTCN) | White Volta | Drought Early Warning system enhance data accessibility, climate forecasting, and adaptation planning and communication | Online Portal for climate data.<br><br>Drought and Flood forecast system | Hydrological models Training | Communities within the White Volta Basin. Improving the resiliency of crops to drought through strengthened early warning within Ghana. | Early warning system (drought) |

Water Resources Commission has also invested over US$ 4 million in flood and drought hazard assessment in White Volta and Oti River basins. The Water Resources Commission is also

involved in the early warning and disaster reduction efforts. During the period under review, the Commission has implemented projects in the areas listed in Table 10.

*Table 10: Early warning/disaster risk reduction initiative implemented by the Water Resources Commission*

| Name of Initiative | Implementing organisation(s) | Time Frame | Sponsor of Initiative | Scope of Initiative | Objectives | Main Outcomes / Impacts | Main tools used | Beneficiaries | Supporting Adaptation Area |
|---|---|---|---|---|---|---|---|---|---|
| Flood recession agriculture for food security in the white Volta River Basin | HSD | June 2016 – December 2016 | International Water Management Institute | White Volta Basin in the Northern Region | Supervision of gauge readers. Validate, digitise and transmit gauge values. | Monitored and transmitted accurate data during the 2016 flood season. Trained and supervised gauge readers. | Training | Data collection professionals | Building resilience in the vulnerable landscape |
| Flood Hazard Assessment | WRC, UNDP, NADMO, HSD, and GMet | 2010 - 2012 | World Bank | White Volta Basin | Flood hazard assessment of the White Volta Basin | Flood Hazard maps | Hydrological models | Vulnerable communities within the basin | Early warning system |
| Disaster risk management | WRC, UNDP, NADMO, HSD and GMet | 2014 - 2016 | World Bank Global facility for disaster reduction and recovery | White Volta Basin | Development risk management procedure and services for the White Volta | Development of flood early warning system for the white Volta. Development of flood risk maps. Flood forecasting model. | Training Hydrological Models | Vulnerable communities | Early warning system |
| OTI flood hazard assessment | WRC, UNDP, NADMO, HSD, and GMet | 2016 - 2017 | World Bank | OTI Basin | Development of flood maps. Flood Early Warning | Hydrological models | Communities within the OTI Basin | Early warning system (flood) | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | system developed | | | | |
| Improved the resiliency of crops to drought through strengthened early warning within Ghana. | WRC, GMet | 2016 - 2017 | Climate Technology Centre and Network (CTCN) | White Volta | Drought Early Warning system enhance data accessibility, climate forecasting, and adaptation planning and communication | Online Portal for climate data. Drought and Flood forecast system | Hydrological models, Training | Communities within the White Volta Basin. Improving the resiliency of crops to drought through strengthened early warning within Ghana. | Early warning system (drought) |

The demand for timely, adequate, and quality weather and climate information has increased due to increased impacts of climate variability and change, and awareness of the impacts. Despite the collective effort by several institutions to provide climate information, there are several challenges in accessibility, quality, and efficiency in the provision of climate services to various socio-economic sectors. The existing capacity and gaps, particularly in terms of infrastructure and human resources are summarized into Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis in Table 11. This provides the possibility to assess the opportunities and threats that are to be addressed as priorities, using the resources and core competencies available in different institutions that offer climate-related services to achieve the key objectives of the NFCS. This will help attain effective climate services provision in Ghana.

*Table 11: SWOT analysis for GMet*

| **Strengths** | **Opportunities** |
|---|---|
| • Data archiving and management<br>• Availability of expertise in data analysis and research in climate service-related applications<br>• Existing calibration system<br>• A long historical climate data record<br>• Well defined hosts of environmental data and information | • Support for national climate change adaptation efforts<br>• Improvement in the quality, coverage, and accessibility of climate data<br>• Cooperation with international and national organizations |

| | |
|---|---|
| • Existing user interface<br>• Access to Rainwatch open online platform<br>• Access to ENACTS open online platform<br>• Access to IRI-IFC Maproom<br>• Good collaboration with some stakeholders especially farmers<br>• Database of stakeholders<br>• Easy data procurement by users<br>• Strong willingness to improve services<br>• MESSIR-COM | • Users involvement in the value chain of climate service from production to use<br>• Knowledge sharing<br>• Data integration<br>• Implementation of internationally recognized quality control and data rescue in the region<br>• Adaptation of existing practices to improve service delivery to users<br>• Expansion of meteorological observation networks<br>• Building critical mass in research<br>• Developing the capacity of users and professionals |
| **Weaknesses** | **Threats** |
| • No framework on climate information service.<br>• No framework on the communication of climate-related warnings.<br>• Inadequate meteorological infrastructure for weather observation.<br>• Inadequate communication facilities with other stakeholders<br>• Limited human resource development<br>• Insufficient observation network to capture all climatic regimes and local climate.<br>• The low density of the station network for climate monitoring.<br>• Lack of maintenance of the automatic weather stations.<br>• No documentation of the capacity of research expertise in climate applications<br>• The limited human capacity to deliver on the specialized climate services products, application<br>• Lack of coordination of climate service providers<br>• Lack of collaboration by institutions/ stakeholders<br>• Institutional commercial interests<br>• The proximity of climate service providers to the users of climate services<br>• The low levels of awareness on climate change among the population. | • Availability of financial resources to implement projects and programs<br>• Data availability<br>• Products and services from external service providers (foreign competition)<br>• The low literacy rate among the users of climate services |

| | |
|---|---|
| • Limited knowledge by decision-makers on the importance of climate service providers. | |

## 2.2 Responsibilities of Ghana Meteorological Agency (GMet)

The Ghana Meteorological Agency (GMet) is an agency under the Ministry of Communications and Digitalisations of the Government of Ghana. Its mandate is to operate Ghana's network meteorological stations; to observe, monitor and predict the weather and climate of Ghana. It is responsible for collecting, processing, archiving and dissemination of meteorological information to end-users. The observations and monitoring are done through a network of 163 meteorological observation stations which are made up of 143 manual and 20 automatic weather observation stations. Out of these, there are 22 operational synoptic observation stations.. Maps showing the number of and location of the observation network stations are provided in Figure 1. Figure 2 presents the synoptic observation stations in Ghana. Also, there are two marine observation stations located in Tema and Takoradi. There is the provision of location-specific climate data within every 4 km radius in Ghana by merging satellite and gauge data through the Enhancing National Climate Services (ENACTS) initiative. Monitoring of the movement and the tracking of thunderstorm/rain bearing clouds, winds, and ocean waves is done by GMet through the near real-time remotely sensed satellite observations and associated products received from EUMETSAT every 15 minutes.

Regional centres (ACMAD and AGRHYMET) and global centres (NOAA/NCEP, ECMWF, UKMO and IRI) freely provide weather and climate prediction products to GMet through the collaboration agreements it has developed and its status as a permanent representative to the World Meteorological Organization (WMO). Ghana is also a partner to the Rainwatch Alliance. The products received by GMet are analysed and utilised to produce the various forecasts, information for expert advice and early warnings. Rainwatch (rainwatch-africa.org) is an open-access platform for rainfall monitoring which further provides useful information for decision making. The regional centres organize regional seasonal climate outlook forum every year prior to the West Africa rainy season is organized in collaboration with National Meteorological and Hydrological Services (NMHSs) of West African countries. The forum provides a platform for interaction between providers and users for the generation of a consensus-based user relevant climate products in real time. At national level, the prediction

product is downscaled, and a seasonal forecast issued for decision-making in agricultural production and food security, health, water and energy resources management.

### 2.2.1 Categories and Types of Climate Information and Services

The Ghana Meteorological Agency provides a range of products and services for multiple applications. These include Nowcast, 24-hour weather forecast, weekly forecast, dekadal forecast, sub-seasonal, seasonal climate forecast, warnings, tailored information for users and an annual climate bulletin comprising of observed climate trends including various types of climate mean maps on different parameters. GMet issues flood, drought, and Agromet bulletins to inform adaptation planning.

