COMPREHENSIVE ACTION FOR CLIMATE CHANGE INITIATIVE

ANAPRI CACCI REPORT #4

Ghana: Nationally Determined Contribution (NDC) and National Adaptation Plan (NAP) Country Profile and Assessment

Simon Bawakyillenuo, Andrew Agyei-Holmes, Richard Kwabi Ayisi and Philip Aniah

June 2024

Supported by

INNOVATION LAB FOR FOOD SECURITY POLICY RESEARCH, CAPACITY, AND INFLUENCE (PRCI)

MICHIGAN STATE UNIVERSITY

About ANAPRI CACCI Reports

ANAPRI CACCI Reports are publications stemming from implementation of the Comprehensive Action for Climate Change Initiative (CACCI) pilot project in Zambia and Ghana. CACCI is committed to expediting the implementation of Nationally Determined Contributions (NDCs) and National Adaptation Plans (NAPs) by addressing the need for data and analytics and bolstering institutional and coordination capacities. In Africa, CACCI collaborates closely with the African Union Commission, the African Network of Agricultural Policy Research Institutes (ANAPRI), AKADEMIYA2063, and climate stakeholders in selected countries. This partnership aims to inform climate planning and enhance capacities for evidence-based policymaking, advancing progress toward climate-related objectives.

ANAPRI's involvement in the CACCI contributes to the provision of technical expertise, strengthening national, regional, and continental capacities for NDCs and NAPs implementation. In close collaboration with its two-member centers, the Indaba Agricultural Policy Research Institute (IAPRI) in Zambia and the Institute of Statistical Social and Economic Research (ISSER) in Ghana, ANAPRI, through CACCI, supported the Climate Change Technical Working Groups within respective countries and the ministries responsible for coordinating these working groups by offering data and analytical support.

Jointly published with ANAPRI member centers (IAPRI and ISSER) and the Country Climate Change Technical Working Group, the CACCI reports catalogue the key deliverables under the project. The data shared through these reports aim to provide evidence-based insights to practitioners and policymakers spearheading climate action in countries where CACCI is being implemented. CACCI is generously supported by the U.S. Agency for International Development (USAID) through the Feed the Future Innovation Lab for Food Security Policy Research, Capacity, and Influence (PRCI), led by Michigan State University (MSU). It is important to note that the views expressed in this publication do not necessarily reflect those of the funder but represent the perspectives of the authors.

These reports were generated in 2023 and have been in use in-country since that time. All information about policies, programs, and processes are up-to-date as of June, 2023.

About ANAPRI

The African Network of Agricultural Policy Research Institutes (ANAPRI) is a network that brings together various agricultural policy research institutes in Africa. It serves as a platform for collaboration, knowledge sharing, and collective action among its member institutes. ANAPRI works towards promoting evidence-based policy formulation and implementation to enhance agricultural development and food security across the African continent. Through research, policy analysis, capacity building, and advocacy, ANAPRI aims to contribute to sustainable agricultural and rural development in Africa.

About IAPRI

Established in 2011, the Indaba Agricultural Policy Research Institute (IAPRI) is Zambia's first indigenous policy research institute dedicated to policy analysis of the agricultural and environmental sectors. IAPRI is a non-profit company limited by guarantee and collaboratively works with public and private stakeholders. The institute's vision is "to be the Centre of Excellence for Agricultural Policy Research and Outreach in Zambia". IAPRI exists to carry out agricultural policy research and outre ach activities, serving the agricultural sector in Zambia to achieve sustainable pro-poor agricultural development. IAPRI's mandate is to utilize empirical evidence to advise and guide the Government of Zambia and other stakeholders on agricultural investments and policies.

About ISSER

ISSER was established in 1962 as the Institute of Statistics to provide a programme of teaching and research in statistics. In 1969, it was reorganized and renamed the Institute of Statistical, Social, and Economic Research with an expanded mandate to conduct research in the social sciences to generate solutions for national development. ISSER currently serves as the research wing under the College of Humanities, University of Ghana, and engages in several policy-relevant research whose findings are intended to help policymakers on the best policy decisions to make for national development.

Suggested Citation: Simon Bawakyillenuo, Andrew Agyei-Holmes, Richard Kwabi Ayisi and Philip Aniah, 2024. *Ghana: Nationally Determined Contribution (NDC) and National Adaptation Plan (NAP) Country Profile and Assessment.* ANAPRI CACCI Report # 4, Accra, Ghana.

Authors: Simon Bawakyillenuo[1], Andrew Agyei-Holmes[2], Richard Kwabi Ayisi[3] and Philip Aniah[4]

[1] Associate Professor, Institute of Statistical, Social and Economic Research, University of Ghana
[2] Senior Research Fellow, Institute of Statistical, Social and Economic Research, University of Ghana
[3] Senior Lecturer, Economics Department, University of Ghana
[4] Lecturer , University for Development Studies, Tamale, Ghana

Table of Contents

List of Figures v
Acknowledgment vi
1. Introduction 1
2. Context of Climate Change in Ghana 1
2.1 Historical picture of climate change in Ghana 1
2.2 Impact of Climate Change on Development in Ghana 6
2.2.1 Impact on Agriculture 6
2.2.2 Impact on Water Resources 7
2.2.3 Impact on Energy 8
2.2.4 Impact on Health 8
2.2.5 Impact on other sectors, i.e., industry, services (Transportation) 9
2.3 Historical Landscape of Climate Change Policy Architecture of Ghana 9
2.4 Landscape of climate change adaptation and mitigation strategies: 1990s to 2015 10
3. Deconstructing the implementation of Ghana's NDCs and NAPs 11
3.1 Highlights of Key Issues: Paris Agreement (2015) and the Glasgow climate pact (2021) 11
3.2 Overview of Ghana's two National Determined Contributions (GH-NDCs) 17
3.3 Key Adaptation and Mitigation Targets in Ghana-NDCs and their implementation status 19
3.3.1 Ghana INDCs _Adaptation and Mitigation targets 19
3.3.2 Updated GH-NDCs Adaptation and Mitigation targets 21
3.4 Assessment of the initiatives for the implementation of GH-NDCs targets 23
3.4.1 Energy Sector 23
3.4.2 Forest Sector 25
3.4.3 Waste Sector 27
3.4.4 Transport Sector 27
3.5 The landscape of NAPs and implementation in Ghana 28
3.5.1 Adaptation in the Context of National Planning 28
3.5.2 Adaptation Planning in the Context of National Climate Policy 28
3.5.3 Sub-national level adaptation planning and implementation 29
3.5.4 Current National Adaptation Plans (NAPs) 30
4. Status of the Measurement, Reporting and Verification (MRV) System in Ghana 31
4.1 Progress in the implementation of GH-NDCs and NAPS 33
4.2 Gaps in the Implementation of GH-NDCs and NAPs 33
References 35

List of Figures

Figure 1: Ghana's old (left) and newly reclassified (right) Agro-climatic/ecological zones 3
Figure 2: Mean Annual Temperature for Ghana, 1961 – 2021 4
Figure 3: Projected Average Temperature for Ghana from 2010 - 2100 4
Figure 4: Mean Annual Precipitation for Ghana, 1961 – 2021 5
Figure 5: Projected Annual Average Precipitation for Ghana from 2010 - 2100 5
Figure 6: Ghana's Emission Reduction Trajectory from 2020 -2030 under BaU, Unconditional emission and Conditional emission 20

Acknowledgments

The Africa Network of Agricultural Policy Research Institutes (ANAPRI) is a consortium of national agricultural and food systems policy research centers in Africa. Our primary goal is to generate high-quality evidence that supports policymaking across the continent. We are committed to developing the capacity of national agricultural research institutes and fostering dynamic collaborations. Through effective outreach, we provide balanced and non-partisan advice to stakeholders at the national, regional, and continental levels.

We would like to express our gratitude to the African Union Commission for initiating this program and to the United States Agency for International Development (USAID) for providing financial support through the Innovation Lab for Food Security Policy, Research, Capacity, and Influence (PRCI). We would also like to acknowledge the technical collaboration from the PRCI team at Michigan State University during the implementation of the Comprehensive Action for Climate Change Initiative (CACCI).

Additionally, we appreciate the support of the Zambian government, specifically the Ministry of Green Economy and Environment, and the Climate Change Technical Working Group members. We would also like to thank the Ghanaian Government, Policy Link, and other members of the CACCI Technical Working Group for partnering with us to implement the CACCI pilot in Ghana. This work would not have been possible without the hard work of our member research centers, IAPRI and ISSER in Zambia and Ghana, respectively. Lastly, we extend our gratitude to Akademiya 2063 for being a co-implementer of CACCI Africa in Rwanda and Senegal.

Please note that any views expressed or errors remaining are solely the responsibility of the authors. For comments and questions, please contact:

The Executive Director,
Africa Network of Agricultural Policy Research Institutes,
C/O Indaba Agricultural Policy Research Institute, 12 Serval Road, Kabulonga, Lusaka, Zambia.
Telephone: +260 211 261194; Email: info@renapri.org

1. Introduction

The Country Status Assessment and Profile (CSAP) on climate change in Ghana is a report that reviews adaptation and mitigation initiatives implemented in Ghana since the declaration of the Nationally Determined Contributions (NDCs) and National Adaptation Plans (NAPs) in 2015 and 2019, respectively. The report evaluates the current situation after the implementation of the NDCs and NAPs and identifies major trends that could affect Ghana's ability to achieve their targets. The main aim of this assessment is to undertake a country-baselining and stock-taking analysis to make recommendations relevant to assist the Government of Ghana and other stakeholders in implementing the NDCs and NAPs under the Paris Agreement on Climate Change.

The assessment was conducted using a mixed methods approach, reviewing quantitative indicators and qualitative data such as policy changes and regulatory environment. Key national documents were consulted for the empirical review, including Ghana's intended nationally determined contribution, updated NDCs, and NAPs. A stakeholder consultative workshop was also adopted, with Steering Working Groups (SWGs) providing in -depth feedback and additional documents relevant to the objective of the assessment.

The report is divided into five sections, including the historical context of climate change, the impacts on key development sectors, the implementation status of Ghana's NDCs and NAPs, the status of the Measurement, Reporting and Verification (MRV) systems in Ghana, and the progress and gaps in the implementation of Ghana's NDCs and NAPs.

