Adapting Together, Thriving Tomorrow

# Ghana National Adaptation Plan 2025

UN environment programme

GREEN CLIMATE FUND

**Contacts Information**

No. 91 Starlet Street, Opp
Telephone: 050 6694760 /
050 6699466

P.O. Box M.326

info@epa.gov.gh

www.epa.gov.gh

**Document Information**

Title: Ghana National Adaptation Plan – 2025

Prepared for: Government of Ghana with support from GCF and UNEP

Document Citation: EPA, [2025], [Ghana National Adaptation Plan]. Prepared through the NAP Readiness Process with technical support from UNEP and funding from GCF.

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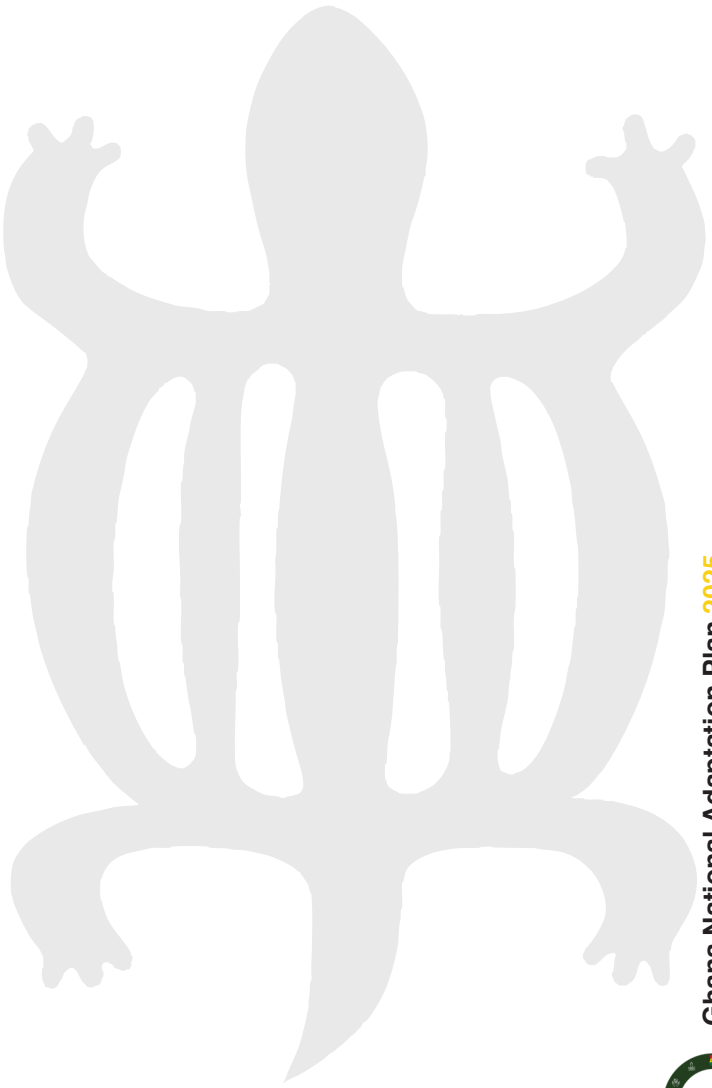
# ACRONYMS/ ABBREVIATION

| | |
|---|---|
| **AfDB** | African Development Bank |
| **CCKP** | Climate Change Knowledge Portal |
| **CCV** | Climate Change Vulnerability |
| **CLIMFINTRACK** | Climate Finance Tracking |
| **COP** | Conference of the Parties |
| **CSA** | Climate-Smart Agriculture |
| **CSPGs** | Cross-sectoral Policy Groups |
| **CWG** | Cross-sectoral Working Group |
| **DANIDA** | Danish International Development Agency |
| **DRM** | Disaster Risk Management |
| **DRR** | Disaster Risk Reduction |
| **ECOWAS** | Economic Community of West African States |
| **EPA** | Environmental Protection Authority |
| **GCF** | Green Climate Fund |
| **GDP** | Gross Domestic Product |
| **GEF** | Global Environment Facility |
| **GFIM** | Ghana Fixed Income Market |
| **GHG** | Greenhouse Gas |
| **GIPC** | Ghana Investment Promotion Centre |
| **GNAP** | Ghana's National Adaptation Plan |
| **GoG** | Government of Ghana |
| **GSGDA II** | Ghana Shared Growth and Development Agenda (Second) |
| **GSIF** | Ghana Strategic Investment Framework |
| **HiAP** | Health in All Policies |
| **IFRC** | International Federation of Red Cross and Red Crescent Societies |
| **INDC** | Intended Nationally Determined Contribution |
| **IPCC** | Intergovernmental Panel on Climate Change |
| **KASA** | KASA Initiative Ghana (a Natural Resource and Environment Civil Society Platform) |
| **LCDS** | Low-carbon development strategies |

| | |
|---|---|
| **LUCF** | Land Use Change and Forestry |
| **M&R** | Monitoring and Reporting |
| **MDAs** | Ministries, Departments and Agencies |
| **MEL** | Monitoring, Evaluation and Learning |
| **MERL** | Monitoring, Evaluation, Reporting and Learning |
| **MEST** | Ministry of Environment, Science and Technology |
| **MMDAs** | Metropolitan, Municipal and District Assemblies |
| **MoF** | Ministry of Finance |
| **MoFA** | Ministry of Food and Agriculture |
| **MoGCSP** | Ministry of Gender, Children and Social Protection |
| **MTDP** | Medium-Term Development Plan |
| **MTNDPF** | Medium-Term National Development Policy Framework |
| **NADMO** | National Disaster Management Organisation |
| **NAMAs** | Nationally Appropriate Mitigation Actions |
| **NAP** | National Adaptation Plan |
| **NAPF** | NAP Framework |
| **NbS** | Nature-based Solutions |
| **NCCAS** | National Climate Change Adaptation Strategy |
| **NCCC** | National Climate Change Committee |
| **NCCP** | National Climate Change Policy |
| **NCCPF** | National Climate Change Policy Framework |
| **NDCs** | Nationally Determined Contributions |
| **NDPC** | National Development Planning Commission |
| **NGO** | Non-Governmental Organization |
| **NIC** | National Insurance Commission |
| **NRE** | Natural Resources and Environmental |
| **NRS** | National REDD+ Secretariat |
| **PPP** | Public – Private Partnership |
| **RFJ** | Rearing for Food and Jobs |
| **SDGs** | Sustainable Development Goals |

| | |
|---|---|
| **SLM** | Sustainable Land Management |
| **SLWM** | Sustainable Land and Water Management |
| **SYND** | Strategic Youth Network for Development |
| **UNDP** | United Nations Development Programme |
| **UNEP** | United Nations Environment Programme |
| **UNFCCC** | United Nations Framework Convention on Climate Change |
| **USAID** | United States Agency for International Development |
| **WB** | World Bank |
| **WMMA** | West Mamprusi Municipal Assembly |
| **WRC** | Water Resource Commission |



The socio-economic development of Ghana is greatly threatened by its high vulnerability to impacts of climate change as reflected in increasing temperatures across the various ecological zones where rainfall patterns are also becoming less predictable and thus exacerbates poverty amongst the poor and the vulnerable people, particularly women and children. We have also witnessed an increased number of floods in recent years that threaten the lives and livelihoods of a great number of our people. In addition, the northern and coastal savannah areas often experience severe drought due to high temperatures and decreasing annual rainfall. This explains why environmental sustainability, poverty reduction and equitable social development remain the cardinal priorities of Ghana's successive development goals since 2008.

Recognizing the implications of climate change for its national development and in response to international commitments, the Government of Ghana has taken various actions to support climate change adaptation planning, with several climate change-related policies and strategies that have provided the base for the Ghana National Adaptation Plan.

I am honoured to present this National Adaptation Plan (NAP) as a reflection of our steadfast commitment to safeguarding our economy and from the adverse impacts of climate change for the present and future generations. The NAP is Ghana's first National plan on adaptation, consolidating the country's vision for climate resilience. It aligns macro-level adaptation actions with sectoral and district-level vulnerabilities to enhance long-term resilient and adaptive capacity. Furthermore, the Plan seeks to integrate climate change adaptation coherently into relevant policies, programmes and activities in development planning processes, across all sectors and subnational levels.

The Environmental Protection Act, 2025 (Act 1124), which repeals the previous EPA Act of 1994 (Act 490) further strengthens the legal framework for environmental protection in Ghana. It reaffirms that environmental stewardship including climate change adaptation and mitigation is not merely an option, but a national duty.

**Suweibatu Adam (Esq)**

**Chief Director, Ministry of Environment, Science and Technology**

Climate change presents one of the most pressing challenges confronting humanity today, posing far-reaching risks to the environment, human health, food systems and economic development. Ghana is no exception. Over the past decades, the nation has experienced rising temperatures, variable rainfall patterns, floods, droughts and coastal erosion phenomena that threaten livelihoods, natural ecosystems and national development gains.

Recognizing the urgent need for a structured, evidence-based and long-term approach to adaptation, the Government of Ghana, through the Environmental Protection Authority (EPA) and under the Ministry of Environment, Science and Technology (MEST), initiated the formulation of the National Adaptation Plan (NAP) with financial support from the Green Climate Fund (GCF) and technical assistance from the United Nations Environment Programme (UNEP).

The NAP serves as Ghana's comprehensive national framework for identifying, prioritizing and implementing medium- to long-term climate adaptation actions across key sectors and governance levels. It seeks to integrate climate change adaptation into national, sectoral and subnational planning and budgeting processes, thereby enhancing the resilience of ecosystems, communities and the economy.

Ghana's NAP is firmly anchored in the United Nations Framework Convention on Climate Change (UNFCCC) process and responds directly to the guidelines and objectives established under the Cancun Adaptation Framework (2010) and the Paris Agreement (2015). In alignment with Article 7 of the Paris Agreement, which calls for enhanced adaptive capacity, strengthened resilience and reduced vulnerability to climate change, the NAP contributes to the Global Goal on Adaptation (GGA) and supports the integration of adaptation within national planning systems in a transparent, inclusive and gender-responsive manner. The NAP also serves as a key vehicle for implementing the adaptation components of Ghana's Nationally Determined Contributions (NDCs) and advancing the country's broader commitments under the Paris Agreement and the Sustainable Development Goals (SDGs).

Furthermore, the formulation of Ghana's NAP has been guided by the Least Developed Countries Expert Group (LEG) guidelines under the UNFCCC. Consistent with these guiding principles, the process has been country-driven, participatory, gender-sensitive, iterative and based on the best available science. It has built on existing institutional frameworks and development priorities, ensuring alignment with national systems and avoiding duplication of effort. The NAP also upholds the principles of integration, coherence, transparency and capacity enhancement, as prescribed by the LEG, to ensure that adaptation planning contributes effectively to sustainable and resilient development.

The preparation of this NAP went through extensive consultation, analytical thoroughness and inclusive participation. It brought together stakeholders from across government institutions, academia, civil society, the private sector and local communities. The process has produced critical technical outputs, including national and sectoral vulnerability assessments, downscaled climate projections, adaptation action plans and a Monitoring and Evaluation Framework. Additionally, a Climate Vulnerability Information Portal has been developed to facilitate data access and evidence-based decision-making at all levels.

Since its inception in 2019, the NAP process has benefited from continuous engagement with Ghana's Eighth Parliament, whose leadership and oversight have provided valuable

policy direction and accountability. This collaboration continues under the Ninth Parliament, reinforcing the vital role of legislative engagement in advancing national climate resilience.

The NAP embodies Ghana's enduring commitment to a coherent, inclusive and sustainable approach to adaptation. It reaffirms the nation's resolve to safeguard its people, ecosystems and economy from the impacts of climate change while advancing the objectives of the UNFCCC, the Paris Agreement and the LEG's global vision for adaptation planning.

On behalf of the Government of Ghana, I extend deep appreciation to all partners, institutions and stakeholders whose technical expertise, collaboration and dedication have made this national framework possible. The Environmental Protection Authority remains steadfast in its commitment to ensuring that the NAP is effectively implemented, regularly updated and fully integrated into national and subnational development planning.

It is my sincere hope that this document will serve as a strategic guide for policymakers, practitioners and development partners as we collectively advance Ghana's transition toward a climate-resilient, inclusive and sustainable future.