**a. Daily Weather forecast**

Weather forecasts are issued for cities in Ghana on a daily basis dubbed '24-hour forecast' in weather briefs targeted at the general public for general use. The forecast provides expected conditions of selected weather parameters and phenomena for different duration for up to three days over the entire country. The forecast is updated every six (6) hours at about 5am, 11am and 5pm every day. The information is given for the preceding day, and disseminated through the media (TV, Radio, WhatsApp, Twitter, Facebook, Email-list of recipients and website) to the general public. The forecasts contain speed and direction of wind, percentage probability of rain, humidity, UV Index, temperature, visibility, time for sunrise and sunset. These variables have been upgraded into a map for easy visualization and interpretation.

**b. Weekly forecast updates**

The weekly forecast is based on climate models from ECMWF, METEO FRANCE, GMet WRF, UK-MET OFFICE, NOAA and NCEP for probability of rain, humidity, and temperature. This is updated on Mondays, Wednesdays and Fridays of the week.

**c. Dekadal Bulletins/Forecast**

The dekadal bulletin is made up of observed climate variables for the previous 10-days and an Extended Weather Forecast for the next ten days over the country. They are normally presented as spatial and temporal performance of rainfall, temperature, relative humidity and winds among others for cities across the country. It also provides reports on the stage of crop

development, general assessment of crop performance including current and expected yield from the farms.

### d. Seasonal Climate Forecast

These are products that are developed for the three months running averages of the expected rainfall for seasons as March-April-May (MAM), April-May-June (AMJ), May-June-July (MJJ), June-July-August (JJA), July-August-September (JAS) August-September-October (ASO), September-October-November (SON) to cater for the bimodal rainfall pattern of the southern part and the unimodal rainfall pattern of the northern part of Ghana. Each of these are presented in probabilistic form with three categories: below normal, near normal and above normal. Rainfall intensities produced help farmers to know when and what to plant. Other products disseminated are onset and cessation of rainfall date, and dry spell within the rainfall season. The products are targeted at farmers for agricultural planning and to the general public.

### e. Weather Warnings

Weather warnings are issued according to the intensity of weather events especially with approaching storms and consequential rainfall. They are normally reported with the nature of storm, the time of approach, where it is coming from, and where it is going. Dissemination of the warnings is crucial because the warnings come at a short notice. All possible media platforms are used in this case and they get a lot of shares on social media platforms unlike the usual forecasts. Currently, GMet provides impact-based forecast (IBF) to communicate high impact weather events to stakeholders for preparedness, mitigation and response to disaster risk reduction. Global Challenges Research Fund (GCRF) African Science for Weather Information and Forecasting Techniques (African-SWIFT) helped in the provision of Nowcast Satellite Application Facility (NWCSAF) as tool for improving nowcasting and IBF.

### f. Coastal and Marine forecast

Coastal and Marine forecast contains significant wave height, secondary and primary swells, current, sea surface temperature, visibility, pressure at sea, rainfall at sea, sea breeze, tidal waves, wave height. This forecast is issued to the general public and particularly an emphasis given to fisher folks where certain criteria or threshold are expected as warnings.

### g. Annual Climate Reports

Yearly climate updates are reported and given out to stakeholders and decision makers. The updates are made up of monthly variations of rainfall, mean temperature, minimum temperature, maximum temperature, sunshine duration and intensity, etc for all stations in the country. Climate projections of the rainfall and temperatures and future extreme climate events such as drought and floods are also reported.

### h. Tailored information for users

- **Aviation/Aeronautical forecast:** Tailored for the aviation industry. The information contains Terminal Aerodrome forecast (TAF), METAR, SPECI, and SIGMET. Flight folders are also issued to the airlines and used by the pilots to plan their flight and the luggage to carry. It contains wind speed and direction, temperature, pressure, and turbulence zone at various levels.
- **Marine forecast:** Prepared for the Oil and Gas industry.
- **Volta River Authority forecast:** Weekly weather report prepared for Volta River Authority responsible to generate, transmit and distribute electricity in Ghana.
- **Weather forecast for GASIP farmers:** These are customized 3 days weather forecast for farmers who have signed up with Ghana Agricultural Sector Investment Programme (GASIP) and the dissemination has been via SMS. GASIP supports about 60,000 smallholder farmers with production inputs to increase productivity, yield and incomes.
- **Area Forecast for the Airforce:** Customize temperature, cloud height and distribution.
- **Police Forecast**: This contains a 24 hour weather forecast
- **Weather report:** Issued to insurance companies and other stakeholders upon request

## 2.3 Infrastructure Capacity of the Ghana Meteorological Agency

Figure 1 presents the 163 meteorological observation stations in Ghana. They are made up of 143 manual observation weather stations and 20 automatic weather observation stations. The southeastern part of Ghana has a high density of the stations unlike the northern half, which has a limited number of stations for observations with a low density of station network. There are 22 operational synoptic observation stations (Figure 2). These stations are almost well

distributed over the country for the geographical representation but not for the transition zone of Ghana.