2. Context of Climate Change in Ghana

2.1 Historical picture of climate change in Ghana

Ghana comprises 4 main Agro-climatic zones (ACZs) distinguished by varied precipitation and temperature patterns, namely the northern belt, transition, forest, and coastal zones (Fig. 1). However, a reclassification of the existing 4 ACZs into 5 has been carried out by Yamba et al. (2023). The new classification designates the Northern belt into the Guinea Savannah and Sudan Savannah zones reflecting current climate variability and change realities (Yamba et al., 2023). In the new classification, the Guinea Savannah zone expands southwards engulfing some parts of the transition zone and

slightly extending to some parts of the forest zones (Fig. 1). Expansion of the coastal zone has also engulfed all places surrounding the coast (World Bank, 2021).

Among the 5 new ACZs of Ghana, the Sudan Savannah zone exhibits the highest seasonality index (SI) values. This zone covers areas in the northern fringes (Upper East Region) with a uni-modal rainfall regime (4-5 months) and marked longer dry seasons (October – April). Temperature ranges from as low as 20˚C during the harmattan to about 40˚C before the onset of the single rainy season. The zone also records the smallest annual rainfall amount of around 900 mm in Ghana (World Bank, 2021). The next zone with the second highest SI values in Ghana is the Guinea Savannah, extending between latitudes 8˚N and 10˚N. Although the rainfall pattern is also uni-modal, the rainy season ranges between 5-6 months, especially around the Tamale, Yendi, and Wa areas and around 6-7 months in the Kete-Krachi and Bole areas. Temperature ranges from 20˚C to 35˚C, slightly lower than the Sudan Savannah zone. The rainfall amount is also higher than the Sudan Savannah zone ranging from 1100 and 1200 mm (Yamba et al., 2023).

The transition zone has comparable characteristics in rainfall and temperature patterns with the forest zone. However, the mean annual precipitation is slightly lower than in the forest zones. The forest zone exhibits the lowest SI[1] values. The forest zone has a bi-modal rainfall pattern, a major (March to July) and minor (September to October) rainfall season. The forest zone also shows the lowest temperature (18˚C to 35˚C) in Ghana (Dazé and Echeverría, 2016). Conversely, the zone records the highest amount of total annual rainfall of around 1300–1800 mm. With regards to the coastal zone, comparable features to that of the Guinea Savannah zone are shown. However, bi-modal rainfall regime is experienced in the coastal zone.

Generally, Ghana's climate is tropical, with distinct variations in total annual rainfall between Sudan Savannah and coastal zone (800–900 mm) and forest zone (1900 mm). The reliability of annual and seasonal rainfall patterns and temperature increases with decreasing latitudes from North to South (Yamba et al., 2023). The dry season period in

[1] "SI" refers to " Seasonality Index," which is a climatic classification index used to characterise different climatic zones in Ghana. The SI index is based on rainfall and temperature patterns observed in specific regions.

Ghana occurs around December to March amid arid and dusty north-easterly trade winds or harmattan winds that originate from the Sahara Desert (Dazé & Echeverría, 2016). This dry season is equally characterised by low humidity, cool nights (Temperature <20°C), and hot days (Temperature > 25 °C) (World Bank, 2021). Ghana's high vulnerability to climate change poses a threat to future growth and development. Drought, rising sea levels, increasing temperatures, and unpredictable precipitation adversely impact hydropower production, infrastructure, food security, agriculture, and livelihoods (World Bank, 2021).

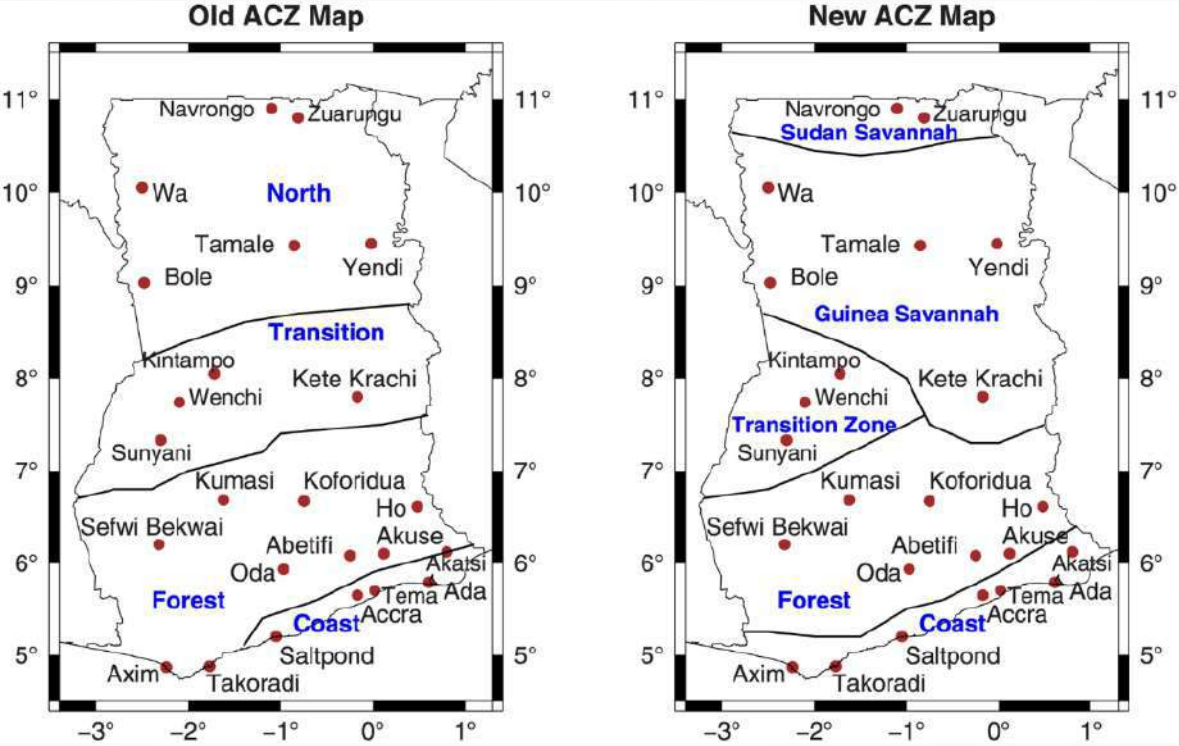

Figure 1: Ghana's old (left) and newly reclassified (right) Agro-climatic/ecological zones

Source: Adopted from Yamba et al., 2023

An examination of data from the World Bank Group's Climate Change Knowledge Portal (CCKP) (2022) from 1961 to 2021 reveals that generally, Ghana's mean annual temperature is about 27.3°C, while mean annual precipitation is around 1,190mm. Figure 2 shows the trend of the annual mean temperature for Ghana from 1961 to 2021. Ghana's mean temperature has increased by about 1°C since the 1960s (a mean increase of 0.21°C per decade)[1] the number of very hot days (temperature >35°C) has increased by about 13% per year, and hot nights (Temperature >26°C) have also increased by about 20% per

year. The lowest mean annual temperature (26.59 °C) was recorded in 1971 while the highest mean annual temperature (28.3°C) was observed in 2021. The most considerable increase has been observed in the months of April, May, and June, with a mean rise of 0.27°C per decade. The Northern Belt (Sudan and Guinea Savannah zones) have recorded a higher rate of increase in temperature than the forest and transition zones (World Bank, 2021; Yamba et al., 2023). Generally, the rate of precipitation, hot days and nights increases have been pronounced in the northern part of Ghana. Sudan and Guinea Savannah zones have experienced about a +37% rise in temperature, while the southern belt (transition and forest zones) has experienced minimal temperature increases. The mean annual temperature increase is consistent with the regional temperature observations for West Africa and resonates with findings in earlier studies including (McSweeney, New, & Lizcano, 2010; MESTI, 2012; Dazé and Echeverría, 2016; World Bank, 2021).

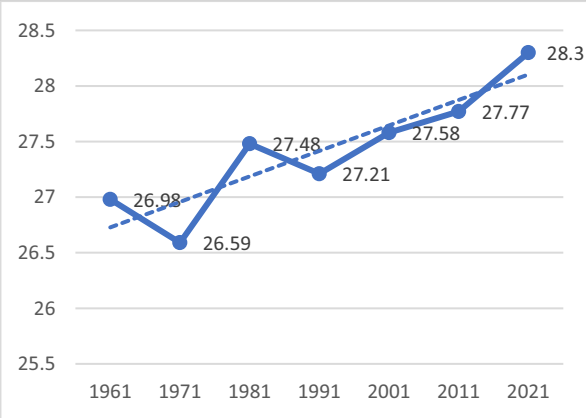

Figure 2: Mean Annual Temperature for Ghana, 1961 – 2021

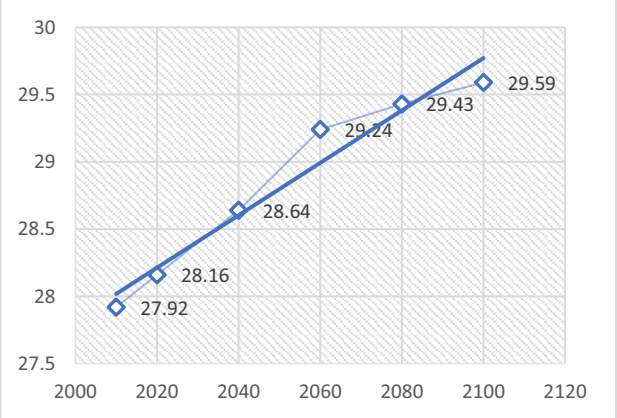

Figure 3: Projected Average Temperature for Ghana from 2010 - 2100

Source: World Bank Group's CCKP, October 2022

The future projections of temperature and precipitation patterns are based on the Coupled Inter-comparison Project No.5 (CMIP5) data ensemble, a resource database presented in the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC) (World Bank Group's CCKP, 2022). Ghana's temperature is projected to increase continually by a mean annual increase of 1.0 ^{0}C to 3.0^{0}C by 2050 and 2.0^{0}C to 5.0^{0}C by 2100 (Fig. 3). Using General Circulation Models (GCM), the IPCC (2014)

projects mean annual temperatures increases of 0.9°C, 2.1°C, and 4.0°C by the years 2035, 2065, and 2100, respectively.