**Prof. Nana Ama Browne Klutse**

**CEO, Environmental Protection Authority, Ghana**

# ACKNOWLEDGEMENTS

The development of Ghana's National Adaptation Plan represents a landmark achievement in the country's pursuit of climate resilience and sustainable development. This process has been the result of extensive collaboration, technical excellence, and sustained commitment by a broad range of national and international partners, institutions, and individuals.

The Government of Ghana, through the Environmental Protection Authority and under the auspices of the Ministry of Environment, Science and Technology, extends its profound appreciation to all stakeholders whose invaluable contributions have made the preparation of Ghana's NAP possible.

Special recognition is accorded to the members of the Cross-Sectoral Policy Groups (CSPGs) for their unwavering dedication and technical guidance throughout the development of the sectoral vulnerability assessments and adaptation plans. The EPA also acknowledges the continued support and engagement of Ministries, Departments and Agencies (MDAs), the Metropolitan, Municipal and District Assemblies (MMDAs), development partners (DPs), academia, the private sector, and the varied levels of civil society organizations. All these partners have played diverse roles in shaping the content and direction of the plan and its associated documents.

The Authority expresses deep gratitude to the Green Climate Fund for the financial support provided, and to the United Nations Environment Programme for serving as the delivery partner. Special mention is made of Ms. Jessica Troni and Mr. Essey Daniel, the Task Manager, whose technical direction and consistent support have been instrumental in guiding this process. The EPA further acknowledges the exceptional leadership of Ms. Julie Greenwalt, the Chief Technical Advisor (CTA), for her outstanding contribution to the technical rigor and quality of the NAP.

Sincere appreciation is also extended to the National Adaptation Plan Steering Committee for its oversight and strategic guidance, and to the various consultants who undertook specific studies and produced key outputs under the NAP Readiness Project.

The EPA acknowledges with gratitude the collaborative support received from partner organizations, including UNDP, WaterAid Ghana, SYND, SIGRA, YEFL, IOM, the International Institute for Sustainable Development (IISD), and the Global Center on Adaptation, for their complementary initiatives and technical inputs that enriched the NAP process. The Authority equally recognizes the contributions of the Ghana Health Service, the local assemblies, and other sectoral agencies whose engagement has strengthened the inclusiveness and applicability of the NAP.

The EPA is extremely indebted to Foresight Planners and Research Africa Limited, who have been the central technical body for all the Climate Risks and Vulnerability Assessments as well as the Sector and District Adaptation Plans presented in this document. The team comprises of Dr. Bob Manteaw (Lead Consultant), Prof. Philip Antwi-Agyei, Dr. Yaw Agyeman Boafo, Dr. Portia Adade-Williams and Dr. Kofi Asare. Our gratitude also goes to Rev. Ing. Prof. Eric Ofosu Antwi and his team for leading the Economic Analysis of Adaptation Options work. And to all other Consultants who contributed to the technical work, we say, thank you.

We wish to extend our thanks to the Institute for Research and Policy Alternatives (IRPA) team for their hard work, collaborative approach and overall efforts to deliver this comprehensive plan.

The Authority expresses special appreciation to the management and staff of the Environmental Protection Authority, whose institutional leadership and technical contributions have been vital to the successful completion of this process. Special recognition is given to the Chief Executive Officer, Professor Nana Ama Browne Klutse, for her visionary leadership, Ing. Esi Nerquaye Tetteh, Mr. Felix Addo-Okyireh and to Dr. Daniel Tutu Benefoh for their strategic coordination and technical oversight.

The efforts of the NAP Project Management Unit (PMU) led by Nana Dr. Antwi-Boasiako Amoah and ably supported by Ms. Stella Okoh, Mr. Isaac Kwabena Danso, Dr. Sandra Kesse-Amankwa, Mr. Richmond Aidoo, Mr. Samuel Otoo, Ms. Marilyn Christian, Ms. Esther Mireku, Mr. Samson Botwey and Ms. MaryJane Enchill are deeply appreciated. Their diligence, professionalism, and commitment have been the driving force behind the successful coordination of the NAP process.

To all institutions and individuals who have, in various ways, contributed to this national effort, the Environmental Protection Authority conveys its deepest appreciation. This document stands as a collective accomplishment towards securing Ghana's sustainable and climate-resilient future.

**Mrs. Esi Nerquaye Tetteh**

**Deputy CEO, Technical Services**

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**Ghana is increasingly vulnerable to the adverse impacts of climate change, with rising temperatures, erratic rainfall, prolonged droughts, floods, and sea-level rise posing serious threats to its people, economy, and environment. These climatic changes have profound implications for the country's development trajectory, affecting key sectors such as agriculture, water resources, health, infrastructure, and biodiversity.**

In response, the Government of Ghana has developed the National Adaptation Plan (NAP) 2025, a strategic framework aimed at integrating climate change adaptation into national, sectoral, and sub-national development planning. The goal of the NAP is to reduce the country's vulnerability to the adverse impacts of climate change by building adaptive capacity and resilience; and facilitate the integration of climate change adaptation into Ghana's medium term and long-term development pathway supported by well-coordinated and effective institutions and governance structures, finance for implementation, capacity development, coherent policies and legislation at national, regional and district levels and well-integrated at different sectors and ecosystems. A similar framework is also established at sub-national levels.

Ghana's National Adaptation Plan (GNAP) is anchored on strategies, policy and legislative frameworks and finances. It advances the country's ongoing efforts to address climate change within a sustainable gender-responsive development context. The GNAP is aligned with key national policy documents, including, the National Climate Change Policy (NCCP), the Low Carbon Development Strategy (2016), the Environmental Protection Act, the National Determined Contributions (NDCs), sectoral climate resilient strategies, and regional and district /metropolitan Assembly plans. Together, these frameworks support the effective implementation of the GNAP.

The GNAP is developed in line with the United Nations Framework Convention on Climate Change (UNFCCC) standards and guidance, which call for a country-driven, gender-responsive, participatory and transparent approach to climate adaptation planning. The NAP is designed to strengthen Ghana's resilience to climate change by integrating adaptation into national development policies, sectoral strategies and sub-national planning frameworks, consistent with the objectives of the Cancun Adaptation Framework. Specific attention is paid to vulnerable groups and ecosystems and integration of traditional and indigenous knowledge. It also supports Ghana's commitments under the Paris Agreement, particularly Article 7 on adaptation, by providing structured means to enhance adaptive capacity, reduce vulnerability and mainstream climate resilience across all sectors. Flexibility and responsiveness to evolving national needs remain central to the GNAP which is why an accompanying sustainability strategy has been developed to strengthen its implementation.

The plan is anchored on six enabling factors for the successful integration of climate change adaptation particularly in a gender-responsive manner into Ghana's development agenda.

The six enabling factors are:

a). strong institutional planning and governance structures

b). comprehensive capacity development

c). meaningful stakeholder engagement

d). integration of adaptation priorities into national and sub-national budgets

e). mobilization of international and domestic finance for implementation

f). effective information sharing and knowledge management.

The NAP process was informed by detailed climate hazard, risk, and vulnerability analyses involving 26 Metropolitan, Municipal and District Assemblies (MMDAs), carefully selected to provide basic representation of the six agro-ecological zones. These analyses identify priority areas within the MMDAs across the ecological zones most at risk, enabling targeted adaptation actions. Sector-specific plans have been developed to address the unique climate challenges and opportunities in agriculture and food security, water resources, health, infrastructure, and biodiversity.

In the agriculture sector, adaptation measures include promoting climate-resilient crop varieties, strengthening irrigation systems, and enhancing pest management. For water resources, the plan emphasizes sustainable watershed management and improved water storage and monitoring infrastructure. The health sector focuses on building resilient healthcare systems, developing early warning mechanisms, and enhancing community health awareness. In the area of infrastructure, adaptation actions aim to climate-proof critical assets, improve drainage systems, and promote climate-resilient urban planning. To protect biodiversity and ecosystems, Ghana will invest in forest restoration, wetland protection, and sustainable marine and aquatic resource management.

In addition, a youth engagement strategy that positions the youth as active contributors to climate action was developed. It identifies the youth as agents of change, strengthens inclusivity, seeks to build their capacity and enhance their participation in decision-making. The strategic areas of engagement include; policy and governance, skills development and innovation, climate-smart agriculture and food security, and ecosystem restoration. To ensure the mainstreaming of gender into the entire NAP Process, a gender strategy was developed by the EPA, with support from the NAP Global Network's Country Support Hub to advance key gender issues that must be considered for Ghana's NAP Process.

The successful implementation of the NAP depends on strong institutional coordination and capacity, inclusive stakeholder engagement, and adequate financing. A robust monitoring, evaluation, and learning (MEL) system has been developed to ensure progress tracking, learning, and adaptive management. Capacity building, knowledge sharing, and integration of gender and equity considerations are also central to the plan's long-term sustainability.

Ghana's National Adaptation Plan presents a transformative vision for a climate-resilient and climate-compatible economy, ensuring that climate adaptation becomes a core component of development planning. Through this plan, Ghana reaffirms its commitment to safeguarding its people, economy, and ecosystems from climate-related risks while pursuing inclusive and sustainable growth for future generations.

# 1

# Introduction

## 1.1 National Circumstances and Context

Ghana is a vibrant and dynamic country with rich natural resources, diverse ecosystems and a resilient population that continuous to drive sustainable growth and development. Its strategic location along the Gulf of Guinea offers benefits such as fertile agricultural land, abundant water resources and an expanding energy and infrastructure base. Ghana's governance framework and development agenda provide a solid foundation for addressing emerging challenges, including those posed by climate change. Building on its progress in economic transformation and social development, Ghana is well positioned to integrate climate adaptation into its national priorities and ensure a climate-resilient future for all its people.

Ghana's climate is changing and the effects are already being felt. Increasing temperatures, changing rainfall patterns, stronger and less predictable storms will all present a serious challenge to the people, communities from small-scale farmers to business owners, from industry to central and local governments and the economy of Ghana (NCCPF, 2018). The adverse effects of climate change and variability on the climate sensitive sectors of Ghana's economy threaten the country's continued development progress and its attainment of the Sustainable Development Goals. There is therefore a pressing need for Ghanaian society and businesses to adapt to the adverse impacts of a changing climate.

Climate change response depends on the country's national circumstances which inform and influence its mitigation and adaptation policies. This section highlights Ghana's geographical profile, demography and socio-economic status.

## 1.1.1 Geography

**Ghana** is situated on the west coast of Africa, bordered by Togo to the east, Côte d'Ivoire to the west, Burkina Faso to the north and the Atlantic Ocean to the south. It covers a total land area of 238,535 square kilometres and situated close to the equator. The country is within the tropical savannah climate zone and is divided into six agro-ecological zones. Agricultural land as a share of land area of Ghana increased from 51.4 % in 1969 to 65 % in 2018 growing at an average annual rate of 0.48%. Another important land cover change in Ghana is the increased change in arable land from 7.5 % in 1969 to 20.7 % in 2018, growing at an average annual rate of 2.15%9. Forest area as a share of land area of Ghana fell gradually from 38.5 % in 2001 to 35.1 % in 2020 (Government of Ghana, 2021).

**Agricultural Land Increased to**

**65%**

**in 2018**

**Forest Area fell gradually from 38.5% in 2001 to 35.1% in 2020**

## 1.1.2 Demography

As of 2021, the population was estimated at 30.8 million, with women outnumbering men at 15.6 million (50.7%) and 15.2 million (49.3%) respectively, children (0-14 years) comprising 35%, youth (15-35 years) at 38%, and approximately 4% representing individuals aged 65 and above (GSS, 2021; Atiglo, 2023). By 2024, the population had grown to 34.4 million (World Bank, 2024). The working age population is projected to account for 60.8% of the total population in 2025. Ghana maintains a youthful demographic profile, with roughly 57% of citizens under the age of 25. This supports the value of including youth in climate change adaptation planning under the NAP's youth engagement strategy. Additionally, more than half of the population (54.4%) resides in urban areas (Ghana Disaster Risk Profile, 2019). Due to the limited economic opportunity and climate change vulnerability of the Sudan Savannah and Guinea Savannah, many people turn to migrate to southern Ghana, especially Accra to find better opportunities (Ghana Fourth National Communication (NC4) to the UNFCCC, 2020).