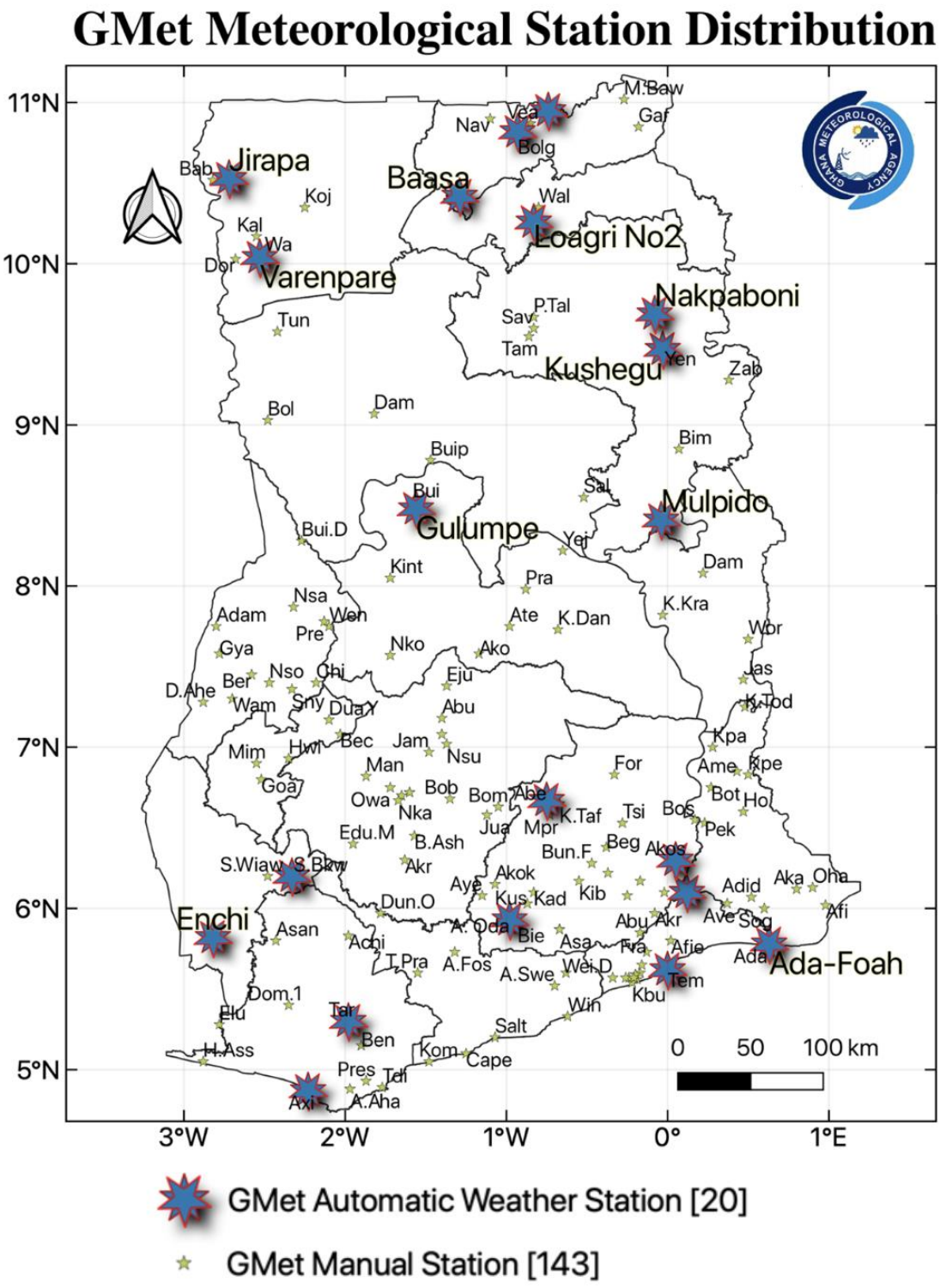


Figure 1: Observation stations network in Ghana

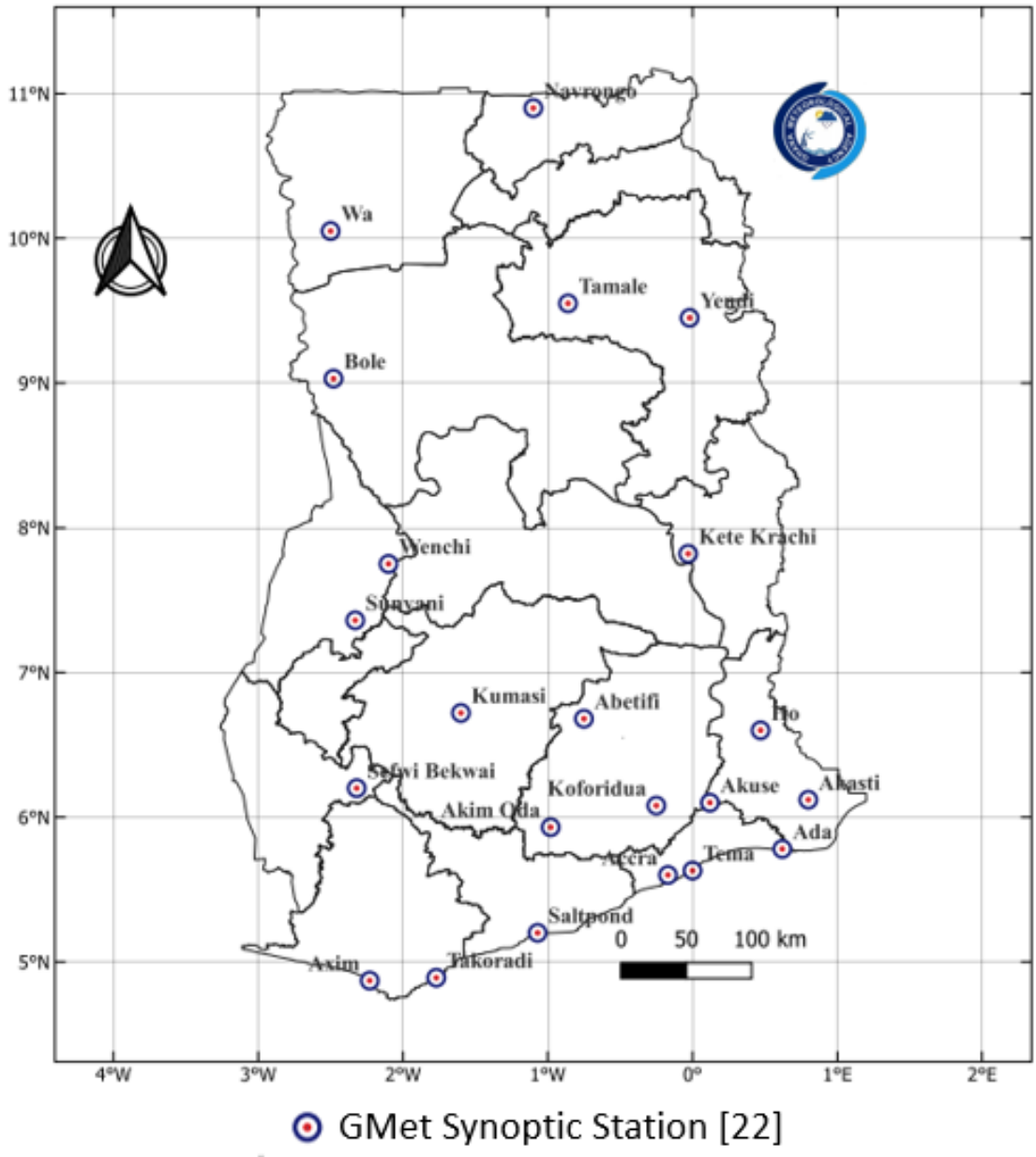


Figure 2: Synoptic observation stations network in Ghana

Picture 1: Calibration instrument

GMet have acquired and is using the calibration instrument to calibrate weather instruments. The calibration is vital to ensure the accuracy of meteorological data and information. Adequate meteorological infrastructure - weather observation stations are required to allow for the smooth operation of GMet. GMet has successfully implemented weather information dissemination systems for weather determination – both web-based audio recorded forecast in local languages.

## 2.3 Gaps and needs

Implementation of the NFCS requires resources and expertise to develop science-based information along with the technologies and innovative solutions to enable effective adaptation, mitigation and risk management activities associated with climate variability and change. Inadequate meteorological infrastructure, inadequate communication facilities with other stakeholders, human resource development and inadequate facilities in weather and climate forecasting are the major challenges facing effective provision and utilization of climate services. Table 13 presents a detailed need of communication facilities and meteorological equipment, the gaps and the priority actions for climate service delivery. Another challenge is the high running cost of operational activities and inadequate government budgetary allocations. The recommendations and strategies for climate services delivery in Ghana from the stakeholders feed into the NFCS and are presented in annex 3.

## 2.4 Ongoing Projects

GMet has ongoing collaboration projects. These projects when completed will boost the climate information service they provide.

Weather Information Dissemination system (WIDS) is a one-year project funded by the Global Challenges Research Fund (GCRF) which is being implemented by the Makerere University, Uganda, in collaboration with some Meteorological Institutions and Universities in East and West Africa. The goal of this project is to improve weather and climate information dissemination through the application of suitable ICTs to stakeholders. The system is currently running in Uganda and Tanzania and it is being implemented in South Sudan, Nigeria and Ghana. WIDS provides real-time and accurate weather products (forecasts, weather advisories and warnings) via web interface platform and mobile USSD code to stakeholders. The system has an audio section that translates forecast into local languages for farmers as a unique feature.

GCRF African Science for Weather Information and Forecasting Technique (SWIFT) is a project that seeks to improve weather forecasting technique in Africa to improve socio-economic development and livelihood. University of Leeds, UK, in collaboration with Meteorological Institutions and Universities are leading this project in Senegal, Ghana, Nigeria and Kenya. User's engagement, Nowcast and storm tracking, Forecast evaluation, sub-seasonal to seasonal with publications are some deliverables of this project. Through this project, GMet is running a pilot sub-seasonal to seasonal forecast for some farmers in Ghana.

# SECTION 3: PRIORITY ACTIVITIES TO BE UNDERTAKEN TO REDUCE GAPS AND MEET USER NEEDS

This is to maximize access and utilization of climate services. A well-developed user interface will enhance effectiveness in the use of climate services thus significantly contribute to climate-informed planning and decision-making.

## 3.1 Current Climate Services Information System

The Climate Service Information System is the operational core of the NFCS. It is the mechanism through which climate information of past and present is routinely collected, quality controlled, stored and processed to generate products and services, standards, communication and authentication that inform often complex decision-making across a wide range of climate-sensitive activities and sectors. Table 7 outlines the current services available in Ghana from GMet and other partner organizations. Table 12 provides the users of climate services, the gaps, priority actions, indicators and estimated cost associated with each priority action in short and medium term. Table 13 provides the communication needs and the needed institutional strengthening for service delivery across all the sectors in short and medium term.