Ghana's precipitation patterns show significant interdecadal and interannual variability, with a 2.4% annual reduction since the 1960s, with the highest rainfall in 1991 and the lowest in 2001 (Figs. 4 and 5). Precipitation in Ghana is already highly variable, and it's projected to continue in the same trend throughout the century. Intra-annual variability and high intensity rainfall events are expected to increase in some parts of Ghana. The projected highest rainfall amount is expected around the year 2060 (1345.75mm) while significant decreases in precipitation are expected by the turn of 2080 (1270.78mm) (World Bank Group's CCKP, 2022).

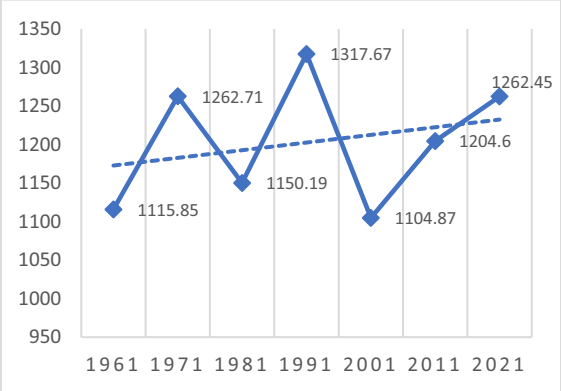

Figure 4: Mean Annual Precipitation for Ghana, 1961 – 2021

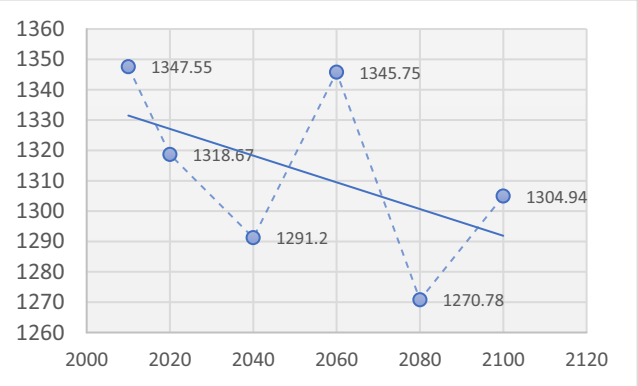

Figure 5: Projected Annual Average Precipitation for Ghana from 2010 - 2100

Source: World Bank Group's CCKP, October 2022

Annual precipitation for Ghana under a medium emission scenario of RCP4.5 is projected to decrease marginally with pronounced decreases observed for the northern part of Ghana (Fig. 5). Other studies have confirmed the decrease in precipitation by 2080 (MESTI, 2012; World Bank, 2021). However, the southern, and coastal areas are projected to continue to be the wettest parts of the country, while the northern and transitional zones will experience drier conditions (Dazé & Echeverría, 2016; World Bank, 2021). The forecasts for Ghana synchronise with projections for West Africa that

indicate delays in the onset of the rainy seasons in addition to general declines in rainfall amounts (Christensen et al., 2013).

2.2 Impact of Climate Change on Development in Ghana

The impact of climate change is real and would continue to affect critical sectors of the Ghanaian economy. Productive sectors including agriculture, health, water, energy and forests currently bear the brunt of the negative impacts of climate change. Alth ough the impacts are not equally shared across the globe (Kotir et al., 2011), the distribution of the impacts differs based on the adaptive capacity and resource endowments of countries. Rising temperature, for example, is expected to have net negative im pacts on various sectors of developing countries due to high dependence on forests and agriculture, warmer climates, and low precipitation (Kotir et al., 2011). The IPCC AR5 (2014) projects that by 2100, many parts of Africa will emerge as the most vulnerable to climate change in the world, with losses in agriculture that could be equivalent to 2% and 7% of GDP.

Similarly, climate change impacts infrastructures like roads, buildings, and ports in Ghana's major cities. It also affects drainage systems, energy, water supply, and sanitation. Rising sea levels, coastal erosion, and storm intensity contribute to vulnerability, with coastal areas experiencing inundation, erosion, and saltwater intrusion. Amevoin et al.'s 2018 study highlights coastal erosion, storm surges, and climate change-induced extreme weather events damaging Ghana's infrastructure. Degradation of coastal ecosystems, such as mangroves and coral reefs, further reduces natural protection, emphasising the need for adaptation measures and sustainable management strategies.

2.2.1 Impact on Agriculture

Agriculture, a crucial part of Ghana's economy, contributed 22.2% of GDP in Q2 2022. However, it is highly vulnerable to climate change impacts due to factors like climate variability, unfavourable topography and poor soil fertility.

The agriculture sector's reliance on variable rainfall and rising temperatures has led to decreased yields of stable crops like cereals. Increased interannual rainfall variability and shorter growing seasons are expected to worsen crop yield losses, potent ially increasing

disease and pest incidence, and causing crop failure in certain zones. The decreasing rainfall and drought patterns are expected to worsen desertification and land degradation, hindering production. Rising temperatures will affect fisheries, altering reproductive cycles and migratory patterns. This has led to Ghana spending over $200 million annually on seafood imports and a weakening of the Ghana cedis (Dazé & Echeverría, 2016). Climate change impacts Ghana's agriculture differently based on socioeconomic status, resource endowment, poverty, and gender, with children and women being most vulnerable due to limited access to resources.

In addition to climatic factors, there are several non-climatic factors that have contributed to declines in productivity in Ghana's agriculture sector over the years. These factors play a significant role in shaping the agricultural landscape and need to be highlighted. Limited access to credit, inputs, and extension services hinder small-scale farmers from adopting modern agricultural practices. Post-harvest losses in Ghana are caused by inadequate rural infrastructure, limited market access, improper harvesting and poor farm sanitation. Slow adoption of modern farming technologies, weak governance, and institutional constraints further hinder agricultural development (Zakaria et al., 2020; Arah et al., 2015; Amanor & Chichava, 2015).

2.2.2 Impact on Water Resources

Ghana's freshwater, spanning 5% of the country's land, is impacted by climate change, with non-climate drivers like population expansion and urbanisation compromising water resource sustainability. This leads to droughts and floods, with increasing GHGs associated with water resource risks. The World Bank estimates that 10% of the population may experience 20% decreases in renewable water resources.

Climate change has led to significant socioeconomic losses in Ghana, with 18 major floods and droughts reported since 1950, affecting about 540,000 people annually. The 1983 drought affected over 12.5 million people, particularly vulnerable farmers in Sudan and Guinea savannah zones (Mensah & Ahadzie, 2020). The 2010 flood displaced 700,000 people and destroyed 23,588 acres of farmland and 3234 houses. Climate change is also increasing the frequency of meteorological and agricultural droughts, particularly in the Northern part of Ghana.

Climate change negatively impacts freshwater ecosystems, affecting streamflow and water quality, threatening drinking water sources (United Nations (UN), 2019). Illegal mining in Southern Ghana exacerbates risks, with pollution, droughts, high rainfall, and rising temperatures exacerbating these risks. Women are more vulnerable due to limited resources and lack of voice (Adjei et al., 2022).

Water insecurity risks between Ghana and neighbouring Burkina Faso due to the Volta Basin's reduced flow (World Bank, 2021). The Basin is crucial for hydropower generation, but droughts and floods are affecting access to clean water. Rising sea levels and salinisation negatively affect freshwater sources, wells and boreholes. Poverty - endemic areas, particularly northern Ghana, are also suffering.

2.2.3 Impact on Energy

Energy services drive nation growth, but fossil fuels contribute to GHG emissions (Ebinger, 2011). Ghana's hydropower, sourced from Kpong, Bui and Akosombo dams, accounts for 29% of total installed capacity. Climate change impacts Ghana's energy sector through demand and supply, as well as infrastructure and endowment. Decreasing precipitation weakens hydropower capacity, and meteorological droughts decrease water inflows into Volta Lake. Excessive rainfall and strong winds affect hydropower generation, supply, reliability and efficiency, leading to disruptions and power outages in Ghana's electricity infrastructure.

Ghana's electricity infrastructure is vulnerable to extreme weather events, highlighting the need for resilient infrastructure and proactive measures to mitigate climate change's impact on the country's electricity supply.

2.2.4 Impact on Health

Ghana is highly susceptible to climate change impacts on human health, causing injury and death through events like flooding, bushfires and heatwaves. Asante and Amuakwa-Mensah (2014) study linked climate change to morbidity and mortality patterns due to temperature changes and decreasing rainfall or floods. Secondly, indirect climate change impacts are aggravated by natural systems such as ecosystem and environmental changes, which manifest through impacts on food quality, water quality, air quality (with

allied respiratory diseases), and breeding conditions for vector-borne diseases. Climate change indirectly impacts human systems, affecting emotional and social well-being, productivity, and mental health through human system alteration.

Climate change indirectly impacts health by destroying health infrastructure and service delivery. Extreme events cause destruction, impacting water and food security, ecosystems, infrastructure and human settlements. In Ghana, urban centres face higher disease occurrences due to inadequate access to clean water and sanitation. Increased temperatures and flooding leads to cholera and malaria outbreaks. This is particularly pronounced in urban, northern, and coastal areas. The reduction in rainfall and heat waves is causing exhaustion, heat stroke, and increased malnutrition, particularly among children under 5. The World Bank predicts a 70-fold increase in deaths by 2080.

Ghana is focusing on reducing greenhouse gas emissions in sectors like transport, food and energy to improve air quality and public health. This includes promoting sustainable agriculture, transitioning to cleaner transportation, and adopting renewable energy sources. These efforts align with the country's commitment to sustainable development and climate action.

2.2.5 Impact on other sectors, i.e., industry, services (Transportation)

Climate change could significantly impact Ghana's industries, transport and services, with rising temperatures increasing energy demand and disrupting supply chains, affecting 28% of the country's greenhouse gas emissions. Climate change poses challenges to Ghana's transport networks, including damage to roads, coastal roads and increased maintenance costs due to thermal expansion and sea-level rise (EPA, 2015). In the services sector, climate change can have wide-ranging effects. Increasing temperatures can intensify heatwaves, posing health risks to vulnerable populations and placing additional burdens on healthcare services.