**Ghana's population in 2024 was**

**34.4 million**

**57% of its citizens are under the age of 25 years.**

### 1.1.3 Economy

In 2019, Ghana was ranked among the world's ten fastest growing economies, experiencing growth from 6.3% to 7.1% (African Development Bank, 2020). The economy continued its expansion in 2019, driven by the mining, petroleum, agriculture, and forestry sectors, with the first quarter Gross Domestic Product (GDP) growth estimated at 6.7%, up from 5.4% during the same period the previous year (GoG 2021; World Bank, 2020). Medium-term projections remain positive, anticipating growth of around 5% by 2026 (EuroCham Ghana, 2025). However, despite rapid economic expansion, the ongoing threat of climate change poses significant risks to sustained development gains.

The unemployment rate stood at 13.1% in the fourth quarter of 2024 (GSS, 2025). While this represents a slight decline from 13.3% in the previous quarter, youth unemployment remains alarmingly high at 22.5% for ages 15 to 35 and 32% for ages 15 to 24. The percentage of Ghanaians living below the international poverty line declined from 13.6 % to 11.9% in 2017, a trend reflected in both urban and rural areas. Nevertheless, a higher proportion of males (13.6%) live below the international poverty line compared to 7.6% of females (EPA, 2022).

**Ghana is ranked the worlds ten fastest growing economies**

## 1.2 Background

Ghana recognizes the socioeconomic impacts and development challenges arising from climate change, and as such, has resolved to mainstream climate change into the country's development agenda and its key planning processes at the national and local levels. The National Climate Change Policy (NCCP, 2013) was designed to provide strategic direction and coordination on climate change issues in Ghana, including climate adaptation by clearly defining the pathways for dealing with the challenges of climate change and identifies the opportunities and benefits associated with the shift to a green economy. The NCCP is the country's integrated response to climate change, and its underlying vision is "to ensure a climate-resilient and climate-compatible economy while achieving sustainable development through equitable low-carbon economic growth for Ghana" (MESTI, 2013).

The three objectives of the NCCP are:

i. Effective adaptation

ii. Equitable social development

iii. Mitigation

The government of Ghana has implemented multiple adaptation initiatives and successfully increased resilience in key sectors. Efforts include operationalizing national and sectoral

strategies for climate resilience and strengthening institutions to integrate adaptation into their plans and budgets (NCCP, 2013; NCCMP 2016-2026; NCCS, 2012). These are in line with global and international commitments and declarations such as the 15th African Ministerial Conference on the Environment (AMCEN), United Nations Framework Convention on climate change (UNFCCC), Paris Agreement of December 2015, that have called out the need for a global goal for adaptation that takes into account adaptation needs and associated costs while, including support for Africa and other developing countries to increase adaptation investments and take into consideration an ambitious global mitigation actions in the long-run as supported by an enabling environment including access to finance, conducive policy and relevant legislation, therefore enhancing Ghana's approach in mainstreaming climate adaptation in national and county (sub-national) development planning.

The approach used in developing Ghana's NAP was participatory, evidence-based, and nationally driven. To ensure Ghana's specific context, it combined scientific data, climate scenarios and vulnerability assessments with local and indigenous knowledge. Broad consultations were also held, in addition to ensuring the process was inclusive and gender-sensitive. The NAP was aligned with national development priorities and international frameworks to ensure sustainability in addressing climate risks across all sectors.

## 1.3 Vision and Strategic Objectives

### VISION

**Increase climate resilience and decrease vulnerability at the national and sub-national levels for enhanced sustainable development.**


### STRATEGIC OBJECTIVE 1

**To reduce vulnerability to the impacts of climate change, by building adaptive capacity and resilience to enhance economic development.**

### STRATEGIC OBJECTIVE 2

**To facilitate the integration of climate change adaptation, in a coherent manner, into planning processes and strategies, within all relevant sectors and at different levels, as appropriate.**

Ghana's National Adaptation Plan envisions a future where the country is resilient to climate

change impacts and climate adaptation is integrated into districts and municipal assemblies' medium- and long-term development planning. The framework emphasizes stakeholder collaboration, aligning policies, and building resilience across all levels of society.

Based on the above internationally accepted objectives of the NAP, the specific long-term adaptation objectives of the GNAP are the following:

i. Integrate currently disjointed sectoral and subnational adaptation initiatives to mainstream climate change adaptation holistically within Ghana's long-term development path;

ii. Mainstream and institutionalize the implementation of climate change adaptation in the country's development governance structures to ensure continuity and consistency of pragmatic efforts, and by strengthening the horizontal and vertical integration.

iii. Enhance institutional and individual capacities at the national and subnational levels to support climate adaptation mainstreaming

iv. Mobilize resources from public and private climate finance sources and from both domestic and international sources to enable the country to implement its climate change adaptation initiatives and to develop appropriate technical, material and expert capacities.

v. Establish resilient systems that can withstand disasters and risks imposed by climate change through building collaborative partnerships among the relevant stakeholders and enhancing the thematic integration among different development sectors.

### 1.3.1 Scope of GNAP

The NAP sets clear objectives for adaptation, such as lowering vulnerability, strengthening adaptive capacity, building resilience and promoting sustainable development amid climate change. The GNAP covers vulnerability assessments, adaptation priorities, implementation strategies, resource mobilization, monitoring, evaluation and reporting and communication.

## 1.4 Purpose of GNAP

The purpose of Ghana's National Adaptation Plan is to prioritize climate change adaptation actions in the medium and long term. It is the foundation for Ghana to build resilience to climate change by integrating adaptation into national, sectoral, and district-level development planning. It aims to reduce vulnerability across key sectors and communities, promote informed and inclusive decision-making, and guide strategic investments in climate-resilient development. The NAP also seeks to strengthen institutional coordination, align with Ghana's international climate commitments—particularly under the Paris Agreement—and ensure that gender and social inclusion are mainstreamed throughout the adaptation process.

## 1.5 Guiding Principles for the GNAP

The implementation of the GNAP will be governed by the following specific guiding principles, which are based on relevant and appropriate policies, and strategic guidance documents at the global, national, regional, metropolitan and sectoral levels. The key principles underlying the

NAP process should conform with and be informed by those of the NCCP and NCCAS, as well as those of existing national policies and development agendas, including the Agenda for Jobs (2018) and the Ghana Shared Growth and Development Agenda I & II (GSGDA 2010 -2017).

## 1.6 The NAP Formulation Process

**Guiding Principles for the GNAP**

**1 Ghana-owned & Ghana driven process**

Driven by national needs, linking poverty reduction, sustainable development, and climate resilience.

**2 Gender-sensitive and Gender-responsive Decision Making**

Inclusive & transparent NAP planning and implementation with all stakeholders, especially the youth

**3 Cross-cutting development issue**

Mainstreaming adaptation in agriculture, health, water, cities, DRR, human mobility and biodiversity

**4 Non- Duplication of Efforts**

Building on, & ensuring coherence between adaptation & development planning

**5 Effective Communication**

Tailoring outreach to policymakers, communities, and academia with appropriate channels

**6 Continuous, progressive & iterative process**

Process should be flexible and adaptive

**7 Evidence-based**

Building on existing plans, using science, indigenous knowledge, and multidisciplinary approaches

**8 Monitoring, Evaluation and Learning**

Mechanisms to ensure monitoring and review on adaptation effectiveness

The Government of Ghana recognized the serious risks climate change poses to national development and has made considerable strides to build resilience. Over the years, it has introduced key strategies, policies, programmes and projects such as the National Climate Change Master Plan (2015–2020), the National Climate Change Adaptation Strategy (NCCA 2012), the National Climate Change Policy (NCCP, 2013) and the Nationally Determined Contributions (NDCs 2015, 2021). Building on these, Ghana began its NAP process in 2017 and published the NAP Framework in 2018 which set out the country's vision and principles for adaptation planning. Ghana has been implementing the multi-year project, "Enhancing multi-sector planning and capacity for effective adaptation in Ghana", through the Environmental Protection Authority (EPA) under the Ministry of Environment, Science and Technology (MEST) with support from the Green Climate Fund (GCF) and the United Nations Environment Programme (UNEP). The NAP project supports multi-sectoral, medium- to long term adaptation planning and budgeting in Ghana by promoting the integration of climate change adaptation issues into development planning processes and policies.

The NAPF, coordinated by the EPA, clarified Ghana's approach to its NAP process, identified themes unique to the country and served as a basis for stakeholder engagement. Ghana adopted a hybrid (vertical and horizontal) approach to integrating climate change adaptation in policy and planning. Stakeholders were extensively engaged and consensus built to adopt a sectoral and district focused adaptation planning and mainstreaming process. Prioritized climate-sensitive sectors were agriculture, biodiversity and forestry, water, energy, cities and disaster risk reduction, and health. Gender and youth considerations were made as cross cutting issues (GoG, 2021). Sectoral priorities were identified through the development of climate change vulnerability assessments for key sectors, and local adaptation priorities identified through the process of developing stand-alone adaptation plans for districts.

The assessments considered data on vulnerabilities of sectors, agro-ecological zones and marginalized social groups (women, youth, and differently abled people), current and future impacts of climate change. Adaptation options were evaluated using a Multicriteria Decision Making (MCDM) Analysis and prioritized gender-sensitive adaptation actions in different sectors and regions. Capacity building in the systems and tools for integration of adaptation plans and budgets; coordination mechanisms, climate finance, climate data analysis, monitoring, reviewing, and reporting at national and sub-national levels was included in the whole NAP formulation process.

The NAP process also included the development of a Gender Strategy, which is instrumental in empowering women and ensuring their strong participation in climate adaptation efforts. In Aowin Municipal Assembly for example, despite facing unique challenges such as limited access to land, technology and financial resources, women in the agricultural sector continue to demonstrate resilience. Initiatives within the NAP are helping to break down traditional barriers and therefore providing them more opportunities for technical training, decision-making and economic empowerment. By integrating gender considerations into policy development and fostering supportive frameworks, Ghana is working towards a future where women are equipped to lead effective climate adaptation. They are also able to contribute to sustainable agriculture and in the strengthening of community resilience.

The final step involved drafting and validation of the NAP at national and sub-national level. Stakeholders' concerns and experiences were considered in reviewing the document. The NAP process required strong coordination, was participatory and engaged diverse array

of stakeholders including members of government agencies, local authorities, civil society, academia, the private sector, and traditional leaders who engaged through the Cross Sectoral Policy Groups (CSPGs).

# 2

# Policy and Regulatory Framework

Several policies and strategies have been established globally to address the impacts of climate change. In Ghana, the NAP process was guided by relevant global, regional and national policies and strategies. This chapter provides an overview of the international and regional frameworks, and national level polices, strategies and legislation that are relevant to the implementation of Ghana National Adaptation Plan. (Appendix 1).

## 2.1 International Frameworks

Ghana became a member of the UNFCCC after ratification in September 1995 and is required to ensure that climate change issues are taken into consideration in national development planning. The country ratified the Kyoto Protocol in 2003, thus committing to implement climate-friendly policies and participate in global efforts to combat climate change, by focusing on adaptation strategies and sustainable development. Since ratifying the Paris Agreement in 2016, the Government of Ghana has worked to implement its NDCs, outlining climate mitigation and adaptation strategies. Similarly, Ghana's NAP is aligned to the SDGs which specifically calls for strengthening resilience and adaptive capacity to climate related hazards. The interconnected nature of the goals means that success in one leads to success of others. Another key agreement is the Sendai Framework on Disaster Risk Reduction 2015-2030, which aims to achieve a substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons.

## 2.2 Regional Frameworks

The African Union's Agenda 2063 is a strategic framework for socio-economic transformation of the continent by 2063. It builds on and seeks to accelerate the implementation of past

and existing continental initiatives for growth and sustainable development. Agenda 2063 identifies agriculture as one of the sectors of the economy to be transformed to achieve the needed sustainable development across the continent (AU, 2017).

The Regional Climate Strategy (RCS), supported and led by ECOWAS, creates a coherent basis for long-term climate action (2030 and 2050 horizons). It aims to consolidate and make coherent an intervention framework for the fight against climate change in the ECOWAS zone, taking into account both the adaptation and mitigation dimensions of climate change in line with the Paris Agreement and the 2030 Agenda consisting of the Sustainable Development Goals (SDGs).