*Table 12: Action plan for sector needs*

| Sector | Needs | Existent | Gaps | Priority Actions | Indicators | Estimated cost (USD) |
|---|---|---|---|---|---|---|
| Agriculture and food security | Tailored weather and climate information for relevant agricultural practices | Regional, city and town daily weather forecasts | Absence of forecast at district, , community levels | Downscale the forecast to local scale | Availability of forecasts at district and community levels | 150,000 |
| | | Seasonal forecasts | Delay in issuing seasonal forecasts and limited observed data | Improve Infrastructure, high speed internet | Timely forecasts issued | 450,000 |
| | | | Lack of sub-seasonal forecast at monthly time step | Provide sub-seasonal forecasts | Monthly forecasts provided | 150,000 |
| | | | Lack of forecasts for dry season | Provide seasonal and sub-seasonal forecasts for the dry season | Adequate forecast at drought prone areas | 50,000 |
| | Communication strategy for climate information products | Farmer groups are in contact with weather and climate services providers | Lack of interpretation of weather and climate products to the indigenous people | Improvement and localization of communication of weather and climate products | Weather and climate information used appropriately by stakeholders | 50,000 |
| | | Community information systems for dissemination | Forecasts are not prepared in local languages | Prepare forecasts in local languages | Forecasts in local languages available | 50,000 |
| Total for Agriculture and food security | | | | | | 900,000 |

| Sector | Needs | Existent | Gaps | Priority Actions | Indicators | Estimated cost (USD) |
|---|---|---|---|---|---|---|
| Health | National Policy on health and climate change | Human resource capacity | No consolidated policy on health and climate change | A policy on health and climate change | National policy on climate change that addresses health | 40,000 |
| | | Climate Change Integrated into the Management of Priority Health Risks | Forecasts not usable for the health sector | Awareness creation among members of climate service providers towards public health | Guidelines and climate health modules | 100,000 |
| | | | | | Appropriate use of climate health forecast products by stakeholders | 200,000 |
| | Tailored weather and climate information for relevant public health practices | Weather and seasonal forecast of temperature, rainfall, humidity, wind, sunshine. Flood forecasts over Greater Accra Metropolitan Assembly (GAMA) | Lack of forecast on extreme events, eg heat waves (extreme temperature),, droughts.<br><br>Non-existence of flood forecast for other regions | Adequate weather forecast and situational analysis embedded<br><br>Geographical forecast for health centers | Weather and climate health forecast products | 200, 000 |
| Total estimated cost for Health | | | | | | 540,000 |

| Sector | Needs | Existent | Gaps | Priority Actions | Indicators | Estimated cost (USD) |
|---|---|---|---|---|---|---|
| Water resource management | Climatological and hydrological information necessary for water resources management | Seasonal forecast<br><br>Weather forecast | Lack of data on water levels and quality, stream flows.<br><br>Poor drainage system | Provide equipment for monitoring water volume, water quality, flood alert | Equipment for monitoring water resources installed in all water bodies in the country | 500,000 |
| | | Maps of surface water resources | Maps are not easily accessible | Maps of water bodies | Map and update station maps | 200,000 |
| | | Runoff data | Lack of evapotranspiration data<br><br>Lack of historical data | Provide equipment for measuring evapotranspiration.<br><br>Establish a data centre | Records of evapotranspiration, water levels, stream flow rates, quality of water bodies | 200,000 |
| Total estimated cost for water resource management | | | | | | 900,000 |

| Sector | Needs | Existent | Gaps | Priority Actions | Indicators | Estimated cost (USD) |
|---|---|---|---|---|---|---|
| Energy | Information on mean wind speed at local level and at different altitudes | Mean wind speed records at the meteorological stations and at ground level<br><br>Records of evaporation | Inadequate of substations at district, city, community levels<br><br>Limited expertise at the local level | Increase number of substations for wind speed measurement<br><br>Strengthen local capacities in collecting and disseminating wind data | Increased number of substations<br><br>Decentralized substations | 30,000,000 |
| | Information on<br><br>wind direction at<br><br>different altitudes | Wind direction records at the meteorological stations and at ground level | Information on<br><br>wind direction in all regions<br><br>and localities of the country<br><br>Lack of upper air stations | Increase number of substations for wind direction measurement | Increased number of substations | 30,000,000 |
| | Sunshine duration | Sunshine duration records at the meteorological stations | Inadequate observation stations | Increase the number of observation stations | Improved data | 10,700,000 |
| | Irradiance | Solar radiation records at the meteorological stations | Inadequate observation stations | Increase the number of observation stations | Improved data | 10,000,000 |
| | Information on Cloud Cover | Cloud cover records at the meteorological stations | Inadequate observation stations | Increase network density, data collection, processing and dissemination | Number of stations established | 10,000,000 |
| | Constant electricity supply for substations | Hydro and thermal energy supply | Unguided power influx resulting in breakdown of equipment and data gaps | Use climate friendly power supply (like solar) for electricity supply to the substations | Stable power supply | 20,000,000 |
| Total estimated cost for Energy | | | | | | 117,000,000 |

| Sector | Needs | Existent | Gaps | Priority Actions | Indicators | Estimated cost (USD) |
|---|---|---|---|---|---|---|
| Disaster risk reduction | Disaster Risk Management system | National Administration of Disaster Management Organization (NADMO) | • Lack of investors<br><br>• Challenges with funding<br><br>• Lack of sensitization on the role of NADMO | Resource NADMO and GMet | Effective Disaster Risk Management system | 5,000,000 |
| | Data on climate hazards (heavy rains, winds, dry episodes, evaporation, temperature) at the local level | Weather and Seasonal information on wind, rainfall and temperature | Lack of timely weather forecast | Effective weather forecast | Better Understanding of the dynamics of extreme events | 100,0000 |
| | Data on wildfires during the dry season | Human resource capacity (Wild fire tenders at National and District levels)<br><br>Use satellite data to estimate scars | Low resolution satellite information<br><br>Inadequate district estimation of fire scars<br><br>Prediction and estimation uncertainties | Provide dedicated high resolution satellite information<br><br>Provide of satellite ground receiving station<br><br>Improve district level information<br><br>Deploy drones to complement information from fire tenders in deeper forest | A well structured database of wild fires in Ghana established<br><br>Satellite ground receiving station installed | 2,000,000 |
| | Drought and Flood Monitoring | Drought and Flood Monitoring | Drought and Flood Monitoring | | Increased frequency of Drought and Flood Monitoring | 600,000 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Risk and Vulnerability<br><br>Flood maps | Risk and vulnerability maps at district level | Low accessibility to flood maps | Increase accessibility of flood and disaster risk maps | Risk and vulnerability maps easily accessible Risk and vulnerability maps | 150,000 |
| | Research activities on climate risk management | Uncoordinated research at the Academic Institutions on extreme climate and risks | Lack of research on extreme events dynamics | Research by NADMO, GMet AND Academic Institutions on extreme events | Projection of extreme events at seasonal to annual scale | 500,0000 |
| Total estimated cost for Disaster Risk Reduction | | | | | | 8,350,000 |
| Grand total of sector estimated cost | | | | | | 127,690,000 |