2.3 Historical Landscape of Climate Change Policy Architecture of Ghana

The United Nations Framework Convention on Climate Change (UNFCCC) was established in 1992 to address global climate change threats. Ghana joined the Convention in 1995, joining other international agreements like the Kyoto Protocol and

the Paris Agreement, as Sub-Saharan Africa was already experiencing climate change impacts.

Ghana has developed various frameworks and policies to address climate change threats, including the National Climate Change Policy (NCCP) launched in 2013. Prior to this, Ghana had other policies and frameworks, such as the National Medium-Term Development Policy Framework, Vision 2020, National Environment Policy, National Youth Policy, GSGDA, Forest and Wildlife Policy, Energy Policy, Re newable Energy Policy, Low Carbon Development Strategy, and National Climate Change Adaptation Strategy.

In 1995, the government of Ghana prepared a long-term development plan, termed as the Vison 2020 (GoG, 1995). The document outlined five key long-term development objectives for the country in the areas of human development, economic growth, rural development, urban development, and environmental management. Regarding the environment aspect of the key thematic areas, the plan identified objectives relating to things such as agriculture and forestry, water and sanitation, and environmental sustainability. To facilitate the implementation of the Vision 2020 plan, a series of medium-term development plans have been developed by successive governments to guide in the implementation of the key policies outlined.

Ghana is actively working on climate change mitigation and adaptation through carbon market and non-market approaches, aligning with UNFCCC's Paris Agreement agenda. The country has entered and is partnering with other countries, such as Switzerland, Singapore, Sweden, South Korea and the UAE. Ghana has established a national carbon market arrangement and developed a digital infrastructure for emissions tracking. With 12 ongoing mitigation projects, Ghana is dedicated to reducing GHG emissions at both national and global levels. Ghana's commitment to climate change mitigation and adaptation is evident through its efforts in the carbon market, digital infrastructure and bilateral cooperation.

2.4 Landscape of climate change adaptation and mitigation strategies: 1990s to 2015

Ghana, despite contributing less to GHG emissions, is more vulnerable to climate change impacts due to its critical sectors like agriculture and energy. Around 70% of the

population relies on agriculture and forest products. To reduce vulnerability and increase resilience, various mitigation and adaptation initiatives have been developed at local and national levels.

Since the 1990s, Ghana has implemented 47 adaptation and mitigation policies focusing on national development, resource management, climate change, disaster risk reduction, agriculture, fisheries, forestry, flood/flood risk management, water resources management, urban planning, rural development, poverty reduction and gender. As indicated by Mensah et al. (2016), about 75% of these key action plans were initiated between 2010 and 2014. Mitigation policies aimed to reduce emissions from key sectors, while adaptation aimed to increase resilience in vulnerable sectors. These policies consider economic, environmental and social aspects, reflecting the country's future development. The policies are a mixed bag, including sectoral-level adaptation and mitigation policies/strategies, national-level adaptation and mitigation policies/strategies, sub-national level adaptation and mitigation policies/strategies, and informal adaptation and mitigation strategies.

3. Deconstructing the implementation of Ghana's NDCs and NAPs

3.1 Highlights of Key Issues: Paris Agreement (2015) and the Glasgow climate pact (2021)

The Paris Agreement: In December 2015, the global community, particularly UNFCCC parties, convened in Paris to discuss climate change threats. The goal was to agree on measures to combat climate change and strengthen existing actions for a low-carbon future. The agreement was signed in New York on 22 April 2016. Highlights of this Agreement are as follows.

Provisions on Mitigation: The provisions in the Agreement require Parties to set their own targets known as nationally determine contributions (NDCs) and ensure the achievement of those targets. As a sign of fulfilling each individual country's commitment to the convention, all parties are expected to prepare a report that provides clear and transparent information on the progress of their contribution and communicate such to the convention every five years. Again, the report (national communication) should prescribe various domestic measures and how these measures have been pursued. In this regard developed countries were charged to embark on absolute carbon reduction

targets whiles developing countries are encouraged to strengthen their current mitigation effort but to move towards absolute reduction targets as things get better in the future.

Provisions on Adaptation: As one of the provisions established under the Paris Agreement, a global goal for climate change adaptation was set. The Convention recognises that adaptation is a global challenge and therefore realised the need to build adaptive capacity and strengthen resilience as well as help reduce vulnerability to climate change. The main target under this provision is to limit the increase of the global temperature to $1.5\,^{0}C$. In this regard, the provision aims at helping individual countries to strengthen their adaptation efforts, encouraging corporations, and also seeking international support in both technical and finance. Individual countries who are party to the convention were encouraged to formulate and implement adaption strategies that will be communicated periodically to the convention.

Long-term temperature goal: Again, under the Agreement, the global effort to strengthen adaptability was re-affirmed by setting a goal of limiting the global temperature increase to a level well below $2\,^{0}C$ preferably to $1.5\,^{0}C$. To achieve the $1.5\,^{0}C$ temperature goal, as stated above, countries should aim to reach the global peaking of greenhouse gas emissions (GHGs) as soon as possible.

Support, Education and Information: The support of developed countries to the developing countries in their effort to fight climate change was reaffirmed under the Agreement. Developed countries were to provide both technical and financial support to developing countries so that they can build a strong and climate-resilient future. Also, a party from developed countries were encouraged to provide voluntary support. Additionally, the Agreement established a provision for the promotion of education and training, as well as increasing awareness of climate change and making information on adaptation and mitigation easily accessible. Furthermore, as part of the provisions, it was established all information in the form of a report to the convention would go through a technical review.

Global Stocktake: The Paris Agreement established a global stocktaking approach. The maiden edition was scheduled to take place in 2023, and thereafter, it is repeated every 5 years. The aim of the initiative as agreed by the parties is to help in assessing collective progress toward accomplishing the purpose of the Agreement in a comprehensive and facilitative way. Findings from the initiative will assist parties to update and improve upon their efforts, as well as support and increase international collaboration on climate action.

Cooperative Approaches: Cooperative Approaches, as outlined in Article 6 of the Paris Agreement, emphasise international collaboration in tackling climate change. This provision recognises that no single country can effectively address climate change on its own. It encourages countries to engage in cooperative activities such as emissions trading, sustainable development mechanisms, and non-market approaches. These approaches facilitate the transfer of mitigation outcomes, technologies, and finance between nations, enabling cost-effective and efficient climate action. By promoting cooperation, the Paris Agreement encourages countries to work together, share best practices, and leverage each other's strengths to achieve their emission reduction targets and advance sustainable development.

Loss and Damage: The concept of Loss and Damage, embedded within the Paris Agreement, acknowledges that some adverse effects of climate change may go beyond the scope of adaptation and result in irreversible losses and damages. This provision addresses the impacts that vulnerable countries and communities face due to the slow-onset processes and sudden events caused by climate change. It recognises the need for support and cooperation in dealing with these impacts, including financial assistance, technology transfer, and capacity building. Loss and Damage highlights the responsibility of developed nations in assisting developing countries that are most affected by climate change-induced losses and damages, ensuring that the burden is shared collectively.

Technology and Capacity: The Paris Agreement recognises the importance of technology development and transfer as well as capacity building to enhance the implementation of climate action globally. Technology transfer involves the sharing of environmentally sound and state-of-the-art technologies between countries, particularly from developed

to developing nations. This transfer enables developing countries to access and adopt sustainable technologies that can contribute to their mitigation and adaptation efforts. Capacity building supports the strengthening of institutional, human, and technical capacities to address climate change challenges. It aims to enhance the ability of countries, particularly developing ones, to plan, implement, and monitor climate actions and policies. By prioritising technology transfer and capacity building, the Paris Agreement aims to bridge the technology and capacity gaps between nations, promoting equitable and inclusive climate action.

Implementation Process: Since the adoption of the Paris Agreement in 2015, several important processes and milestones have taken place to facilitate its implementation and ensure collective global action on climate change. These processes have aimed to provide guidance, establish rules, and enhance cooperation among countries. Here is an overview of the key steps in the implementation of the Paris Agreement:

Marrakesh Accord (COP22, 2016): The Marrakesh Accord was a crucial milestone in the implementation of the Paris Agreement. It served as the platform for countries to discuss and develop a roadmap for translating the Agreement's goals into action. The Accord highlighted the need for enhanced climate ambition, financial support, and capacity-building for developing countries.

Nationally Determined Contributions (NDCs): Under the Paris Agreement, countries are required to submit NDCs, which outline their voluntary emission reduction targets and climate actions. The process of preparing and updating NDCs has been ongoing since the Agreement's adoption, with countries expected to enhance their ambitions over time.

Talanoa Dialogue (COP23-COP24, 2017-2018): The Talanoa Dialogue was a global conversation facilitated by the United Nations to take stock of collective efforts towards the goals of the Paris Agreement. This dialogue aimed to promote transparency, share experiences, and encourage countries to raise their climate ambitions.

Paris Agreement Rule Book (COP24, 2018): The Rule Book provides a set of guidelines and procedures to operationalise the Paris Agreement. It covers various aspects, including

transparency, accounting for emissions and finance, adaptation, and compliance. The Rule Book ensures that countries follow common rules and standards in reporting their progress and implementing climate actions.

Global Stocktake: The Global Stocktake is a periodic assessment of collective progress towards the long-term goals of the Paris Agreement. It evaluates the effectiveness of mitigation efforts, adaptation measures, and support provided by countries. The first Global Stocktake is scheduled to take place in 2023, with subsequent cycles every five years.

Climate Finance: Mobilising financial resources to support climate action is a critical aspect of the Paris Agreement. The Agreement encourages developed countries to provide financial assistance to developing countries for mitigation, adaptation, and capacity-building efforts. The process of scaling up climate finance and achieving the goal of $100 billion annually by 2020 has been a key focus of international negotiations.

COP Meetings and Subsidiary Bodies: The Conference of the Parties (COP) meetings serve as the main decision-making body for the Paris Agreement. These annual meetings provide a platform for countries to negotiate, review progress, and make decisions on key issues. The subsidiary bodies, such as the Subsidiary Body for Scientific and Technological Advice (SBSTA) and the Subsidiary Body for Implementation (SBI), support the COP in addressing specific technical and implementation matters.