## 2.3 Overview of National Frameworks

Ghana's NAP is supported by a number of key policies and strategies that provide direction, integration and coherence for climate action. At the core are the NAP Framework, the National Climate change Policy (2015 – 2020), and the Nationally Determined Contributions (2020-2030) which set establish the overarching mandate for adaptation and align Ghana's commitments with international obligations. Building on these are the Medium-Term National Development Policy framework (MTNDPF), the National Disaster Management Organization (NADMO) mechanisms for disaster risk reduction, and the Climate-Smart Agriculture and Food Security Action Plan, which help link adaptation to wider development and resilience goals. Finally, enabling frameworks such as the Constitution of Ghana (1992), Integrated Water Resources Management Plan (IWRM Plan), the Ghana Shared Growth and Development Agenda II (GSGDA II), and the National Climate Change Master Plan (NCCP) provide the enabling environment and coherence needed to ensure GNAP can be effectively implemented across sectors.

## 2.4 Selected Legislation Relevant to the Implementation of GNAP

An analysis of the policies, legal and regulatory framework reveals that for effective implementation, the GNAP needs: clear governance mandates; risk information and early warning; climate risk consideration in planning and investments; resilient land use, water, agriculture, health and energy systems; financing enforcement and M&E to track adaptation results; inclusion (gender, vulnerable and local communities); and local implementation capacity.

It is important to highlight the system-level strengths that Ghana has. There are clear institutional anchors in place for environment (Act 1124), planning (Act 480), land/spatial (Act 925), water (Act 522), meteorology (Act 682), agriculture value chains (Act 324), and health (Acts 525,851/852). The Energy Diversification policy (Act 1045) enhances resilience of critical infrastructure and services while decentralized planning architecture provides means to mainstream NAP priority actions and budgets intro district and regional plans. Further, the enforcement powers in public health and environmental domains can support compliances with adaptation relevant standards.

**Table 1: Summary of Enabling Aspects of Select Laws, their Strengths and Gaps**

| Legislation | What it Enables for the NAP | Strengths | Gaps |
|---|---|---|---|
| **Environmental Protection Act, 2025 (Act 1124)** | Creates an Environmental Protection Authority, consolidates environmental statutes, and oversights on climate and environment | Centralizes climate/ environmental regulation, potential to issue adaptation regulations and standards. | No standalone adaptation law, need explicit powers for adaptation planning. Resources and enforcement will be pivotal. |
| **Renewable Energy (Amendment) Act, 2020 (Act 1045)** | Diversifies energy, supports energy security under climate stress (e.g hydropower variability) | Concrete pathway to resilient power systems, and co-benefits for mitigation | Focused on supply; doesn't mandate climate resilient energy planning, off-grid resilience for health/water services, or adaptation finance mechanisms |
| **National Development Planning Systems Act, 1994 (Act 480)** | Embeds decentralized, participatory planning, and provides coordination across levels | Mechanism to mainstream NAP into MMDAs Medium-Term Development Plans and budgets | Act predates modern climate mandates, needs explicit requirement for climate-risk identification, use of hazard/ climate scenarios and NAP aligned KPIs in plans and public investment appraisals |
| **Land Use and Spatial Planning Act, 2016 (Act 925)** | Enables spatial frameworks to factor climate risks; climate-proofing infrastructure | Strong anchor for risk-informed land zoning (setbacks, flood plains, coastal erosion etc) | Implementation may lag; need binding use of hazard maps, blue-green infrastructure standards, nature-based solutions, and enforcement against encroachment. |
| **Water Resources Commission Act, 1996 (Act 552)** | Sustainable water allocation and basin management. | Platform for drought/flood management, climate informed abstraction permits, Integrated Water Resource Management. | Update to require climate scenarios in allocation plans, environmental flows, groundwater protection, and drought contingency triggers; clarify roles with disaster management. |

| Legislation | What it Enables for the NAP | Strengths | Gaps |
|---|---|---|---|
| **Ghana Meteorological Agency Act, 2004 (Act 682)** | Legal basis for weather/ climate services; advice to government | Foundation for early warning and climate services for agriculture, DRR and health | Need open data/data-sharing mandates, localized dissemination duties, multi-hazard early warning integration, and financing for network maintenance. |
| **Grains Development Authority Act, 1970 (Act 324)** | Supports seed multiplication, farmer organizations and standards which are key to climate resilient crops | Can accelerate scale-up of drought/heat/flood-tolerant varieties and post-harvest resilience | Update to explicitly prioritize climate-resilient varieties, climate-smart extension and climate risk for value chains. |
| **Ghana Health Service and Teaching Hospitals Act (Act 525)** | Governance for service delivery and program coordination | Means to integrate climate health risks (heat stress, vector-borne diseases, floods) into service delivery. | No explicit climate-health resilience mandates (health facility climate standards, backup power/ water, surveillance triggers and heat-health action plans. |
| **National Health Insurance Act, 2012 (Act 852)** | Pathway to protect vulnerable groups from increased health costs associated with the climate | Can finance preventive services for climate risks. | Doesn't earmark benefits for climate sensitive conditions or surge financing during climate disasters; needs adaptive benefit design. |
| **Public Health Act, 2012 (Act 851)** | Strong powers on disease control, sanitation, environmental health | Enforcement leverage for vector control, water/ sanitation during floods and droughts | Add climate specific surveillance, thresholds for public health emergencies linked to climate, and coordination protocols with GMet, WRC and NADMO. |

Strong leadership and consistent policies are critical for mainstreaming climate change and implementation of adaptation efforts in development planning.

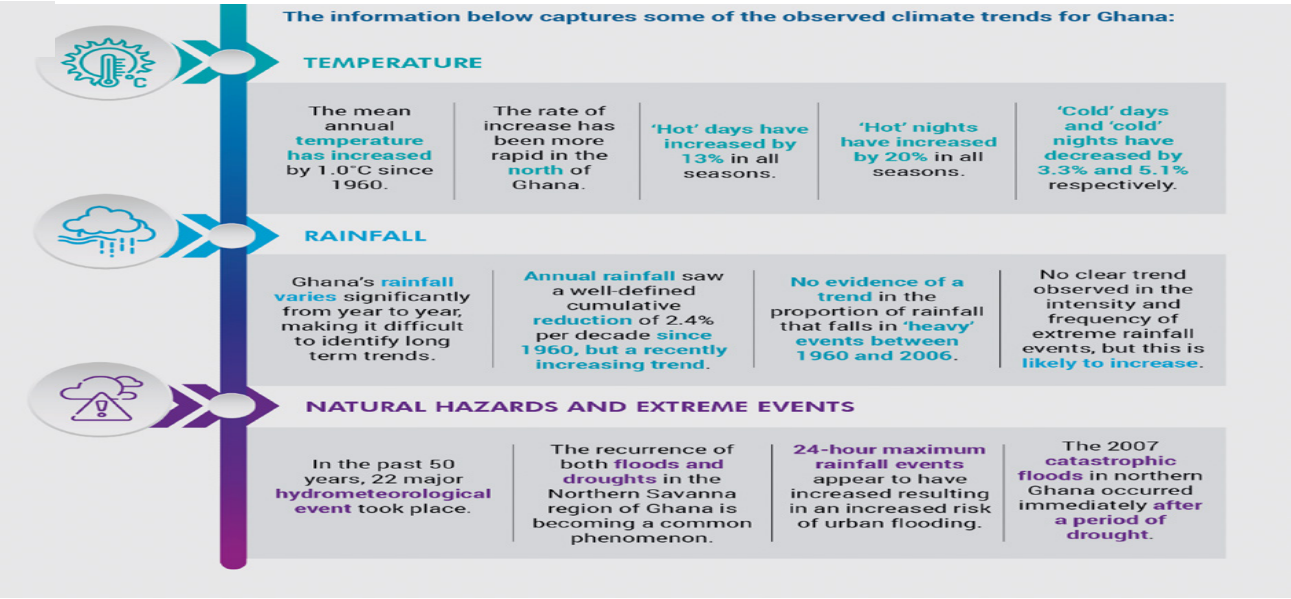
# 3

# Climate Trends, Hazards and Risks in Ghana

## 3.1 Introduction

This chapter will focus on current and projected climate trends (temperature and rainfall) for different scenarios and understanding the key climate hazards and risks such as heat, droughts, floods and sea-level rise with a view to informing and prioritizing adaptation actions. A summary of the observed climate trends for Ghana based on climate projections completed as part of the NAP process is provided in the following figure:

**Figure 1: Observed Climate Trends for Ghana**




*Source: EPA (2023), Summary for Decision Makers, Climate Projections and Climate Risks for Ghana.*

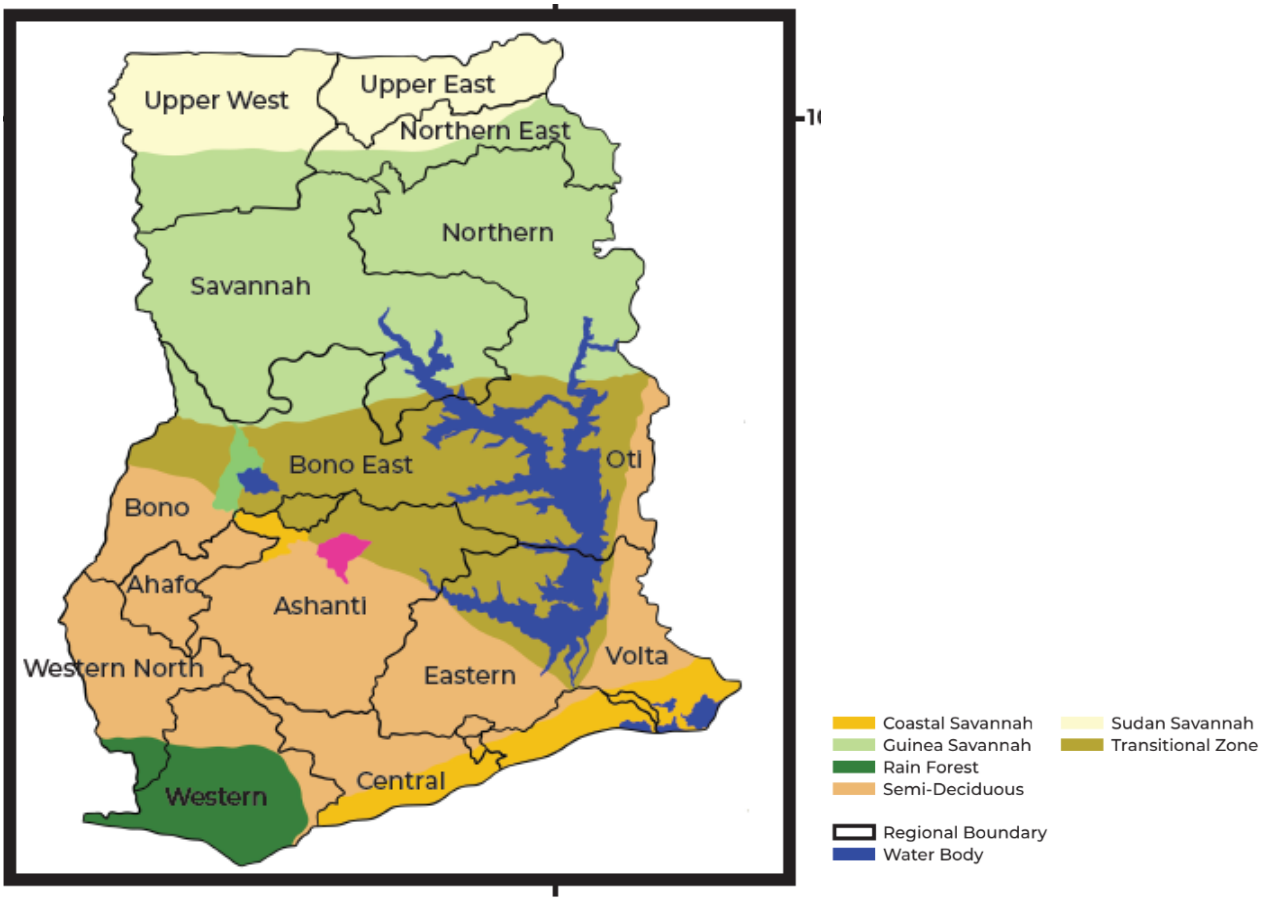
## 3.2 Current and Future Climate Trends in Ghana

### 3.2.1 Rainfall Patterns and Variability

Ghana has a tropical climate with two main seasons: the wet season and the dry season. In northern Ghana, the rainy season lasts from April to mid-October, while in the south it extends from March to mid-November. The country's tropical climate is relatively mild for its latitude. From December to March, the harmattan - a dry desert wind - blows across northeastern Ghana, reducing humidity and bringing hotter days and cooler nights to the region. Average daily temperatures in Ghana range from 30°C during the day to 24°C at night, with relative humidity levels between 77% and 85%. The southern part of the country experiences a bi-modal rainy season, occurring from April to June and again from September to November. In the north, squalls typically occur in March and April, followed by intermittent rainfall until August and September, when precipitation peaks. Annual rainfall varies between 78 and 216 centimetres (31 to 85 inches).