*Table 13: Action plan for cross sectoral needs*

| Sector | Needs | Existent | Gaps | Priority Actions | Indicators | Estimated cost (USD) |
|---|---|---|---|---|---|---|
| Communication and awareness | Dedicated communication policy and strategy | A communication structure | • No structured communication policy and strategy<br><br>• Lack of high-speed internet for information access | • Set up a consultancy to evaluate existing structures<br><br>• Develop a communication policy<br><br>• Develop sector specific communication strategy | Policy document developed along with strategic documents for sectors | 10,000,000 |
| | Effective communication platforms on the scope and importance of weather and climate services, including outreach to communities | Uncoordinated local level and institutional synergies on climate related project outcomes | • Lack of communication platforms between service providers and end users | • Increase outreach programmes on radio and TV platforms<br><br>• Disseminate forecast over print media,<br><br>Social media, websites, billboards | • Dedicated Radio and TV stations for weather and climate information<br><br>• Increased programmes on weather and climate realized | 30,000,000 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | and local Communicators. | | |
| | Quality weather and climate information | Radio and television broadcasting of weather and climate information to the general public. | Radio and television broadcasts of weather and climate information are not tailored and targeted to end users. | Establish quality assurance process for weather and climate information | Quality assurance process established for weather and climate information before dissemination. | 20,000,000 |
| | Capacity building of communicators | Communicators of weather and climate products are mostly general radio/TV presenters | • Misrepresentation of weather and climate products by secondary communicators<br><br>• Lack of capacity of communication experts in weather and climate products. | Train journalists, advocates, grassroots leaders, schools ambassadors, and civil society organizations to dissemination weather and climate Information | Communicators trained to understand technical language in<br><br>English and in the major local languages | 20,000,000 |
| | Understanding of the language used for the dissemination of climate information to users | Some products are disseminated in English and a few in local languages | Lack of communication of weather and climate products in local languages at the community level | Establish dissemination platforms for major languages in Ghana. | Information dissemination platforms for all major languages established. | 10,000,000 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | |
| | Dialogue between service providers and end users | Sector actors and service providers communicate on need basis | • Research results and weather information are poorly communicated with end users | | | 20,000,000 |
| | • Access to weather and climate information by end users | Weather and climate information communicated on WhatsApp, websites, TV and radio | • Poor radio coverage at community level | • Dedicated communication platforms for weather and climate information for all user groups<br><br>• Set up a dedicated time and period for weather updates | End users able to access information from service providers easily | 20,000,000 |
| | A well informed website for weather and climate service providers | A website of GMet | Uncoordinated weather and climate products and services | Establish a well-informed website as a first point of call to encompass the various sectors | Enhanced website to integrate the services by all providers and products to various sectors | 37,000,000 |
| Total | | | | | | 167,000,000 |

| Sector | Needs | Existent | Gaps | Priority Actions | Indicators | Estimated cost (USD) |
|---|---|---|---|---|---|---|
| Institutional strengthening (human resources, equipment, mobility and infrastructure) | Optimization of hydro-meteorological observation network | 22 Synoptic and other observation networks<br><br>Hydro, Agro, Climate, Rainfall, auto manual<br><br>Automatic weather stations installed<br><br>2 tidal gauges<br><br>Marine forecast | Weak national observation network<br><br>Few automatic weather stations installed and operational<br><br>Only 2 marine stations installed | • Purchase and install automatic weather stations<br><br>• Acquire and install weather stations with pollution sensors<br><br>• Install more marine stations<br><br>• Acquire more conventional equipment for weather stations<br><br>• Strengthen the hydrological observation for a sustainable monitoring of water resources (surface and underground water) | Automatic weather stations installed<br><br>More marine stations | 40,000,000 |
| | Human resources development | One Meteorological observer per station<br><br>2 twice in a year monitoring or per demand depending on the data quality, calibrations, etc, but lack of funds they don't do it 2 a year | • Limited capacity of meteorological observers<br><br>• Limited human resources | Training of meteorological and hydrological observers<br><br>• Training of staff at postgraduate level in specific areas to support weather and climate<br><br>• Specialized training of staff at the WMO Regional Centres | Number of staff trained | 20,000,000 |
| | Infrastructural development | Lack of infrastructure to house meteorological staff and equipment | Rehabilitation and construction of Offices and staff residences | • Support for residences for staff<br><br>• Rehabilitation and construction of housing facilities for equipment | | 30,000,000 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | Vehicles/motorbikes for monitoring of the stations | | |
| | Data transmission mechanism strengthened | Internet connectivity | • Lack of High speed internet connectivity<br><br>• Poor management of internet | • Establish High speed internet connectivity for data transmission<br><br>• Build capacity for the needed expertise ( data processing, data management, and networking) | • High speed internet connectivity for data transmission established<br><br>• Needed expertise available | 30,000,000 |
| | Tools for data analysis | Limited equipment and tools for processing meteorological data | Lack of state-of-the-art equipment and tools for processing data | Procure state-of-the-art equipment and tools for processing data | State-of-the-art equipment and tools for processing data procured | 30,000,000 |
| Total | | | | | | 150,000,000 |
| Grand total action plan for cross sectoral needs | | | | | | 317,000,000 |

## 3.2 TIMELINE OF PLANNED PRIORITY ACTIVITIES

Following Table 12 and 13, the action plan for sector needs, this section describes the priority activities proposed in the 5-year priority activities implementation schedule, ranging from short-term to mid-term activities.

A timeline for the implementation of priority activities (see Annex 1) was proposed to the participants of the validation workshop. An activity was prioritized if it got a large number of voters (e.g. score 10) testifying the urgency of the implementation of this action that participants wanted in the short term. In various interviews added to the expert judgment, the activities summarized in the table below will be able to obtain in order of merit the best scores.

*Table 14: Short term activities and estimated cost*

| Priority | Gap | Priority Activities | Budget USD |
|---|---|---|---|
| 1 | Weak national observation network and processing equipment | • Purchase and install automatic weather stations<br>• Acquire and install weather stations with pollution sensors<br>• Install more marine stations<br>• Procure state-of-the-art equipment and tools for processing data<br>• Strengthen the hydrological observation for a sustainable monitoring of water resources (surface and underground water) | 8,000,000 |
| 2 | Limited capacity of meteorological observers and human resource | • Training of meteorological and hydrological observers<br>• Training of staff at postgraduate level in specific areas to support weather and climate<br>• Specialized training of staff at the WMO Regional Centres<br>Training of meteorological and hydrological observers<br>• Training of staff at postgraduate level in specific areas to support weather and climate<br>• Specialized training of staff at the WMO Regional Centres | 2,000,000 |
| 3 | Lack of legal and Sustainable Financial support of the Activities of the National Framework for | Facilitate to pass the bill on climate services and advocate for the effective and sustainable implementation of the action plan | 600,000 |

| | | | |
|---|---|---|---|
| | Climate Services | Monitoring and advocacy actions for the effective and sustainable implementation of the action plan by the GMet and its partners<br><br>Determining a sustainable source of funding for NFCS-Gh activities<br><br>Construction and renovation of offices and residential houses at regional stations. | |
| 4 | No communication policy and strategy | • Set up a consultancy to evaluate existing structures<br><br>• Develop a communication policy<br><br>• Develop sector specific communication strategy<br><br>• Train journalists, advocates, grassroots leaders, schools ambassadors, and civil society organizations to dissemination weather and climate Information | 10,000,000 |
| 5 | Lack of infrastructure to house meteorological staff and equipment | • Support for residences for staff<br><br>• Rehabilitation and construction of housing facilities for equipment<br><br>• Vehicles/motorbikes for monitoring of the stations | 3,000,000 |
| Total | | | 23,600,000 |

*Table 15: Medium-term activities and estimated costs*

| N° | Priority Sectors | Budget USD |
|---|---|---|
| 1 | Agriculture and Food Security Sector | 900,000 |
| 3 | Water Resources Sector | 900,000 |
| 4 | Health Sector | 540,000 |
| 5 | Energy Sector | 117,000,000 |
| 2 | Disaster Risk Reduction Sector | 8,350,000 |
| Total cost of medium-term | | 127,690,000 |

# SECTION 4: PROPOSED INSTITUTIONAL ARRANGEMENT FOR IMPLEMENTATION OF GHANA NFCS

This section proposes implementation arrangements for climate services at the national level in Ghana. The Ghana NFCS implementation plan includes an institutional arrangement of the operational plan for the climate services chain and user platforms, financial implementation and monitoring and evaluation plan. The institutional arrangement provides information on consultation plan between providers and users of climate services in Ghana.