Enhanced Ambition and Implementation: Since the Paris Agreement, there has been growing recognition of the need to increase ambition and accelerate climate action. This includes efforts to strengthen NDCs, advance technology transfer, promote capacity-building, and foster international cooperation. Various initiatives, such as the Climate Ambition Alliance, Race to Zero, and global campaigns, have emerged to encourage greater ambition and engagement from all stakeholders.

The implementation of the Paris Agreement is an ongoing and dynamic process, with countries continually working to enhance their climate actions and align them with the Agreement's objectives. The processes mentioned above, along with continuous

negotiations, dialogues, and actions at the national and international levels, contribute to the collective effort towards addressing climate change and achieving the goals of the Paris Agreement.

The Glasgow Climate Pact: The Glasgow Climate Pact took place in Glasgow in December 2021. The aim of COP26 was to increase climate action and support for the next decade. The main issues agreed upon at the Glasgow conference were to improve the global efforts to enhance resilience to climate change, reduce GHG emissions and provide the required financing as well as to reaffirm the pledge by the developed countries parties to provide $100 billion yearly to developing countries. In addition, the Parties committed to working together to close the gap between existing emission reduction plans and what is needed to cut emissions so that the Paris Agreement's 1.5^{0}C global temperature goal may be fulfilled. Furthermore, nations were called upon to phase down unabated coal power and inefficient subsidies for fossil fuels. Below are highlights of some of the key issues[2] of the Pact.

Science and Urgency: The importance of scientific tools is recognised for effective climate change fight at the COP26. The convention has therefore opened its door for collaboration with other international and sister climate related institution like the Intergovernmental Panel on Climate Change (IPCC) and the World Meteorological Organisation (WMO) to present their contributions. Further calls have been placed inviting more of such collaboration from the scientific world. Another matter that has to do with urgency is enhancing the targets set in relations to mitigation and adaptation and finance was also emphasised so that the gaps identified in the Paris Agreement can be addressed.

Adaptation: Serious concerns were raised regarding the findings of the IPPC Working Report especially, on the fact that extreme weather is getting worse and worse each time there is a marginal rise in temperature. The parties at the conference were, therefore,

[2] All information are picked from the advance version of UNFCCC Conference of the Parties serving as the meeting of the Parties to the Paris Agreement Report of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement on its third session, held in Glasgow from 31 October to 13 November 2021, assessed at https://unfccc.int/process-and-meetings/the-paris-agreement/the-glasgow-climate-pact-key-outcomes-from cop26?gclid=CjwKCAjwwL6aBhBlEiwADycBIKt82b9k7lPoKoZDVVHaaG81QqcfZVkVdIdZsaX12OODl-1LfcE4BBoC7p0QAvD_BwE

encouraged to increase support in order to help build stronger societies that are more resistant to climate change. Science was identified as the best available tool to be used, but its deployment should have developing country parties in mind as the top priority.

Adaptation Finance: The Glasgow pact recognised the insufficiency in the provision of climate funds to developing country parties to support adaptation. There was, therefore, the call to developed country parties to scale up their provision of climate finance urgently and significantly. Again, multilateral development banks and other financial institutions as well as private sectors were called upon to support developing country Parties to scale up their adaptation plans.

Mitigation: The COP26 reaffirmed the Paris Agreement's goal of limiting the global temperature increase to 1.5°C above pre-industrial levels. The pact welcomed efforts by Parties to communicate new or updated nationally determined contributions, long-term low greenhouse gas emission development strategies and other actions that demonstrate progress towards the achievement of the Paris Agreement temperature rise goal.

3.2 Overview of Ghana's two National Determined Contributions (GH-NDCs)

As Article 4 of the Paris Agreement and UNFCCC decisions 1/CP.21 and 4/CMA.1 stipulate, all Parties are required to determine locally, measures or plans/actions to increase resilience and reduce vulnerability to climate change threat. Ghana developed its initial nationally determined contribution (INDC) 2016 and subsequently updated it in 2020 to cover the period 2020 to 2030 (MESTI, 2021). The main institutional body responsible for the GH-NDC to function is the MESTI and EPA. While the MESTI coordinates the activities and also advocates resource allocation at both cabinet and parliament, the EPA tracks and reports on the progress, achievements and challenges to the UNFCCC and the various local stakeholders, and also reports on support needed and received.

The INDC focussed on 31 programmes actions covering 7 key sectors of the economy. The 31 programmes include 20 mitigation and 11 were adaptation (MESTI, 2015). For the 10-year period, an estimated total of $22.6 billion would be required to implement these 31 measures. $6.3 billion is expected to be raised domestically and $16.3 billion from

external sources. This will help to meet the goal of reducing emissions by 15% relative to the business-as-usual scenario by the end of the period (MESTI, 2015). Note that the Updated NDC has 47 Programme of Actions, focusing on 19 Policies, 11 sectors and 8 socio-economic outcomes.

The updated GH-NDCs document (MESTI, 2021), however, proposes 47 programmes focusing on 19 policies, covering 11 sectors and 8 socio-economic outcomes. Like the INDC, the updated GH-NDCs have 13 adaptation measures and 34 mitigation measures. Out of the mitigation measures, 9 are unconditional[3] and are expected to result in emissions reduction of 8.5$MtCO_2e$ by 2025 and a further 24.6 $MtCO_2e$ by 2030 – whiles the remaining 25 are conditional, and if the country is able to secure funds to implement them, that will also result in emissions reduction of 16 $MtCO_2e$ and 39.4 $MtCO_2e$ by 2025 and 2030, respectively (MESTI, 2021). The updated GH-NDCs has a long-term objective of contributing to 2900 avoidable premature death per year, creating 100 million jobs, reducing emissions by 64 $MtCO_2e$, and building the resilience of 38 million people cumulatively by 2030 (MESTI, 2021).

For adaptation, Ghana's NDCs (GH-NDCs) demonstrate commitment to climate change adaptation and resilience building. The key adaptation measures outlined in the NDCs encompasses various sectors. In the agricultural sector, Ghana aims to ensure food security and resilience by promoting climate-resilient farming practices, improving water management, and implementing early warning systems for farmers. Water resource management is also a priority, with plans to develop integrated management plans, enhance infrastructure, and establish monitoring systems for floods and droughts. The GH-NDCs recognise the risks posed by sea-level rise, coastal erosion, and storm surges, leading to a commitment to developing coastal zone management strategies to protect vulnerable areas and support affected communities. Furthermore, Ghana seeks to build climate-resilient health systems by improving disease surveillance, and healthcare infrastructure, and raising public awareness about climate-sensitive diseases (MESTI, 2021). The GH-NDCs are aligned with the national development plans, hence,

[3] The implementation is not conditioned on the availability of funds. Funds are already allocated for the implementation of the 9 programmes

their success will lead to the achievement of long-term national goals as well as sustainable development goals.

3.3 Key Adaptation and Mitigation Targets in Ghana-NDCs and their implementation status

As a party to the United Nations Framework Convention on Climate Change (UNFCC) and the Kyoto Protocol, Ghana has made efforts to meet its commitments to contribute to the realisation of the objectives of the Convention. In line with this, Ghana developed and submitted its Intended Nationally Determined Contributions (INDCs) to the Secretariat in 2015. Subsequently, the updated Nationally Determined Contributions (GH-NDCs) were drawn and submitted in 2021. The INDCs and GH-NDCs were prepared in line with the National development circumstances of the country. Both sets of adaptation and mitigation measures have been proposed. This section outlines the mitigation and adaptation targets in the Ghana INDCs and the updated GH-NDCs. It discusses the implementation statuses of these mitigation and adaptation targets.

3.3.1 Ghana INDCs _Adaptation and Mitigation targets

Ghana in its INDCs proposed 31 programmes of actions: 20 mitigation actions and 11 adaptation actions. These were proposed for implementation in the following seven priority sectors of the country from 2020 to 2030 to bring about low carbon climate resilient adaptation and reduced GHG emissions.

- Land use including food security
- Climate-proof infrastructure
- Equitable social development
- Sustainable mass transportation
- Sustainable energy security
- Sustainable forest management; and
- Alternative urban waste management.

The mitigation goal under the INDC was to reduce, unconditionally, its GHG emission by 15% of a business-as-usual (BAU) emission scenario of 73.95MtCO2e by 2030. While based on the condition that external support is being made available to cover full cost of mitigation actions, an additional 30% emissions reduction was envisaged. In total, upon

full implementation of both conditional and unconditional mitigation programmes of actions, the country had a target to reduce GHG emissions by 45% below BAU level by 2030. Given a baseline GHG emissions per capita of 1.3tCO2e, a total of 0.5tCO2e reduction of the country's per capita emission to 0.8tCO2e would be realised both conditional and unconditional mitigation contributions. Ghana's emission reduction trajectory is shown in Figure 6.

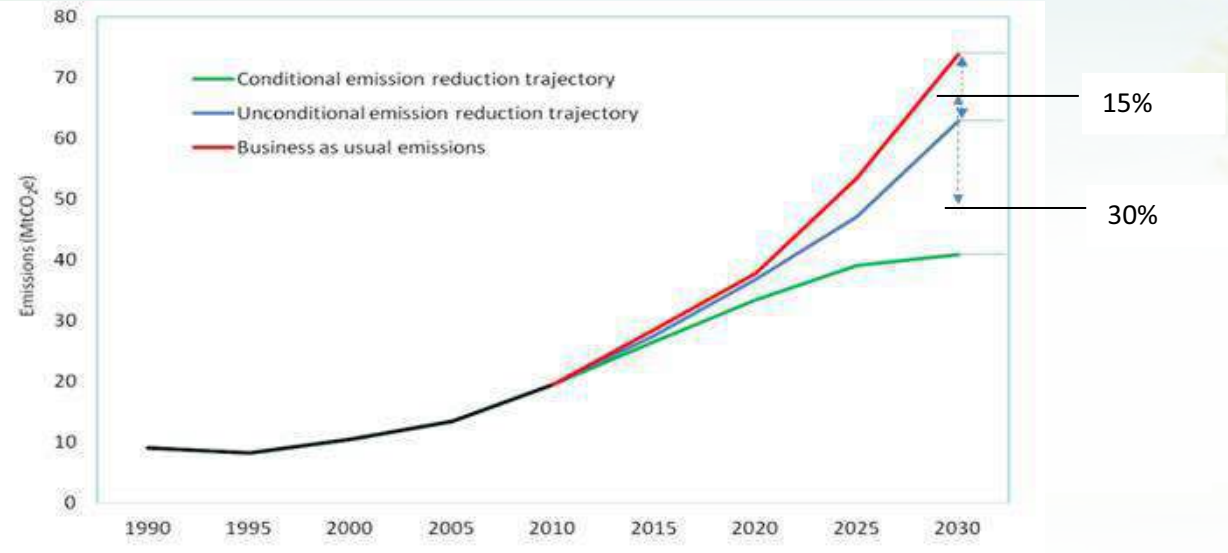

Figure 6: Ghana's Emission Reduction Trajectory from 2020 -2030 under BaU, Unconditional emission and Conditional emission