Ghana has six (6) main agroecological zones **(Figure 2)** namely Sudan Savannah, Guinea Savannah, Transitional Zones, Semi-Deciduous Forests, Coastal Savannah and rainforest. The rainfall patterns in Ghana's agroecological zones vary significantly, influencing agriculture and food security.

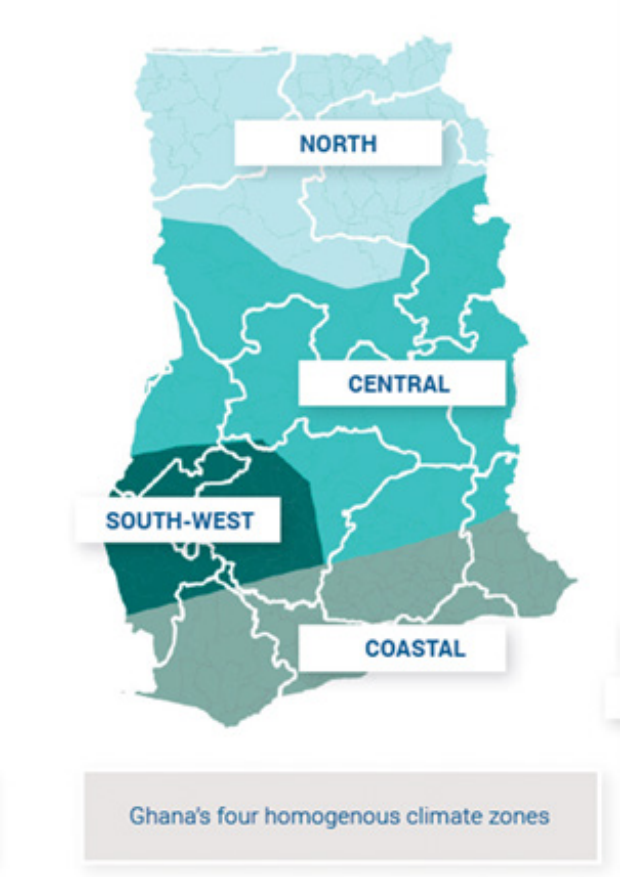
**Figure 2: Agroecological Zones in Ghana**




*Source: Bibiani Climate Vulnerability Assessment Report (2024)*

To better understand variation within the country for the climate projections, the country was separated into four climate zones (north, central, south-west and coastal) based on an analysis of current rainfall patterns and expected changes. **Figure 3** shows the four climate zones used for the projections

**Figure 3: Ghana's four homogenous climate zones**



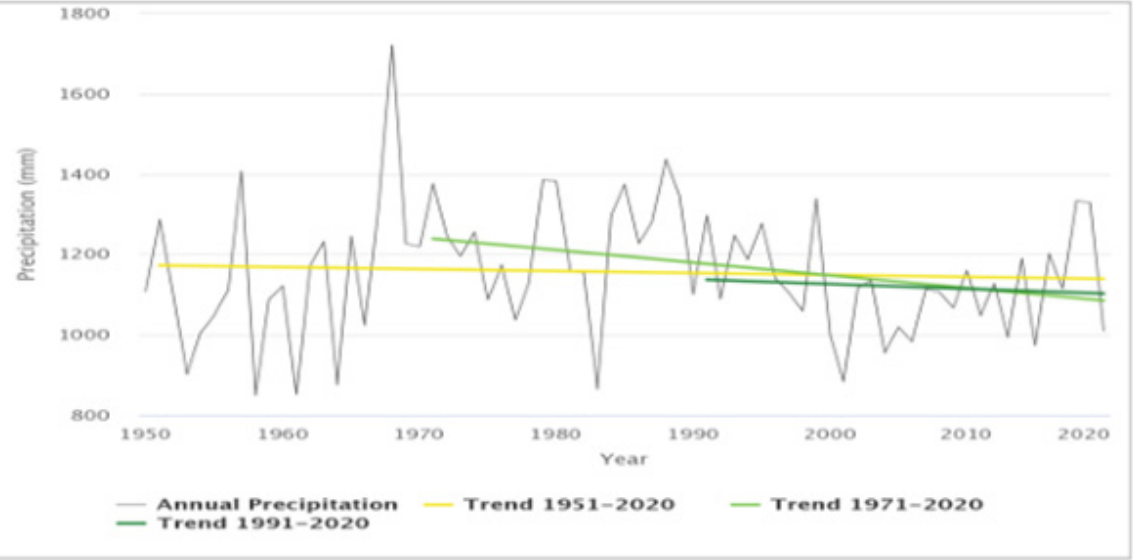

***Source: EPA (2023), Climate Projections and Climate Risks.***

### 3.2.2 Current and Projected Trends in Rainfall

#### 3.2.2.1 Current Rainfall Trends

The country's average rainfall is approximately 1,236 mm per year, with fluctuations observed over different decades **(Figure 4**). In 2022 and 2023, precipitation was 1,227 mm and 1,299 mm respectively. Historically, Ghana recorded its highest rainfall in 1968 (1,791 mm) and its lowest in 1983 (836 mm). From 1901–1950, rainfall was relatively stable, with consistent seasonal patterns. However, from 1951-1980, notable fluctuations in rainfall have been observed with drought frequency increasing in the 1970s. For the 1981–2020 periods, rainfall has generally increased, but with regional disparities—the transition zone and northern regions have faced rainfall deficits, while the forest and coastal zones have seen more stable precipitation (Ghana Meteorological Agency, 2020).

**Figure 4: Annual precipitation trends in Ghana**

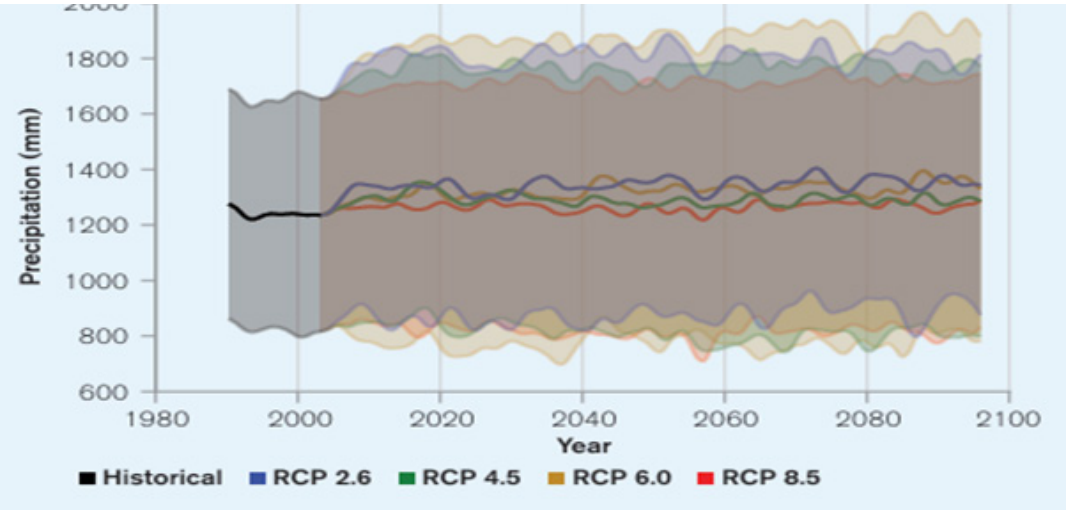



***Source: EPA (2024). CCAAP for Biodiversity & Ecosystems Sector***

### 3.2.2.2 Projected Rainfall Trends

Rainfall in Ghana is highly variable and will continue to be so throughout the century. However, heavy rainfall events are expected to increase. Additionally, changes in 1 to 5-day rainfall maxima trends will likely increase in some areas but are expected to decrease in others. More erratic and intense rainfall during the wet season is expected, along with lower precipitation levels during the dry season; larger decreases in the southern regions. Intense rainfall events are also likely to result in flooding and flash floods, as well as river bank erosion. Overall, annual precipitation in Ghana is expected to largely remain the same by the end of the century under a high emissions scenario of RCP8.5; however coastal zones are expected to receive higher rainfall than central or northern areas (World Bank, 2021).

**Figure 5: Change in projected annual average precipitation for Ghana**




***Source: World Bank, 2021.***

Future projections of precipitation are more uncertain compared to projections of temperature or sea level rise. Identifying trends in annual mean precipitation is challenging due to significant natural variability over multi-decadal periods and substantial uncertainty within modelling approaches. The projections undertaken for the NAP indicate that yearly rainfall might increase with climate change, however, there are also clear indications that there will be increases in extended dry periods. These changes present a serious challenge for DRR efforts, as they increase the frequency of both droughts and floods, requiring improved infrastructure, water management, and early warning systems in urban areas. On the other hand, more rainfall during certain periods may lead to a rise in extreme weather events, such as flooding, in southern regions. Research has shown that rainfall varies greatly in Ghana's middle regions, with rates of variation ranging from 25.3% to 70.8% (Braimah et al., 2022).

**Figure 6: Trends in rainfall in the four climate zones.**

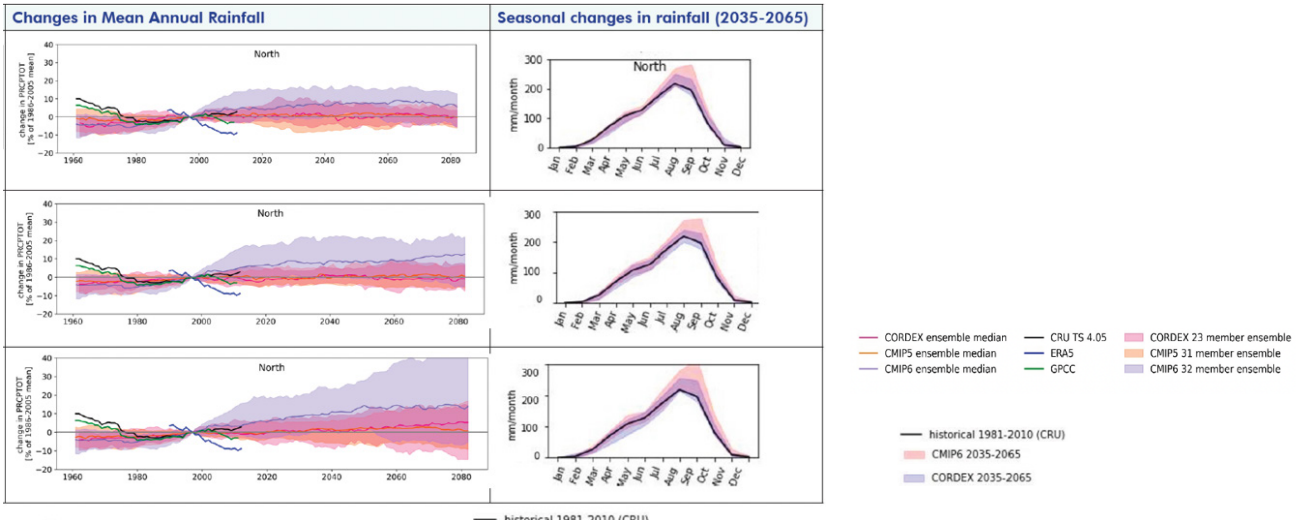
| Climate Zones | Rainfall % change per decade | | |
|---|---|---|---|
| | **RCP2.6** | **RCP4.5** | **RCP8.5** |
| North | -10 | +10 | +60 |
| Central | -0 | +0 | +60 |
| Southwest | +10 | +10 | +60 |
| Coastal | -10 | +30 | +80 |

***Source: EPA, Climate Projections and Climate Risks, 2023.***

Agricultural productivity is severely impacted by this change, especially in rain-fed systems. These climate trends have had a significant impact on Ghana, influencing important areas including agriculture, water resources, and health. Reduced agricultural yields have resulted from rising temperatures and unpredictable rainfall patterns in agriculture, especially for key crops like maize and cassava. Farmers find it more and more challenging to plan ahead and maintain production due to this uncertainty (Guodaar et al., 2021). Decreased rainfall has resulted in widespread water scarcity, which has a significant impact on water resources and makes it difficult to get water for household use as well as for agricultural irrigation posing risks of food security in Ghana (Ingrao et al., 2023).