## 4.1 Institutional arrangement for climate services

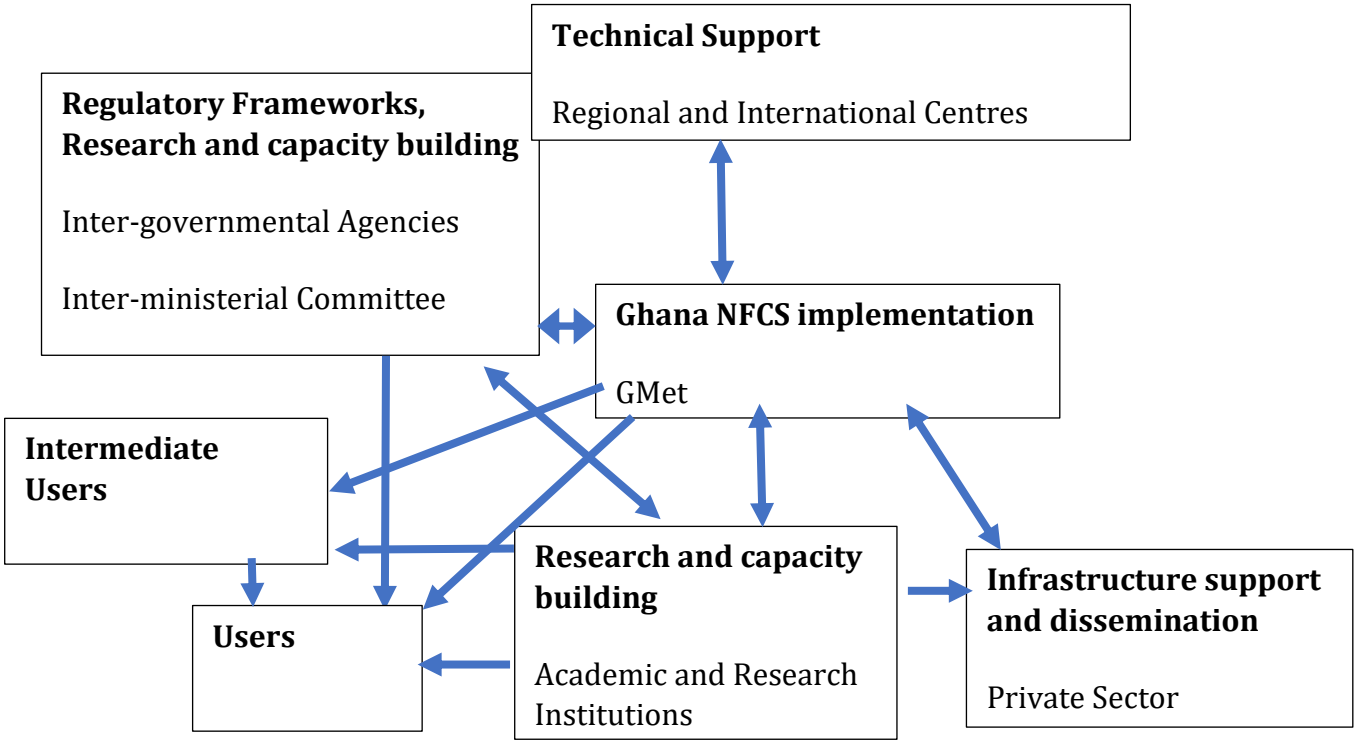


Figure 3: A model representation of institutional arrangement for the implementation of NFCS

Figure 3 represents five sets of entities identified in the value chain of the implementation of the Ghana NFCS. GMet will be responsible for implementing the NFCS in Ghana. GMet has the capacity to process data into useful information and deliver user-specific information. The regional and international centres provide technical support and data for successful operation of the GMet. Inter-governmental agencies are a set of government agencies that formulate policies and regulations to support the implementation of NFCS. They also have the capacity to conduct training and research to support the capacity of GMet in this process. Academic and Research institutions are able to acquire data and information from the primary sources and process data into user-specific information to support GMet. Users may have diverse needs ranging from general weather and climate information to a more specific tailor-made information. Users include health sector, agriculture, general public, disaster risk management, Small Scale Enterprises. The Private Sector in this category as intermediate users do business through direct use of products and services of weather and climate information. For instance Ignitia, a private sector provides location specific daily, monthly and seasonal weather forecast to small scale farmers to help farmers via SMS in partnership with mobile network operators. Farmerline, also a private sector distributes weather forecasts and provides real time agriculture education to farmers via voice in local languages. Most users cannot afford the cost of service and the combined cost of data procurement, its processing, customization and delivery to the user is huge. Table 16 describes the users of climate services of different categories. GMet is faced with challenges, which includes lack of financial, human and infrastructural resources to be able to implement the NFCS. The Private Sector can greatly improve the product and services of GMet and subsequently improve the business outlook of intermediate users who do business. The Private Sector can collaborate through the infrastructure provision and dissemination of information. They can specifically do the following:

1. Leverage the cost of data acquisition by government through provision of resources and absorption of certain cost component in data acquisition.

2. Partner Academic and Research Institutions to develop platforms for delivering data through telecommunication sector as cost sharing. By so doing, government agencies can be in business by acquiring data and selling it to users on a subsidy. The Private Sector can manage the data and then deliver useful information to the - users at a nominal price.

3. The intermediate users may also be the Private Sector which use the information to improve their products and services which in the long run support GMet in ease of burden. At the end, there is a ready market for the data acquired by the GMet and they are processed by the intermediate users and the value of the data is indirectly related to the gains made by GMet. The improved products and services achieved by intermediate users is directly seen in the profit made by the private sector, which in turn spends part of its proceeds to leverage the cost of data acquisition and management.

*Table 16: Users of climate services in the category, description, and use of climate services*

| **Climate services users** | **User description** | **Use of climate services** |
|---|---|---|
| General public | The general public refers to the individual residents of Ghana. | The general public usually uses climate services to prepare in advance for the incidence of extreme weather and climate events. The public can plan with the climate information for time and amount of rain, temperature range, wind conditions, heat waves, etc. if the information is disseminated on time and in the required format. |
| Academic Institutions | Universities, Colleges | These institutions can serve as both users and providers of climate services. These institutions need climate information to conduct research, which can be climate-related or not, and in some cases, climate data can be combined with non-climate data to produce required outputs. |
| Research Institutions | These include several research institutions in various sectors, such as:<br>• Water research commission<br>• Agriculture research institutions<br>• Ghana Atomic Energy Commission<br>• Ghana Space Science and Technology Institute Centre for Scientific and Industrial Research | These institutions are mainly government-owned research institutions, which require climate services in the form of data and information and use this to conduct research, which can be climate-related or not, and in some cases, climate data can be combined with non-climate data to produce the required outputs. |
| Government Institutions | These include government institutions such as the following;<br>• Ministries<br>• Commissions and Agencies<br>• Municipalities and Districts | The government of Ghana needs climate information and products to adapt and mitigate climate change impacts. The use includes; |

| | | |
|---|---|---|
| | • National Disaster Management Organization (National, regional and local)<br>• Government entities<br>• Government banks, Funding entities, etc. | • Development of climate change adaptation plans.<br>• Policy-making (including how climate change will impact on current government policies).<br>• Inform government plans, programs, and projects.<br>• Resource optimization<br>• Water and energy resource planning.<br>• Resilient infrastructure development<br>• Disaster management and readiness, etc.<br><br>Early warning services to the public. |
| Private Sector | These include private sector companies not limited to;<br><br>• Manufacturing companies<br>• Mining companies<br>• Petrochemical and chemicals companies<br>• Small and medium enterprises<br>• Insurance companies<br>• Financial institutions (banks, asset management, etc.)<br>• Agriculture firms or farming groups<br>• Tourism<br>• Logistics and transportation firms<br>• Telecommunication firms | To be climate-resilient, the private sector must protect their investment by ensuring that the risk of climate change is understood, and its impact on the business can be managed.<br><br>They can partner the government of Ghana through the GMet to support the provision of climate services. |
| Media | Media will include the following organization;<br><br>• Television broadcasting institutions<br>• Radio broadcasting institutions<br>• Newspaper print companies<br>• Magazine print companies<br>• Online news | Media require climate services from providers to be able to broadcast or publish climate information and products to the broader user communities within their area of reach, and the information must be simple and easy to understand. |
| NGOs | Most NGOs have activities that have a direct touch with the general public. They have a responsibility to ensure that their beneficiaries are better prepared for climate risks and disasters. | NGOs can use climate information to assist their beneficiaries in preparing for possible climate risks and disasters. They can also provide capacity development and interpretation of climate information and products. |

## 4.2 Financing Implementation of National Framework for Climate Services

Financing Climate Services in Ghana: A Shared Responsibility for Government, Private and Donor Partners. From the identification of a gap to the co-production of climate information to the point of subduing the last mile barrier and making sure climate information reaches its intended users requires funds. Each stage requires an investment that will be offset by the preservation of life, property and the ecosystem.