Source: MESTI, 2015

The GH-NDCs also highlight the country's commitment to adapting to the impacts of climate change and building resilience. The key points of the GH-NDCs adaptation commitments include but are not limited to; agriculture and food security where Ghana acknowledged the vulnerability of its agricultural sector to climate change and committed to implementing adaptation measures to ensure food security and resilience. This included promoting climate-resilient farming practices, improving water management in agriculture, and enhancing early warning systems for farmers. Also, the INDCs recognised the importance of water resources and committed to strengthening water resource management to adapt to climate change impacts. This included developing and implementing integrated water resources management plans, improving water infrastructure, and enhancing monitoring and early warning systems for floods and droughts. Again, the INDCs had a commitment on coastal zone management. The

risks posed by sea-level rise, coastal erosion, and increased storm surges have been recognised in the INDC. The INDCs encompassed a commitment to developing and implementing coastal zone management strategies to protect vulnerable coastal areas, enhance coastal resilience, and support communities affected by climate change impacts. On adaptation, the INDCs goal is to enhance sustainable development by decreasing vulnerabilities and increasing climate resilience. Efforts on adaptation under the INDCs are hinged on:

- Good governance and inter-sectoral coordination,
- Enhancing Capacity-building, the role of science, technology, and innovation,
- Ensuring adequate financing from both domestic and international sources,
- Increasing access to information by informing, communicating, and educating the citizenry; and
- Ensuring adherence to accountable monitoring and reporting.

Investment Requirements

Ghana needs $22.6 billion for adaptation and mitigation programmes, with 45% for mitigation and 55% for adaptation. To mobilise 21% of the total investment needs, Ghana plans to mobilise 21% at the national level, while the remaining 89% will come from external sources.

3.3.2 Updated GH-NDCs Adaptation and Mitigation targets

The updated GH-NDCs represent enhanced,0 and more ambitious targets for climate change adaptation and mitigation actions. The programmes of actions have been increased from 31 in the INDC document to 47, comprising 13 adaptation actions and 34 mitigation actions. The country targets to achieve the following adaptation and mitigation outcomes by 2030:

- To reduce absolute greenhouse gas (GHG) emission by 64 MtCO2e.
- Prevent, at least, 2900 premature deaths per year by improving air quality.
- Create over a million decent and green jobs.
- Provide benefits for about 38 million people, most of them being the youth and women.

The adaptation and mitigation measures are divided into unconditional[4](9) and conditional[5] (7) programmes of actions. Ghana aims to implement 9 unconditional mitigation programmes of action and 7 unconditional adaptation programmes of action. The other 25 mitigation and 6 adaptation programmes of action are conditional on the receipt of additional external funding support. The implementation of the 9 unconditional mitigation actions is estimated to reduce GHG emissions by 8.5 MtCO2e GHG reductions by 2025 and a further 24.6 MtCO2e by 2030 compared to a BAU baseline. The implementation of the 25 conditional mitigation actions would result in a further reduction in GHG emissions by 16.7 MtCO2e by 2025 and 39.4 MtCO2e by 2030 compared to a BAU baseline.

Regarding adaptation measures, the updated GH-NDCs highlight the country's commitment to adapting to the impacts of climate change and building resilience. The key points of the updated GH-NDCs adaptation commitments include adaptation planning where the aim is to develop and implement a national adaptation plan (NAP) to guide its adaptation efforts. The NAP involves the identification of adaptation priorities, the development of adaptation strategies, and the mainstreaming of adaptation into national policies and programmes. Agriculture and food security are other adaptation commitments outlined in the updated GH-NDCs. Ghana recognises the vulnerability of its agricultural sector to climate change and commits to implementing adaptation measures to enhance agricultural productivity, improve irrigation systems, promote climate-resilient farming practices, and strengthen early warning systems for farmers.

Additionally, Ghana aims to enhance water resource management and improve access to clean water through the implementation of adaptation measures such as the construction of small-scale water infrastructure, water conservation practices, and the development of drought management plans. Given its extensive coastline, Ghana is committed to implementing measures to address coastal erosion, sea-level rise, and increased storm surges. This includes the development of coastal protection infrastructure, the promotion of sustainable coastal management practices, and the relocation of vulnerable communities.

[4] Actions determined to be implemented solely with nationally mobilised resources
[5] Actions that can only be implemented with external financial (other resources) support

Investment Requirements

The 47 mitigation and adaptation programmes of action from 2020 to 2030 will require between USD 9.3 and USD 15.5 billion, with additional funding for 16 unconditional programmes, 31 unconditional actions and biennial support for activity coordination.

3.4 Assessment of the initiatives for the implementation of GH-NDCs targets

3.4.1 Energy Sector

Key energy sector interventions aim to transition from fossil fuels to cleaner, renewable energy sources, and explore thermal energy for electricity generation from heavy fuel oil to gas and steam. Key interventions implemented are outlined below.

i. Conversion from an open-cycle gas power plant to a combined-cycle power plant

Ghana has adopted a policy of retrofitting existing power plants to be able to use steam for power generation. New plants have also been built with combined cycles that allow for the use of steam instead of only fossil fuels. This process was started in 2 014 and still ongoing. The objective is to increase the installed capacities of the thermal plants, reduce the use of heavy crude oil and reduce GHG emissions. So far, as of 2016, completed projects has increased by 847 MW steam capacity in seven existing thermal power plants. These include:

- A 120 MW plant by Takoradi International Company
- A 110MW generated by Takoradi Thermal 2 (T2) Power Plant
- A 110MW by Tema Thermal 1 Power Station (TT1PS)
- A 110 MW by CENIT
- 110 MW by Kpone Thermal Power
- 247MW by Karpowership
- 40MW Takoradi 3 Thermal plant

The result of these interventions is the reduction in GHG emissions by 700.3 kt/CO2e/year since 2016 to date. This means a total reduction in GHGs emission by 3,501.5 kt/CO2e (EPA, 2021).

ii. Fuel switch from heavy fuel oil to natural gas thermal power plants

Ghana is transitioning from heavy oil to gas for electricity generation in thermal plants, aiming to reduce emissions and power generation costs. Investments of USD13.2 billion have been made in gas infrastructure, including a processing facility in the Tweneboa -

Enyenre-Ntomme (TEN) and Sankofa fields. The country has a natural gas master plan and a capacity to produce 450m standard cubic feet a day (EPA, 2021).

iii. Scaling up deployment of renewable energy

Ghana aims to increase renewable energy use to 10% by 2030 and reduce greenhouse gas emissions. The Renewable Energy Act 1045 has been amended to mandate investment in non-utility renewable energy for fossil fuel suppliers, producers, and companies contributing to greenhouse gas emissions. The VRA has completed two solar power projects in Northern Ghana, and a mini-grid electrification policy has been implemented, involving the installation of 300 MW distributed solar PV systems and building 300 solar mini grids.

Ghana has added 2,751 kW of power capacity from solar PV systems, including 1,109kW for Coca-Cola Bottling Company, 400.4kWp at Kasapreko, and a 45kW micro-hydropower project at Tsatsadu Falls. Additionally, 135,000 solar lanterns have been distributed to rural communities. The country has implemented measures to reduce natural gas flaring, including the establishment of a $1 billion gas processing plant and the adoption of national legislation to limit normal and emergency flaring.

iv. Energy Efficiency Improvements in Homes and Businesses

The Ghanaian government is promoting energy efficiency to reduce energy consumption and GHG emissions. The government has developed standards and regulations for electrical appliances, including refrigerators, light bulbs, and air conditioners. The "light for all initiative" has distributed 12 million LED bulbs to households, schools, and businesses, resulting in carbon savings of 0.96Mt. Additionally, 367,348 LED streetlights have been installed under the Ghana Power Compact programme.

The GIZ Energy Efficiency for Households and SMEs project in Ghana has implemented public sensitisation and education activities, including training military officers in energy efficiency and conservation, recruiting and training 280 Energy Efficiency Advisors and training 16,142 beneficiaries in three cities. Public educational materials and giggles are also produced (EPA, 2021).

Despite government and private sector efforts to promote energy efficiency, there are gaps in public education and adoption of energy-efficient appliances, with lower-income households using home-used appliances and businesses importing non-efficient ones, despite comprehensive nationwide programmes.

v. Promotion of clean cooking solutions

The clean cooking measures aim to increase LPG usage and improve energy-efficient cookstoves for wood fuel users. The programme aims to have 50% of residential, commercial and industrial users adopt LPG by 2030. By 2019, 151,500 households received 151,500 cylinders and 132,800 stoves and accessories. Education on LPG benefits and the harmful impacts of wood fuel stoves was provided. The Cylinder Recirculation programme licenses three companies to build and operate LPG bottle plants.

An evaluation of the programme conducted by Asante et al (2018) in 5 communities showed that 58% of households had never refilled their LPG cylinders nine months after the initial filled cylinder was delivered. Also, only 8% of household were still using t heir LPG cylinders at 18 months after the initial distribution. Households cited cost and distance to LPG filling stations as the main reasons for the non-use of LPG. Additionally, even those household who were using LPG did not do so exclusively, as they still used fuelwood for cooking some meals. The intermittent shortage of LPG nationwide has also contributed to the low adoption of LPG use (Broni-Bediako & Amorin 2018). However, Ghana is aiming to halve biomass cooking population and develop a Clean Cooking Strategy to promote clean energy use. Despite 37% LPG adoption, the country is still far from achieving universal clean energy usage by 2030.