In the northern climate zone, the climate projections suggest a change in rainfall is possible of up to +/-15/20% with a slightly greater chance of around a 5% increase in annual average rainfall compared to the base years but there is also a relatively significant change of decreases in rainfall. The graphs below show how each of the three emission scenarios evolves over time and the greatest increase in rainfall is during August and September.

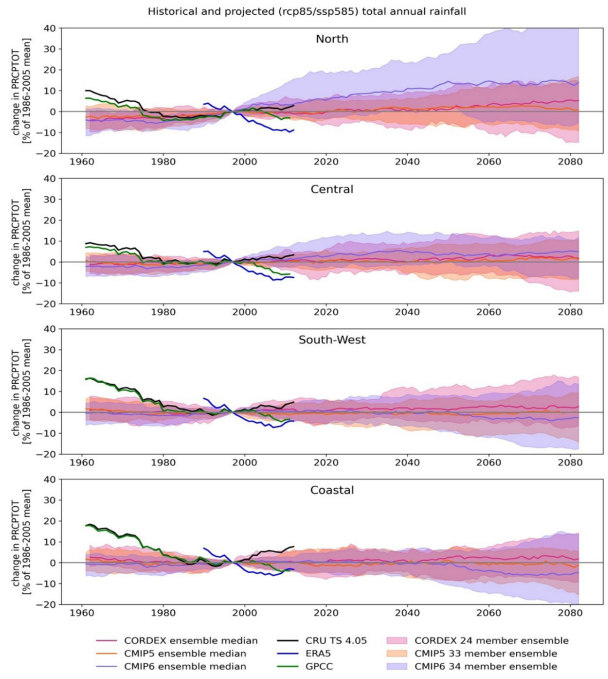
**Figure 7: Changes in average mean annual rainfall in the northern coastal zone.**




***Source: EPA, Climate Projections and Climate Risks, 2023.***

In the central zone as with the northern one, there is a slightly greater chance of small increases in annual average rainfall. In the southwestern climate zone, a small decrease in rainfall is slightly more likely than an increase whereas in the coastal zone, there is an equal chance of around 10% increases and decreases in annual average rainfall with a change of up to +/- 20% possible. The figure below shows the range of historical and projected precipitation changes at the high emission scenario RCP 8.5 based on a range of models utilized for the country's climate projections.

**Figure 8: Plume plots illustrating the evolution of total annual rainfall in Ghana's homogeneous climate zones in simulations of historical and future climate under RCP8.5/SSP585 scenarios**




***Source: EPA (2022), Downscaled Temperature and Precipitation Scenarios Repor***

### 3.2.3 Current and Projected Trends in Temperature

Historical climate data indicate a steady rise in temperatures across Ghana, with northern regions experiencing more pronounced warming compared to the south. Since the 1970s, the country's average temperature has increased by approximately 0.21°C per decade. Climate projections suggest that by 2050, temperatures in the northern regions could rise by 2.1°C to 2.4°C, significantly increasing the risks to urban infrastructure, public health, and livelihoods due to intensified heat stress and increasingly erratic weather patterns (Asante et al., 2014).

The rise in greenhouse gas (GHG) concentration has led to a projected increase of between 1.7 to 3.7 °C (very likely range) by 2080 relative to the year 1876, depending on future GHG emissions scenario (Ghana National Climate Change Policy, 2013).

The table below summarizes the projected temperature changes per decade based on emissions scenarios for each of the four climate zones. Temperature changes in all four zones are similar. Higher annual average temperature values occur, as expected, with increasing emissions. Under RCP2.6, the increases tend to plateau after mid-century; there is also some plateauing in the final two or so decades under RCP4.5, but temperatures increase throughout the century under RCP8.5, reaching an average rise of almost 4ºC. For the North Zone, the 100-year return value under RCP8.5 increases up to 6ºC.

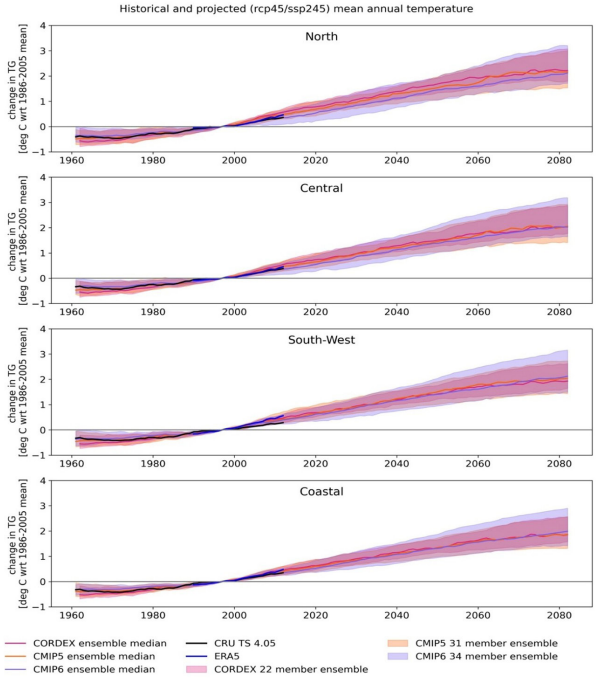
**Table 2: Projected temperature changes per decade based on emissions scenarios**

| Climate Zones | Temperature ºC per decade | | |
|---|---|---|---|
| | **RCP2.6** | **RCP4.5** | **RCP8.5** |
| North | +0.09 | +0.24 | +0.57 |
| Central | +0.08 | +0.23 | +0.55 |
| Southwest | +0.08 | +0.23 | +0.52 |
| Coastal | +0.08 | +0.22 | +0.50 |

***Source: EPA, Climate Projections and Climate Risks, 2023***

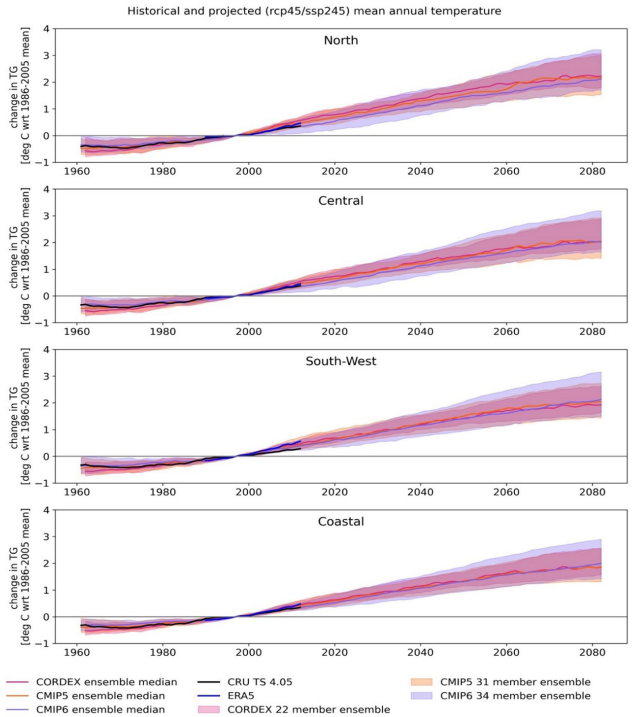
The plume plots featured below (Figure 9) show the range of projected temperature increase from different models analyzed for each of the four regions for both the mid-level emissions scenario (RCP 4.5) and high level of emissions (RCP 8.5).

## Figure 9: Projected change in mean annual temperature for all climate zones – RCP4.5 – SSP2




*Source: EPA (2022), Downscaled Temperature and Precipitation Scenarios Report*

## Figure 10: Plume plots illustrating the evolution of mean annual temperature in Ghana's homogeneous climate zones in simulations of historical and future climate under RCP8.5/SSP585 scenarios



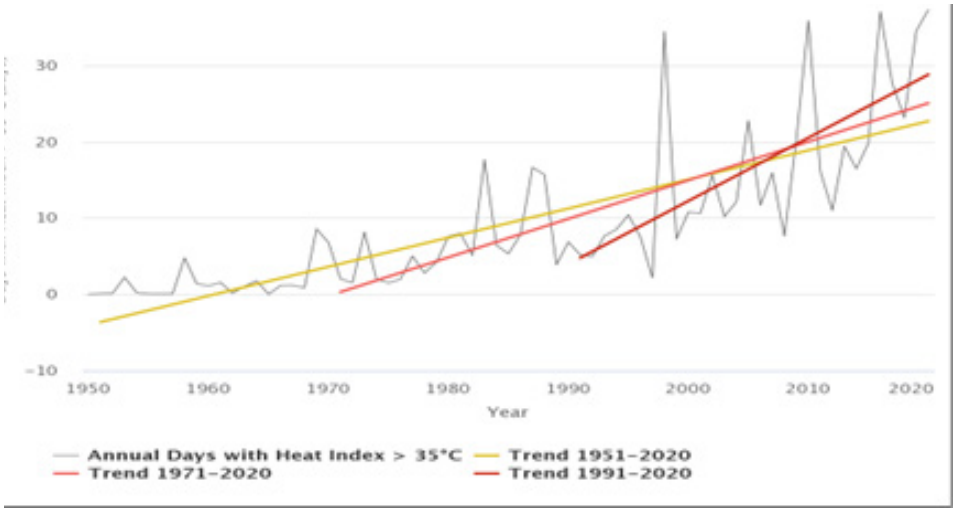

*Source: EPA (2022), Downscaled Temperature and Precipitation Scenarios Report*

In Northern Ghana, the rise in annual mean temperatures is projected to result in an increase in the annual number of very hot days (days with daily maximum temperature greater than 35 °C). Temperature projections suggest that by 2050, temperatures in the northern regions could rise by 2.1°C to 2.4°C, posing a significant risk to urban infrastructure and public health due to heat stress and erratic weather patterns (EPA, 2024). With the most pronounced increase between September and November.

Similarly, other regions in Ghana have experienced disproportionate high average annual temperatures ranging from average daily temperatures ranging from 26°C - 29°C with fluctuations of between 6°C to 9°C in Volta River headwaters, upper, central and Ashanti/ southern Ghana) within the year (World Bank Group's Climate Change Knowledge Portal (WCCKP, 2022; World Bank 2021). The numbers of very hot days with maximum temperature of more than 35°C and hot nights with minimum temperatures of more than 26°C have increased by over 13% and 20% per year respectively. The most pronounced increase occurs between September and November with more rapid rates of increase reported in the North of Ghana, and minimum temperature increase in the southern regions (rainforest and coastal and agro-ecological areas). In support, (Arhin, 2022) has reported on the increase in the average number of hot nights in a year at 73 (an extra 20% of nights), the average number of 'hot' days in a year increased by 48 (an additional 13.2% of days) while the number of cold nights per year has fallen by 18.5 (5.1% of nights) and the number of cold days per year has decreased by 12 (3.3% of days); while extreme rainfall events have increased, and the average yearly temperature has risen by 1°C.

As the projected annual mean temperatures rises, the annual number of very hot days (days with daily maximum temperature >35°C) are also projected to rise especially over northern Ghana **(Figure 11)** under the medium/high emissions scenario. Under the medium/high emissions scenario, on average over all of Ghana, projections of 34 more very hot days per year in 2030 than in 2000, 55 more in 2050, and 94 more in 2080. In some parts, especially in the north of Ghana, this amounts to about 300 days per year by 2080.These extreme temperature changes could worsen heat stress on crops and livestock, affecting livelihoods and food security (Addaney et al., 2021).