The global climate change and variability and its localized effects at the national and community level have different impacts on the livelihoods of people. Financing demands the commitment of all actors from the global scale to the community level. This section of the NFCS provides a framework of financial engineering that underpins the entire framework to guarantee its successful implementation of which the society will enjoy its accrued benefits. According to the action plan for sector needs (Table 12 and 13), Ghana needs four hundred and forty four million, six hundred and ninety thousand US dollars (USD 444,690,000) estimated to effectively finance the NFCS in a short and medium term.

## 4.3 Sources of Funding

To ensure the successful implementation of this framework, it is recommended that funding is explored from local and international sources.

### 4.3.1 Ghana Meteorological Agency and Government Agencies

The current business model ran by GMet is not self-sustaining and cannot fund most of its activities which thus hamper its efforts to offer climate services. GMet is a critical organization that must set the pace and demonstrate its ability to fund itself by first re-engineering its finance model. This can be achieved by moving away from the total dependence of GMet on revenue from selling data and the aviation industry to innovative service delivery to its numerous

stakeholders. Besides other potential sources of funding for climate services in Ghana, the best institution to help itself financially is the Ghana Meteorological Agency and any other government/private institution offering climate information and services. Other major actors must develop a self-sustaining financial model in offering services that are paid for in generating funds to provide state of the art climate services to its users.

### 4.3.2 Government of Ghana

The Ghana government has committed to achieving sustainable development goals and the goals are directly or indirectly affected by weather and climate-related issues. Besides, the challenges posed by climate variability and change, and impacts have not only made climate services compelling but also its financing. The economic implications, environmental impacts, etc, require government commitment in terms of providing an enabling environment for climate services to thrive and providing sustainable financial funding for major stakeholders or actors in Ghana. The government must make a budgetary allocation to fund research, production, and dissemination of climate information.

### 4.3.3 Private Sector

Organizations in the Private Sector are not immune to the impacts of climate variability and changes. The survival of some of these organizations partly hinges on the livelihoods of their clients, which are directly and indirectly affected by weather and climate. The Private Sector in Ghana should provide funding support to actors who are offering climate services. They can also partner key actors or engage the government (GMet) in a Private-Public Partnership (PPP) in providing climate services. This includes banking, insurance, and the entire financial sector.

### 4.3.4 Multilateral funding sources

The global nature of climate change and variability requires a concerted effort that has a global nature in reducing impacts of climate change, building adaptive capacity and resilience of the people. The establishment of the various global funds is commendable but more needs to be done in providing enough funding for climate services. Some of these multilateral funding sources established under the UNFCCC and the Kyoto protocol to be leveraged on are under listed below, although Ghana is not limited only to these funds:

a. Special Climate Change Fund (SCCF)
b. Green Climate Fund (GCF)
c. Adaptation Fund

These funds were established particularly with developing countries in mind to support projects, programs, and policies, short to long term adaptation and mitigation plans, etc towards disaster risk reduction, agriculture, energy, water resources management, and health, among others. Ghana qualifies to access these funds for its climate services.

### 4.3.5 International funds

The implementation of this framework requires strong financial support to actors and the major global players will play an import role. These major financial sector players emanate from the regional to international financial/banking institutions:

a. The World Bank
b. Global Environmental Facility
c. International Monetary Fund
d. Africa Development Bank

The above funding institutions are mandated to provide funding to support climate change mitigation and adaptation. All these financial institutions have been providing funding for climate change, environmental and natural resource management, etc. Ghana can leverage some of these funds to implement this national framework.

### 4.3.6 Development Partners

There are several Development Partners (USAID, GIZ, DFID, WASCAL, etc) in Ghana who have shown interest and commitment to climate services and have supported different projects in Ghana. These Development Partners with interest in weather and climate-related issues would continue to be a major supporters and funding.

## 4.4 Monitoring and Evaluation

Monitoring and evaluation are crucial for measuring the indicators of the actions and tracking the progress of implementation of the NFCS. The implementation of the policy will be monitored and evaluated for effectiveness in meeting the intended goal and objectives. How the process of monitoring and evaluation will be carried out during the implementation of the framework should be a high priority to ensure efficiency. The processes will follow government existing monitoring and evaluation procedures, and the GFCS monitoring and evaluation tool. GMet will be the overall coordinator for different sector activities while other relevant sectors will be responsible for their areas of concern. The monitoring for the implementing activities of the framework should be conducted quarterly. The evaluation mechanism should be carried out annually. The policy will be reviewed and whenever necessary revised at least every five years. The revision will be informed by the results of monitoring and evaluation and other relevant information sources. This will be the initiative of the department responsible for disaster risk management affairs.

# CONCLUSION AND RECOMMENDATIONS

The Ghana National Framework for Climate Services (NFCS) is a part of the global efforts to facilitate timely provision and sector relevant climate services for climate risk reduction and climate adaptation to the impacts of climate variability and change for socio-economic development in Ghana. The framework is a guide to improving existing climate observations and monitoring, data management, research and climate predictions, appropriate user interfacing and capacity development for both climate information services providers and users.

The framework has been prepared by the information from the consultation of stakeholders and the national consultative workshop of stakeholders from the sectors considered in the framework, a literature and documentation review.

The Ghana NFCS gives account of existing structures to support its implementation, outlines priority actions to address the existing gaps for effective and efficient service delivery to the general public, and specific users who may be vulnerable to climate variability and change. A proposed institutional structure and ultimately Ghana's continual commitment to climate change is crucial in achieving the goal of the NFCS.

Another important part of achieving the aim of the NFCS is the successful implementation of the framework. An institutional structure recommending a strong collaboration between GMet and a host of institutions offering their support in key areas are recommended. Technical support, among others are needed from the regional and international centres (like ACMAD and ECMWF); the inter-governmental ministries and agencies are users of the climate information and at the same time provide tailored climate information to other users, while providing policy directions and offering capacity building to GMet. Similarly, Academic and Research institutions have the capacity to do research and training of Experts for GMet. The Private Sector could play an important role in easing the infrastructure challenges and developing custom products for users. They could be intermediate users or partners of GMet to provide support along the value chain of climate information service.

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Annexes

## Annex 1: Work plan for the implementation of major activities of the NFCS-Gh

| Gap | Priority Activities | 2022 | | | | 2023 | | | | 2024 | | | | 2025 | | | | 2026 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| Weak national observation network and processing equipment | • Purchase and install automatic weather stations | | | | | | | | | | | | | | | | | | | | |
| | • Acquire and install weather stations with pollution sensors | | | | | | | | | | | | | | | | | | | | |
| | • Install more marine stations | | | | | | | | | | | | | | | | | | | | |
| | • Acquire more conventional equipment for weather stations | | | | | | | | | | | | | | | | | | | | |
| | • Procure state-of-the-art equipment and tools for processing data | | | | | | | | | | | | | | | | | | | | |
| | • Strengthen the hydrological observation for a sustainable monitoring of water resources (surface and underground water) | | | | | | | | | | | | | | | | | | | | |
| Limited capacity of meteorological observers and human resource | • Training of meteorological and hydrological observers | | | | | | | | | | | | | | | | | | | | |
| | • Training of staff at postgraduate level in specific areas to support weather and climate | | | | | | | | | | | | | | | | | | | | |
| | • Specialized training of staff at the WMO Regional Centres | | | | | | | | | | | | | | | | | | | | |
| | Training of meteorological and hydrological observers | | | | | | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lack of legal and Sustainable Financial support of the Activities of the National Framework for Climate Services | Facilitate to pass the bill on climate services and advocate for the effective and sustainable implementation of the action plan | | | | | | | | | | | | | | | | | | | | |
| | Monitoring and advocacy actions for the effective and sustainable implementation of the action plan by GMet and its partners | | | | | | | | | | | | | | | | | | | | |
| | Determining a sustainable source of funding for NFCS-Gh activities | | | | | | | | | | | | | | | | | | | | |
| | Construction and renovation of offices and residential houses at regional stations. | | | | | | | | | | | | | | | | | | | | |
| No communication policy and strategy | Set up a consultancy to evaluate existing structures | | | | | | | | | | | | | | | | | | | | |
| | Develop a communication policy | | | | | | | | | | | | | | | | | | | | |
| | Develop sector specific communication strategy | | | | | | | | | | | | | | | | | | | | |
| | Train journalists, advocates, grassroots leaders, schools ambassadors, and civil society organizations to dissemination weather and climate Information | | | | | | | | | | | | | | | | | | | | |
| Lack of infrastructure to house meteorological staff and equipment | Support for residences for staff | | | | | | | | | | | | | | | | | | | | |
| | Rehabilitation and construction of housing facilities for equipment | | | | | | | | | | | | | | | | | | | | |
| | Vehicles/motorbikes for monitoring of the stations | | | | | | | | | | | | | | | | | | | | |

**Annex 2: Draft Bill on the organization and operation of NFCS-Gh**

Republic of Ghana

PREMATURE

Subject: Bill to establish, organize and operate the National Framework Climate Services.