3.4.2 Forest Sector

i. Ghana Forest Plantation Programme

The forest plantation programme aims to develop a sustainable timber resource base, enhance environmental quality, reduce pressure on natural forests, increase forest cover and increase carbon sequestration in the forest sector. Several models have been us ed to promote the interventions including the following:

- Modified Taungya system (MTS)

- Community Forest Management Project (CFMP)
- Government Plantation Development Programme (GPDP)
- Private developers on-reserve
- Forest Services Department Plantation
- Forest investment programme
- Expanded plantation programme
- Forestry Commission/Industry plantations
- Large scale off-reserve plantations

Tree planting interventions face challenges in continuous care, often leading to low survival rates. A tracking system is needed to monitor and care for trees, rather than setting ambitious targets.

ii. Ghana Cocoa Forest REDD+ Programme

Ghana signed the Ghana Cocoa Forest REDD+ programme aimed at significantly reducing carbon emissions resulting from cocoa expansion through forest conversion, by promoting appropriate climate-smart cocoa production approaches, including intensification and yield enhancement. The government, through the Forestry Commission, received an advance payment of $1.3 million out of a $50 million agreement (EPA, 2020) with the World Bank's Forest Carbon Partnership Facility for results -based payments for reducing emissions from deforestation and forest degradation, REDD+. The Cocoa Forest REDD+ programme holds a promise to reduce GHG emissions due to expansion of cocoa farms and the use of unsustainable farming practices in the cocoa sector. However, that promise migh t not be realised due to the lack of sustainability in the funding mechanism being used.

iii. Ghana shea landscape emission reduction project

The project, funded by the Green Environment Fund and Ghana Government, aims to reduce GHG emissions in the Northern Savannah shea landscape. It aims to restore 200,000 hectares of off-reserve savannah forests, manage 100,000 hectares of degraded shea parklands, and establish 25,500 hectares of modified Taungya system/forest plantation in severely degraded forest reserves. An integrated monitoring system is to be implemented, while the Reducing Emissions from Deforestation and forest Degradation

(REDD+) safeguards and forest monitoring and reporting system will be strengthened (EPA, 2021).

3.4.3 Waste Sector

The GH-NDCs outline two interventions in the waste sector to combat climate change. These interventions aim to address the challenges related to waste management and promote sustainable practices.

i. Compost and recycling plants

The District Assemblies and private businesses are working together to mitigate waste in the waste sector. Zoomlion Ghana Limited[6] has established compost facilities, which produce compost fertilisers for agricultural businesses. The Ministry of Sanitation and Water Resources is aiming to install 16 compost and recycling plants, with four completed and others in different stages.

Composting plants effectively manage municipal waste, but more sensitisation and logistical support are needed for easier handling. Recycling is insignificant, and policy initiatives like the Planting for Food and Jobs program have not effectively promoted organic fertiliser use. A rigorous promotion of organic fertiliser use by farmers can stimulate expansion in production and plant establishment.

ii. Public awareness and education

The second waste sector intervention in Ghana aims to raise public awareness and promote education on waste management and climate change. This involves community sensitisation, education, and training. Ghana plans to conduct awareness campaigns and workshops, integrating waste management and climate change topics into education curricula. The goal is to reduce GHG emissions and promote sustainable practices.

3.4.4 Transport Sector

i. Promote better urban transit through Bus Rapid Transit, Fleet Renewal, and Inspections

Ghana's government is promoting mass transit through the Metropolitan Mass Transit project, importing high-occupancy buses to reduce GHG emissions. The Customs Amendment Bill aims to stop older vehicles from entering the country. The Ministry of

[6] A private waste management company in Ghana

Transportation has launched an e-drive initiative to promote electric vehicles, with the Accra City vehicle being developed to seek funding from the Green Climate Fund (EPA, 2021).

3.5 The landscape of NAPs and implementation in Ghana

3.5.1 Adaptation in the Context of National Planning

Ghana has integrated climate change adaptation into its national planning, using strategies and frameworks like the NCCP (2013). The National Action Plan (NAP) process identifies and implements adaptation measures across sectors, conducting vulnerability assessments and formulating strategies. Sector-specific plans like the National Climate-Smart Agriculture and Food Security Action Plan and the National Climate Change Health Promotion Strategy aim to enhance resilience in vulnerable sectors. This approach emphasises the importance of integrating adaptation into national planning for a sustainable future.

3.5.2 Adaptation Planning in the Context of National Climate Policy

Ghana has implemented several national policies focusing on climate change adaptation, starting with the National Climate Change Policy in 2013 and the National Climate Change Adaptation Strategy in 2012. The National Climate Change Policy (NCCP) was launched in 2014 by the National Climate Change Committee and supported by the Ministry of Environment, Science Technology, and Innovations (MESTI) and the Environmental Protection Agency (EPA). The policy aims to create a climate-resilient and climate-compatible economy for Ghana, focusing on effective adaptation, equitable social development, and mitigation. Five priority areas for adaptation actions include agriculture, disaster preparedness, natural resource management, equitable social development, and energy, industrial, and infrastructural development. The policy also emphasizes integrated and intersectoral approaches to adaptation planning and implementation, recognising differentiated vulnerability and inclusion. Additional funding will be needed from private and international sources.

The National Climate Change Adaptation Strategy (NCCAS) was developed before the National Climate Change Plan (NCCP) and was funded by the Danish Ministry of Foreign Affairs. It was jointly implemented by the UNEP and UNDP from 2010 to 2020. The NCCAS

aimed to strengthen Ghana's adaptive capacity and build resilience to climate change impacts.

Implementation of the NCCAS focused on the following Adaptation programme areas:

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

3.5.3 Sub-national level adaptation planning and implementation

The Metropolitan, Municipal and District Assemblies (MMDAs) are leading climate change adaptation planning and implementation at the sub-national level. Local actors, led by environmental committees, collaborate with traditional authorities, NGO's, and civil society to identify priorities, plan, and implement adaptation actions within the NCCAS framework (Daze & Echeverria, 2016).

The NCCAs framework has primarily focused on agricultural adaptation interventions, with community-based programs led by international NGOs like CARE's Adaptation Learning Programme, the Canadian Hunger Foundation's Resilient and Sustainable Livelihoods Transformation in Northern Ghana, and the Climate Change Adaptation in

Northern Ghana Enhanced project. These projects aim to build farmers' capacities to adapt to climate change and strengthen crop value chains.

3.5.4 Current National Adaptation Plans (NAPs)

Ghana's climate change adaptation planning began with vulnerability assessments with the Netherlands Government between 2001-2005 and 2008-2012. The National Climate Change Adaptation Programme (NCAP) identified key sectors and priority areas for adaptation. The National Climate Change Adaptation Strategy (NCCAS) was developed in 2012 to build on the NCAP assessments, outlining the country's vision, goals and principles for climate change adaptation. The NCCAS emphasises stakeholder engagement and collaboration for effective implementation.

In 2014, Ghana formulated the NCCP, a comprehensive framework for climate change action that integrates mitigation and adaptation measures, mainstreaming them into development planning and decision-making processes.

The Green Climate Fund (GCF) NAP Process was developed in 2015 to improve adaptation planning and financing. The process assesses sector-specific vulnerabilities and climate risks, identifies adaptation priorities, and develops investment plans. Ghana recognised the need for a systematic approach and developed a NAP Framework in 2018, emphasising cross-sectoral coordination, financing, monitoring and evaluation (GoV, 2018).

Ghana has started a National Adaptation Planning (NAP) process after the expiration of the National Climate Change Agreements (NCCAs) in 2020. A NAP Readiness Proposal to the Green Climate Fund was submitted in 2017, and Ghana received 2.9 million dollars from the GCF to implement the project within 36 months. The National Adaptation Planning Framework was developed in 2018 to guide the process. The NAP process builds upon the commitments and agreements outlined in the Cancun Adaptation Framework and aligns with the requirements of Article 7 of the Paris Agreement. The government has proposed a more sector-based and district-focused approach to adaptation planning and mainstreaming. The Environmental Protection Agency (EPA) will coordinate the development of the NAP, while the National Development Planning

Commission (NDPC) will coordinate district-level planning and mainstreaming of adaptation programs. The new approach emphasises gender-responsiveness, community-based and ecosystem-based adaptation, private sector engagement, and vertical and horizontal integration at all levels of adaptation planning.

Ghana's adaptation planning process began with vulnerability assessments under NCAP initiatives, collaborating with the Netherlands Government. The NCCAS and NCCP provided strategic direction and policy frameworks. The NAP Framework enhanced the approach, leading to the GCF NAP process to mobilise financial resources for implementation. This aims to build resilience and address climate change impacts.

4. Status of the Measurement, Reporting and Verification (MRV) System in Ghana

The Measurement, Reporting and Verification (MRV) system is a comprehensive framework that outlines countries' measures to collect data on GHG emissions, mitigation actions, sustainable development impacts, and financial support, ensuring transparency, accuracy and international benchmarking through three interconnected processes.

The Bali Action Plan (BAP) of 2007 established a global framework for MRV, focusing on improved climate reporting. It mandated developing countries to submit national communications and biennial update reports every four years, followed by international consultation and analysis. The plan also encouraged national governments to establish domestic MRV systems. Ghana is required to develop and publish national communications.

Ghana adopted the Climate Ambitious Reporting Programme (G-CARP) in 2013 to meet Article 13 of the Paris Agreement and the Bali Action Plans call for domestic monitoring reporting. The programme aimed to establish a climate data management system for national and international reports on GHGs, climate action programs, financial and technical support, and Nationally Determined Contributions.

The Ghanaian GCARP system, which is well-suited for the country, is not achieving the same level of progress in its implementation. Reforms have been made to improve the GHG component, which consists of four interconnected components: institutions, data

handling, methods, tools and protocols, and skills development. Government institutions upload data on mitigation activities using a common MRV template, which is then transmitted to the EPA for analysis. The modified Greenhouse Gas Abatement Cost Model (GACMO) is used for calculating GHG emission reductions and implementation costs.

In 2019, a national assessment was conducted to improve the functionality and data integration of Ghana's National Resource Reporting (MRV) system. The report evaluated the system's operation, identified gaps and recommended reforms. The reforms, which took place from 2015 to 2020, aimed to integrate the MRV with Annual Progress Reporting. The institutional arrangement was changed from ad hoc to decentralised, with ministries given primary responsibility for compiling sector GHG inventories. The Environmental Protection Agency, Energy Commission, Ministry of Transport, and Volta River Authority are involved in this process. A GHG data gathering template was also developed for data management. A climate change hub has also been established (http://climatedatahubgh.com/gh/) to enhance data archiving and increase access to the public since 2015 (MESTI, 2019).