**Figure 11: Days with Heat Index > 35 C trends for Ghana**

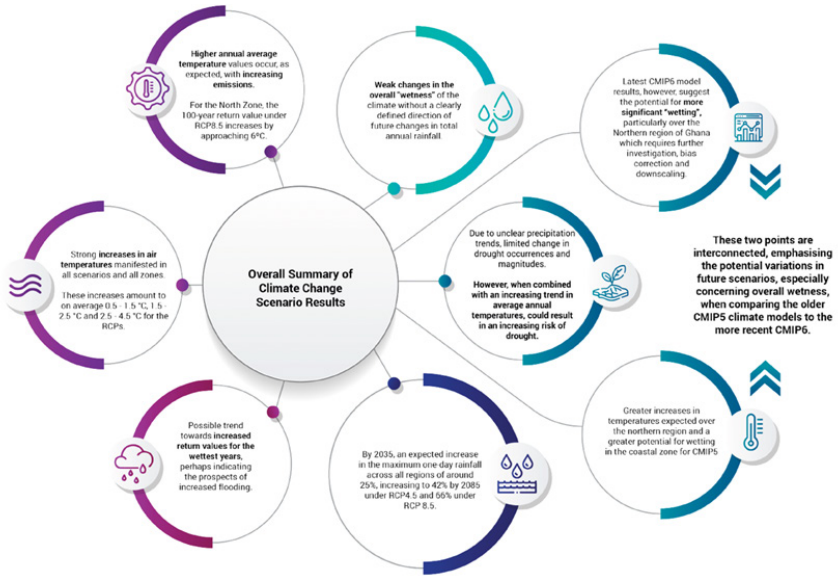



***Source: EPA (2024), CCAAP – Cities & Disaster Risk Sector***

Urban growth in cities like Accra has also led to a reduction in green spaces and an expansion of hard surfaces, raising energy demands for cooling and increasing night-time temperatures which has intensified the urban heat island effect, making extreme heat events frequently surpassing 35°C and occasionally exceeding 40°C more frequent and severe. (EPA/ UNEP (2024), CCAAP – Cities & Disaster Risk Sector; Climate Change Knowledge Portal (CCKP, 2021). Northern Ghana cities are increasingly affected by heat stress, impacting on public health and more so increase heat-related illnesses and fatalities. These changes disproportionately affect vulnerable groups, including the elderly, children, and low-income communities, who are at greater risk during heatwaves (EPA, 2024).

The overall results of the climate change scenarios and potential impacts are summarized in the figure below.

**Figure 12: Overall Summary of Climate Change Scenario Results and Potential Impacts. Source: EPA (2023) Summary for Decision Makers: Climate Projections and Climate Risks for Ghana.**




***Source: EPA (2023) Summary for Decision Makers: Climate Projections and Climate Risks for Ghana***

## 3.3 Overview of Climate Hazards

Ghana's climate is shaped by its location, which makes it subject to the tropical West African Monsoon, the drying effects of the Sahara Desert via the Sahel, and the temperature regulation and tropical storms from the Atlantic Ocean. (IFRC, 2024). Climate change is manifested in Ghana through rising temperatures, declining rainfall, increased variability, rising sea levels, droughts, floods, coastal erosion, wildfires, earthquakes, storms, landslides and high incidences of weather-related disasters posing challenges to the people, its ecology and society (GoG, 2015; WB, 2021). These impacts of climate change affect various sectors and their objectives, places and population in diverse ways, depending on their respective levels of vulnerability, thus threatening economic growth and development.

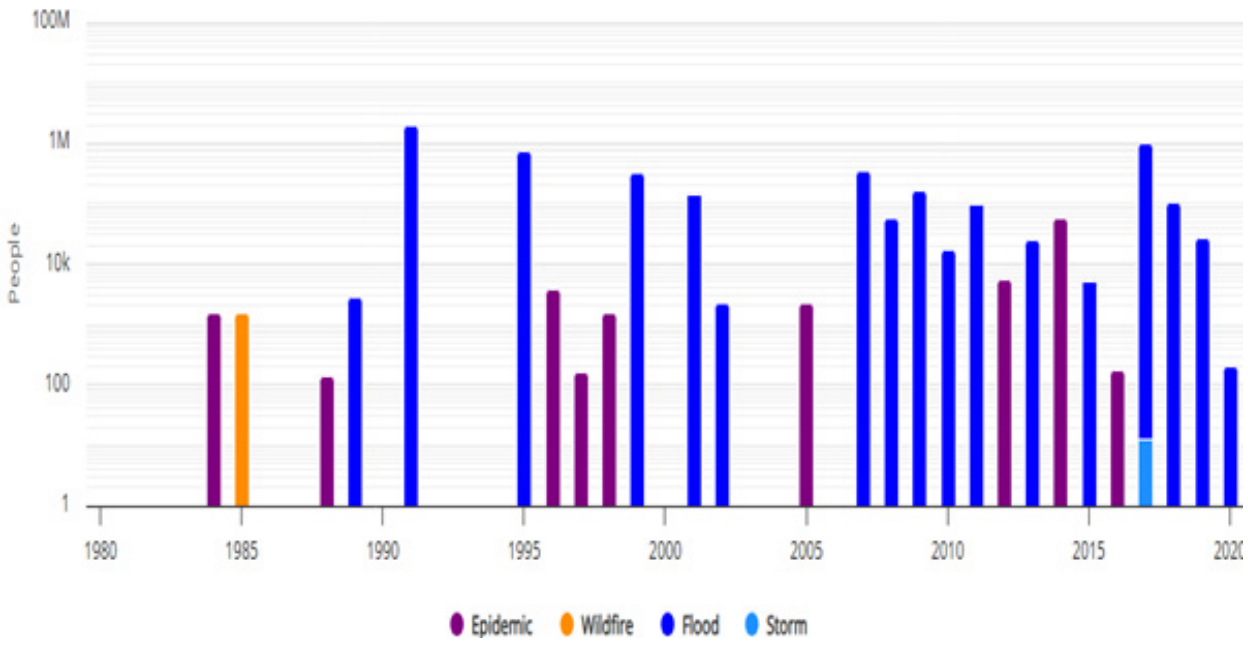
It is estimated that floods impact 45,000 Ghanaians every year while droughts affect about 13% of the country's population. In terms of severity, drought is the most severe affecting about 12,512,000 million people. The natural hazard statistics for 1980-2020 in relation to the number of people affected is shown in **Table 3** and **Figure 13**. On the other hand, the average annual natural hazard occurrence for 1980-2020, illustrated that flood was the most common climate extreme event in Ghana, accounting for 67% of the number of extreme events registered in Ghana followed by epidemics at 30% over a similar period as shown in **Figure 14**.

**Table 3: Distribution of natural hazards for 1980-2020 period in relation to the number of people**

| 1900–2020 | Natural Hazard | Events Count | Total Deaths | Total affected | Total damage (000 USD) |
|---|---|---|---|---|---|
| Drought | Drought | 3 | 0 | 12,512,000 | 100 |
| Earthquake | Ground Movement | 1 | 17 | 0 | 0 |
| Epidemic | Bacterial and Viral Diseases | 21 | 1,268 | 89,735+1031 | 0 |
| Flood | Riverine and flash floods | 17 | 409+13 | 3,859,990 | 33,500 |
| Wildfire | Land Fire (Brush, Bush, Pasture) | 1 | 4 | 1,500 | 0 |
| Storm | Convective Storm | 1 | 20 | 12 | 0 |
| **Total** | | | | | **133** |

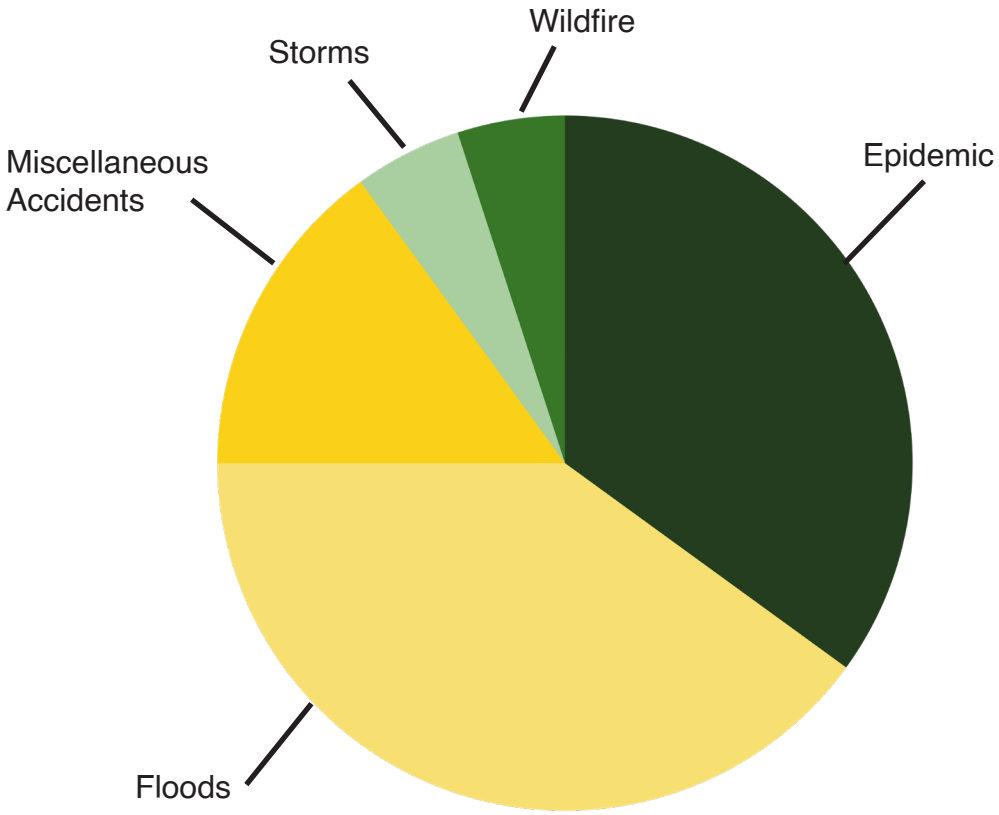
***Source: World Bank (2025), Climate Change Knowledge Portal***

**Figure 13: Number of people affected by key natural hazards in Ghana (1980-2020)**




***Source: EPA (2023), Climate Projections and Climate Risks.***

**Figure 14: Average annual natural hazard occurrence for 1980-2020**




***Source: EPA (2023), Climate Projections and Climate Risks.***

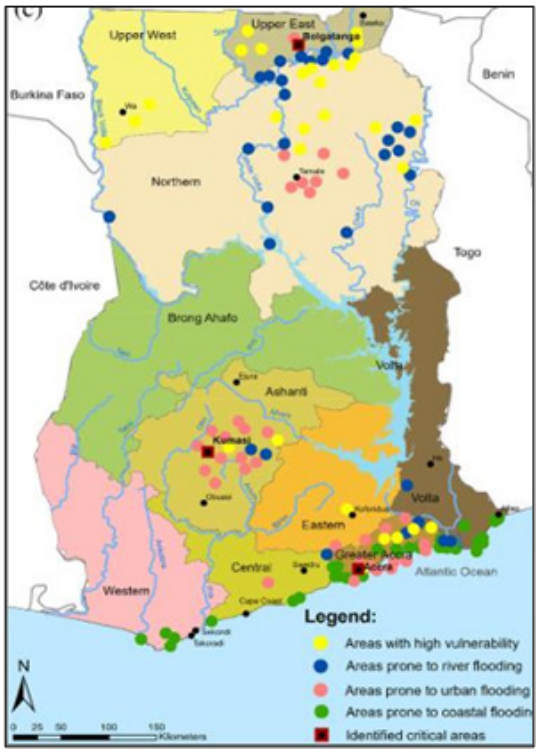
### 3.3.1 Flooding

Flooding is the most severe natural disasters since the 1990s, particularly in urban areas and coastal regions and mainly occurs annually during Ghana's rainy season (June - September) and affects the regions of Greater Accra, Northern, Upper East, Eastern, Volta, Western, Central, Ashanti, Upper West and Brong Ahafo. In recent years, floods have become frequent affecting all regions. For instance, an estimated 70,000 people on average are affected by flooding accounting for 0.24% of the population. However, these numbers can vary significantly from year to year. For instance , the 2010 floods displaced approximately 700,000 people (Mensah et al., 2020). Recent trends indicate that climate change has resulted in an extension of the flood season into November. Flood-prone areas are located mainly along the riverbanks, beaches and dam sites. Urban and metropolitan areas such as Accra, Kumasi, Tema, Tamale, Cape Coast and Sekondi-Takoradi are also affected due to poor drainage systems, human activities and their low-lying topography (IFRC, 2024).

From 1990, flood events have occurred nearly every year. Coastal communities are also facing additional threats attributed to surges in storm and erosion while the northern Savannah region is highly susceptible to droughts and rising aridity. These hazards not only cause immediate destruction but also result in long-term socioeconomic consequences, emphasizing the critical need for sustainable urban planning, improved infrastructure, and robust disaster risk reduction strategies tailored to Ghana's unique vulnerabilities.