The Minister of Communication

Given the Constitution

Considering Decree No. ..... appointing the Minister of Communication;

Considering the decree number  bearing composition of the Government;

On the report of the Director General of Ghana Meteorological Agency

AGREED

**Chapter 1: General provisions**

**Article 1: For the creation**

A National Framework for Climate Services of Ghana (NFCS-Gh) is created, a tool for decision-making adapted to the needs of sectors depending on weather conditions, variability and climate change.

It is under the authority of the Minister of Communication.

The NFCS-Gh is responsible for the:

1. Establishment of a permanent, dynamic and effective platform for dialogue and exchange between users and producers of climate services;

2. Establishment of communication channels between existing and functional national coordination structures;

3. Strengthening of regional and international cooperation to facilitate the exchange of information, expertise and good practices among countries to promote the most appropriate adaptation measures.

## Chapter 2: Organization and operation

### Article 2: Organs

The NFCS-Gh for climate services comprises two bodies:

- Inter-ministerial Committee;

- Scientific and Technical Committee (STC).

### Article 3: The Inter-ministerial Committee

The role of the Inter-ministerial Committee is to develop and implement an appropriate policy, strategy, an annual work plan, and framework for decision making related to climate variability and extreme weather events. Find sources of funding for the implementation of the action plans.

### Article 4: The Inter-ministerial Committee includes:

Chair: Office of the Minister of Communication

Members:

The representative of the Ministry of Environment, Science, Technology and Innovation;

The representative of the Minister of Fisheries;

The representative of the Minister of Water and Sanitation;

The representative of the Minister of Health;

The representative of the Minister of Agriculture;

The representative of the Minister of Energy;

The representative of the Minister of Local Government;

The representative of the Minister of Finance;

The representative of the Minister of Education;

The representative of the Minister of Information.

The secretariat of the Inter-ministerial Committee will be provided by the Ghana Meteorological Agency. The Committee meets once a year at the invitation of the Minister of Communication. The decisions of the Inter-ministerial Committee are taken by a simple majority of the members present.

**Article 5: Scientific and Technical Committee (CST)**

Chair: Office of the Director General, Ghana Meteorological Agency

Members:

The technical experts from government and private sectors, Regional and International Centers.

The Scientific and Technical Committee meets when convened by its chairman, at least four times a year and whenever necessary. The decisions of the Scientific and Technical Committee are taken by a simple majority of the members present.

**Article 6: The Scientific and Technical Committee's missions include:**

1. Implementation of the annual action plan;
2. Ensure the implementation of the production and dissemination of services;
3. Set up climate information systems adapted to the needs of users;
4. Provide information adapted to the targeted sectors, such as analyzes based on
5. meteorological data, multi-time forecasts (daily, 10-day, monthly, seasonal), climate projections and their impacts on priority socio-economic sectors;
6. Make climate information accessible in the main local languages;
7. Ensure the implementation of the information and awareness-raising actions of the stakeholders.

**Chapter 3: Final Provisions**

**Article 7: Procedures for the appointment and termination of the duties of members**

The members of the Inter-ministerial Committee, and the Scientific and Technical Committee are appointed in writing by their respective ministries and / or agencies. The committees could also appoint a substitute for each member.

The function of member of said committees terminates with the termination of the functions for which the person has been designated by his / her department and / or the body concerned, or as a result of replacement made by decision.

**Article 8:** The Minister of Fisheries, Water and Sanitation, Health, Agriculture, Energy, Finance, Environment, Science Technology and Innovation, Education, Information and Communication are responsible, each as far as it is concerned, for the application of this act

which will be published in the Official Gazette.

Accra, on 30th October 2020

The Minister of Communication

Mrs. Ursula Owusu Ekuful

Annex 3: List of stakeholders

1. Remote Sensing and Climate Center, Ghana Space Science and Technology Institute
2. United Nations Relief Agency/Institute for Natural Resources in Africa (UNRA/INRA)
3. CECAR – AFRICA, Japan International Cooperation Agency (JICA)
4. Department of Geography & Resource Development, University of Ghana
5. Physics Department, Kwame Nkrumah University of Science and Technology, Kumasi
6. Geography Department, Kwame Nkrumah University of Science and Technology, Kumasi
7. Earth Observation Research & Innovation Centre, University of Energy and Natural Resource
8. Physics Department, University of Cape Coast
9. Energy Commission
10. Water Resource Commission
11. Hydrological Services Department
12. Landuse and Spatial Planning Authority (formerly Town and Country Planning)
13. Environmental Protection Agency
14. Volta River Authority
15. Forestry Services Division Ghana
16. Civil Aviation Authority
17. Ministry of Food and Agriculture
18. Ministry of Environment Science and Technology
19. Ministry of Lands and Natural Resources
20. IWMI, Accra
21. WASCAL, Accra
22. DFID, Ghana

23. GIZ, Ghana
24. USAID, Ghana

**Media houses**

25. Ghana News Agency
26. Daily Graphic
27. Metro TV
28. TV3
29. UTV
30. Joy FM

Annex 4: NFCS Consultation Workshop Report

See attached.

Annex 5: The recommendations and strategies for climate services delivery in Ghana from the stakeholders

| **Follow up Strategy** | **Recommendations** |
|---|---|
| ➢ There should be another stakeholder consultative meeting to review the draft framework<br>➢ There should be a deliberate and continuous consultation during the implementation of the framework<br>➢ The final draft should be of the framework should be validated prior to adoption<br>➢ There should be key performance indicators as framework to guide implementation<br>➢ Regular reports should be produced and shared to stakeholders on | ➢ There should be a national Climate fund that should be accessible to relevant institutions<br>➢ The framework should be implemented adequately<br>➢ There should be public awareness of the framework<br>➢ The framework should be backed by law<br>➢ Monitoring and evaluation should be enforced to check progressive of the framework<br>➢ A steering committee for the implementation should be established |

| | |
|---|---|
| performance key performance indicators<br>➢ There should be constant communication with stakeholders to receive feedbacks<br>➢ Evaluation workshops should be organized routinely to access the implementation<br>➢ The final framework should be shared with all stakeholders<br>➢ Monitoring and evaluations mechanism should be put in place as part of the framework | ➢ There should be a deliberate effort to get the support of high level and political support to provide necessary funding for the implementation<br>➢ The Ghana Meteorological Agency should work on their channels of communication for climate information and services (Website, toll free line)<br>➢ The Ghana Meteorological Agency should improve its climate data collection and make data freely accessible<br>➢ The Ghana Meteorological Agency should include dry season forecast as part of their seasonal forecasts |

Annex 6: List of International Conventions and National Policies, Strategies and Plan

- Kyoto Protocol
- Paris Agreement
- WMO Convention
- Sustainable Development Goals (SDGs)
- Sendai Framework for Disaster Risk Reduction 2015–2030
- UN Framework Convention on Climate Change (UNFCCC)
- National Adaptation Plan
- National Climate Change Policy
- National Climate Change Master Plan
- National Five-Year Development Plan 2016-2020

Annex 7: Ghana's Nationally Determined Contribution (Gh-NDC)

See attached.