Ghana has made significant progress in its reporting obligations due to the operationalisation of the MRV system. In 2017, the technical assessment of REDD+ forest reference level was completed. With support from Green Environment Facility, Ghana submitted its National Communication to the UNFCCC, completed the first, second, and third biennial update reports, and successfully completed the international consultation and analysis process.

Key achievements of the operationalisation of the GCARP, Ghana's MRV are as follows:

- Ministry of Finance uses a climate finance tracking tool to monitor climate financing from Ministries, Local Government Authorities, Private sector, and CSOs.
- EPA has established an online climate data-hub for Ghana's climate reporting.
- EPA developed an automated standard mitigation template, GHG inventory manual, and QA/QC and Uncertainty Management.
- Climate change indicators are incorporated into environmental reporting of industrial facilities.
- EPA established a national forest monitoring system for improved REDD+ reporting.

- Volta River Authority introduced a voluntary carbon accounting programme.

Despite the advancements made in the MRV system, there are still some gaps and weaknesses, such as:

- Inability to aggregate cumulative effects of individual mitigation programmes.
- Low technical capacity for tracking NDC progress.
- Weak institutional capacity for capturing GHG impacts at national and local levels.

4.1 Progress in the implementation of GH-NDCs and NAPS

Ghana has made significant progress in implementing its NDCs and NAPS, with key progress indicators being achieved.

- Well-defined adaptation programmes in NDCs are enhancing resilience of vulnerable populations.
- $54.5 million from GCF provided to Northern Ghana communities for climate change adaptation.
- Significant progress in reducing GHG emissions in the energy sector through investments in cleaner energy sources.
- Successful start of National Adaptation Planning process post-2010-2020 NAP expiration.
- Regular submission of National Communications and National Inventory Reports to UNFCCC.

4.2 Gaps in the Implementation of GH-NDCs and NAPs

Ghana's progress in climate action is commendable, but there are gaps and shortcomings in the implementation of its GH-NDCs and NAPs that need attention.

- Ghana's adaptation planning has made progress, but limited financing has not covered all planned programmes of action. The Nationally Determined Contribution requires between $9.3 and $15.5 billion for mitigation and adaptation from 2020 to 2030. The funding for these programs is about twenty times lower than for mitigation. Local level adaptation interventions are also lacking, presenting a gap for the implementation of the NDCs and adaptation programs. About half of planned Climate Change Adaptation Programs were not implemented, and over 70% were not completely successful due to limited financing.

- Climate change decisions and planning are currently top-down, with limited resources for sub-national level planning. Local actors, such as farmers, households, and resource managers, make key decisions about land use and resource allocation. To ensure successful adaptation interventions, Ghana's National Adaptation Planning process must include local participation and increase funds flow to district and regional authorities. This bottom-up approach will help address vulnerabilities, coping strategies, and adaptive capacities.
- Furthermore, the Ghana government's efforts in afforestation and reforestation have led to significant tree planting, but a weak monitoring regime has hindered the expected mitigation and adaptation impacts. The lack of a comprehensive mechanism for tracking seedlings and tracking individuals who picked up seedlings results in unreliable tree survival rates. This weak monitoring also leaves local adaptation initiatives, including autonomous adaptation by local communities, unaccounted for in Ghana's adaptation report.
- Additionally, the understanding of climate adaptation mechanisms' differential impacts on gender and geographical locations is limited. The 4th Communication lacks gender and health activities, suggesting more efforts to address gendered impacts, such as addressing women's pragmatic needs during planning and implementation.
- The GCARP, despite significant improvements in the Measurement, Reporting, and Verification System, struggles to accurately account for the impacts of various mitigation measures reported separately.

References

Adjei, V., Amaning, E. F., & Adjokatse , I. T. (2022). The Evil Couple: Illegal Mining in Water Bodies and Climate Change: A Case Study of Ghana. *Journal of Atmospheric Science Research*, *5*(3), 37-51.

Asante, F. A., & Amuakwa-Mensah, F. (2014). Climate change and variability in Ghana: Stocktaking. *Climate*, *3*(1), 78-101.

Asante, Kwaku & Afari-Asiedu, Samuel & Abdulai, Martha & Dalaba, Maxwell & Carrión, Daniel & Dickinson, Katherine & Abeka, Ali & Sarpong, Kwesi & Jack, Darby. (2018). Ghana's Rural Liquefied Petroleum Gas Program Scale Up: A case study. Energy for Sustainable Development. 46. 10.1016/j.esd.2018.06.010. Background Report.

Broni-Bediako & Amorin (2018). The Ghana Liquefied Petroleum Gas Promotion Programme: Opportunities, Challenges and the Way Forward. Innovative Energy & Research. 07.10.4172/2576-1463.1000197.

Climate Risk Profile: Ghana (2021): The World Bank Group. Climate-data-historical.

Dazé, A. and Echeverría, D. 2016. Review of current and planned adaptation action in Ghana. CARIAA Working Paper no. 9. International Development Research Centre, Ottawa, Canada and UK Aid, London, United Kingdom. Available online at: www.idrc.ca/cariaa.

Ebinger, J. O. (2011). *Climate impacts on energy systems: key issues for energy sector adaptation*. World Bank Publications.

Environmental Protection Agency (EPA). (2011). Ghana's second national communication to the United Nations framework convention on climate change (UNFCCC). https://unfccc.int/resource/docs/natc/ghanc2.pdf.

Environmental Protection Agency (EPA). (2020). Ghana's Fourth National Communication to the United Nations Framework Convention on Climate Change. https://unfccc.int/sites/default/files/resource/Gh_NC4.pdf.

Environmental Protection Agency (EPA). (2018). Ghana's National Adaptation Plan Framework. https://faolex.fao.org/docs/pdf/gha189992.pdf.

Environmental Protection Agency (EPA). (2019). Ghana's Fourth National Greenhouse Gas Inventory Report; UNFCCC: Bonn, Germany, 2019; pp. 1–318.

IPCC (2014). Summary for policymakers. In Climate Change 2014, Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change; IPCC: Geneva, Switzerland, 2014.

IPCC, A. (2014). IPCC Fifth Assessment Report—Synthesis Report.

Lansbury Hall, N., & Crosby, L. (2022). Climate change impacts on health in remote indigenous communities in Australia. *International Journal of Environmental Health Research*, *32*(3), 487-502.

MESTI (2012). Ghana National Climate Change Policy. https://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/laws/1259.pdf.

MESTI (2021). Republic of Ghana: Ghana's Third Biennial Update Report to United Nations Climate Change. Accessed 10/10/2022. https://unfccc.int/sites/default/files/resource/gh_BUR3_1282021_submission.pdf.

MESTI (2021). Updated Nationally Determined Contribution under the Paris Agreement (2020–2030); Environmental Protection Agency, Ministry of Environment, Science, Technology and Innovation: Accra, Ghana, UNFCCC; 2021; pp. 1 –27.

MESTI. (2015). Ghana National Climate Change Master Plan Action Programmes for Implementation: 2015–2020. https://www.weadapt.org/sites/weadapt.org/files/ghana_national_climate_change_master_plan_2015_2020.pdf.

MESTI. (2019). National Measurement, Reporting and Verification (MRV) System Assessment Report. https://www.ndcs.undp.org/content/ndc-support programme/en/home/impact-and-learning/library/ghana--national measurement--reporting-and-verification--mrv--sy.html.

MESTI. (2021). Ghana: Updated Nationally Determined Contribution under the Paris *national climate change policy*. Ministry of Environment, Science, Technology and Innovation.

National Development Planning Commission (2014). Medium-term national development nationally determined contributions and the sustainable development goals for West Africa, Climate Policy, 18:10, 1296-1312, DOI: 10.1080/14693062.2018.1431199 policy framework: Ghana shared growth and development agenda (GSGDA) II, 2014-2017.

Republic of Ghana. (2015). Ghana's Intended Nationally Determined Contribution (INDC) and Accompanying Explanatory Note. Science, Technology and Innovation, Accra.

UNDP (2010). National Climate Change Adaptation Strategy. https://www.adaptation undp.org/sites/default/files/downloads/ghana_national_climate_change_adaptation_strategy_nccas.pdf.

United Nations (UN). (2019). Climate change and water: UN-water policy brief. *Geneva: UN Water*.

USAID (2017). Climate Change Risk Profile – Ghana. URL: https://www.climatelinks.org/sites/default/files/asset/document/.

WBG Climate Change Knowledge Portal (CCKP, 2022). Ghana. URL: https://climateknowledgeportal.worldbank.org/country/ghana.

World Bank Open Data, Data Retrieved October 2022. Data Bank: Population Estimates and Projections, Ghana. URL: https://databank.worldbank.org/data/reports.aspx?source=health nutrition-and population-statistics:-population-estimates-and-projections.

World Bank Open Data, Data Retrieved October 2022. Data Bank: World Development Indicators, Ghana. URL: https://databank.worldbank.org/data/reports.aspx?source=2&country worldbank.org/handle/10986/33726 License: CC BY 3.0 IGO.

Africa Network of Agricultural Policy Research Institutes (ANAPRI) is a collaborative network comprising research institutions across Africa dedicated to advancing evidence-based agricultural and food systems policy. With centers spanning 15 countries and totalling 16 in number, ANAPRI conducts rigorous research and analysis to tackle critical challenges in agricultural development, including market dynamics, trade policies, and sustainable practices. By promoting knowledge exchange and collaboration among its members, ANAPRI generates valuable insights to guide policy decisions at national, regional, and continental levels.

Our centres

ACED · ISSER · MwAPATA INSTITUTE · UNIVERSIDADE EDUARDO MONDLANE · ATPI AGRICULTURAL TRADE POLICY INSTITUTE · PILAF · EPRN · ISRA 50 · BFAP DATA DRIVEN INSIGHT · IAPRI · UNIVERSITY OF ZIMBABWE

Contact us

info@renapri.org · *www.renapri.org* · *ANAPRI_info*

Africa Network of Agricultural Policy Research Institutes