Ghana's floods provide valuable lessons for future flood disaster planning. Flooding is a perennial event and one of the major disasters since 1995. The frequency has increased over the past decade due to an increase in population in vulnerable areas (Ansah et al., 2020) in both rural and urban areas **(Figure 15)**.

**Figure 15: Flood hotspot map of Ghana**




***Source: Almoradie et al. (2020)***

The major cities such as Accra, Cape Coast, and Kumasi experience flash and pluvial floods annually (Abass et al., 2023). The frequency of fluvial and flash floods in Kumasi has increased over the past years, due to human activities such as building in waterways (Abass et al., 2022). New flood hotspots are emerging in many parts of Ghana, partly due to poor land use planning, and high variability in rainfall patterns – climate change (Agodzo et al. 2023). For instance, Odaw River catchment in Accra is a major flood hotspot which experiences floods at least twice a year.

Ghana has experienced seven major floods in the last two decades as shown in **Table 4.**

**Table 4: Distribution of floods in Ghana from 1968 to 2024**

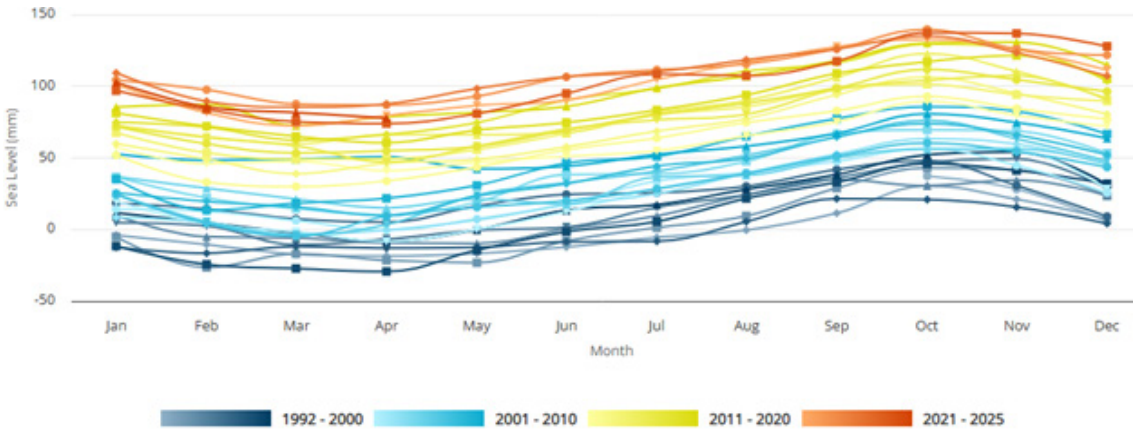
| Date/ Year | Geographical coverage | People affected | Lives lost | Additional impact |
|---|---|---|---|---|
| 2024 | Ghana, cities | more than 4 million people | | Urban areas suffer damage from flooding every year |
| 2023 | Akosombo dam | 35,857 people | | Extensive damage to property and infrastructure |

| Date/ Year | Geographical coverage | People affected | Lives lost | Additional impact |
|---|---|---|---|---|
| 2024 | Ghana, cities | more than 4 million people | | Urban areas suffer damage from flooding every year |
| 2023 | Akosombo dam | 35,857 people | | Extensive damage to property and infrastructure |
| 2018 | Bawku and Talensi Districts | 31,903 people - | | Threat to food security and aggravation of the country's poverty. |
| 2018 to 2020 | Northern Ghana | | 35 | 69 bridges destroyed |
| 2015 | Accra | 1,000 people | 200 | N/A |
| 2007 | Widespread | 365,000 people | | Infrastructure and livelihoods adversely affected |
| 1999 | | 290,000 people | | Vectors for waterborne diseases outbreak such as cholera. |
| 2024 | Akosombo Dam | 35,000 people | | N/A |

### 3.3.2 Sea Level Rise

In 2020, the mean sea level in Ghana indicated an average rise of 3.3 mm per year, and the shoreline was eroding by 0.86 m per year. Projections for Ghana, based on 1990 as a base year, indicated a sea level rise of 10 cm for 2020. Further projections included 23.4 cm by 2060 and 36.4 cm by 2100. By 2053 for example, Sekondi Takoradi coast is expected to experience sea level rise of +0.4metres (Climate Projections and Climate Risks for Ghana, 2023). These predictions highlight the vulnerability of Ghana's coastal areas to rising sea levels. Sea levels along Ghana's coast are projected to rise significantly in the coming decades as shown below.

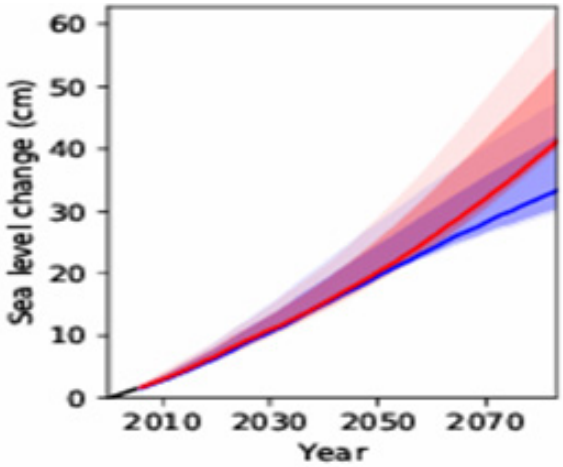
**Figure 16: Total Sea level change by month (1993- Present); Ghanaian Exclusive Economic Zone**




*Source: World Bank (2025), Climate Change Knowledge Portal*

Under the RCP6.0 scenario, sea levels are expected to increase by 11cm by 2030, 20cm by 2050, and 39cm by 2080, according to projections from the Inter Sectoral Impact Model Intercomparison Project (ISIMIP) **(Figure 17)**. This rise poses substantial risks to coastal communities, infrastructure, and ecosystems, intensifying challenges such as coastal erosion, saltwater intrusion, and higher storm surges. These impacts can result in land loss, contamination of freshwater resources, and severe damage to property and livelihoods. To address these threats, Ghana's adaptation strategy must 38 prioritize effective coastal zone management, protective infrastructure development, and proactive community relocation plans (GoG, 2021).

**Figure 17: Sea level rise projections for the coast of Ghana for different GHG emissions scenarios, relative to the year 2000**




***Source: GoG, 2021; World Bank (2025) Climate Change Knowledge Portal***

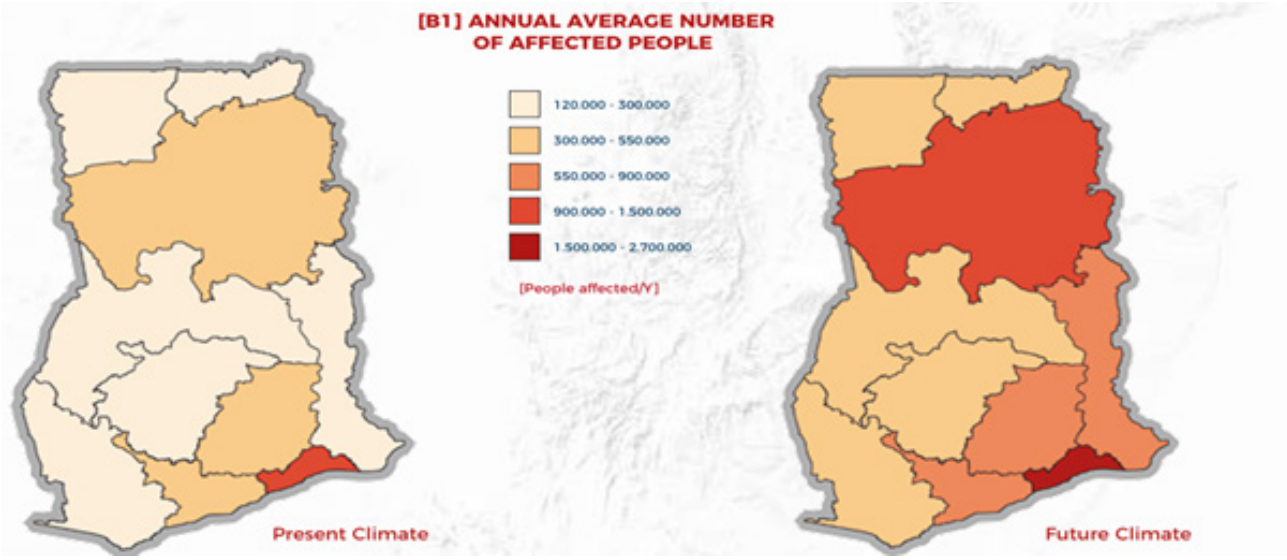
### 3.3.3 Drought

Droughts can have devastating effects on agriculture, water resources, and livelihoods, especially in the northern part of Ghana that is heavily dependent on rainfall for farming. Rainfall variability is projected to rise according to the revised NDC (2021), with projections suggesting that the frequency of severe rainfall events may increase even while overall annual rainfall declines. Projections indicate that by the 2050s, the total annual rainfall in northern Ghana could decline by as much as 10%, hence worsening drought conditions (Ghana NCCAS, 2019). These changes present a serious challenge for DRR efforts, as they increase the frequency of both droughts and floods, requiring improved infrastructure, water management, and early warning systems in urban areas. Prolonged periods of drought may decrease river and groundwater levels, impacting water availability for domestic use, agriculture, and other critical sectors.

Monitoring drought incidence enables stakeholders to identify high-risk zones and implement early warning systems and proactive measures, such as drought-tolerant crop and improved irrigation techniques. For example, Ghana could benefit from targeted interventions such as water conservation practices and reforestation projects to enhance resilience, given it experiences periodic droughts. **Figure 18** represents the annual average of population potentially affected by at least three months of drought conditions, as calculated using the standardized precipitation-evapotranspiration index (SPEI) and using a 3-month accumulation period.

In Ellembelle District for example, the dual threats of water scarcity and contamination stand

**Figure 18: Annual average of population potentially affected by at least three months of drought conditions.**



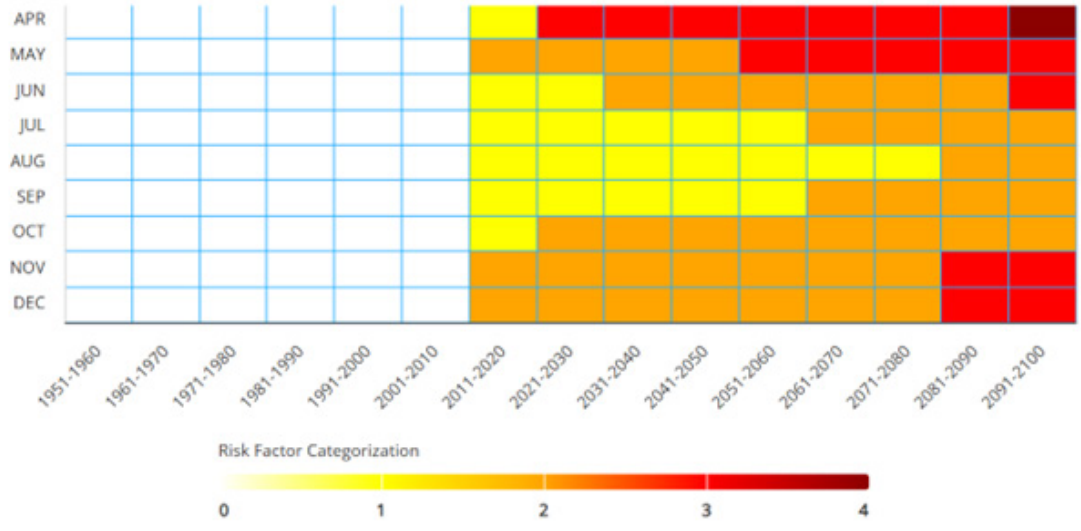

***Source: Ghana Disaster Risk Profile (2019)***

at the forefront of climate-related challenges (EPA, Ellembelle CCRA 2024). The district, characterized by its variable rainfall patterns, experiences periods of intense droughts interrupted by extreme weather events such as floods. Reduced water availability can also lead to overreliance on limited sources, which may not be sustainable.

### 3.3.4 Heat Stress

Climate change is significantly increasing heat exposure across Ghana, particularly in the sudan savannah and forest zones. Temperatures (especially the minimum) is rising faster

**Figure 19: Heat plot for Heat Day Heat Risk Categorization for Ghana, SSP5-8.5; 50th percentile**



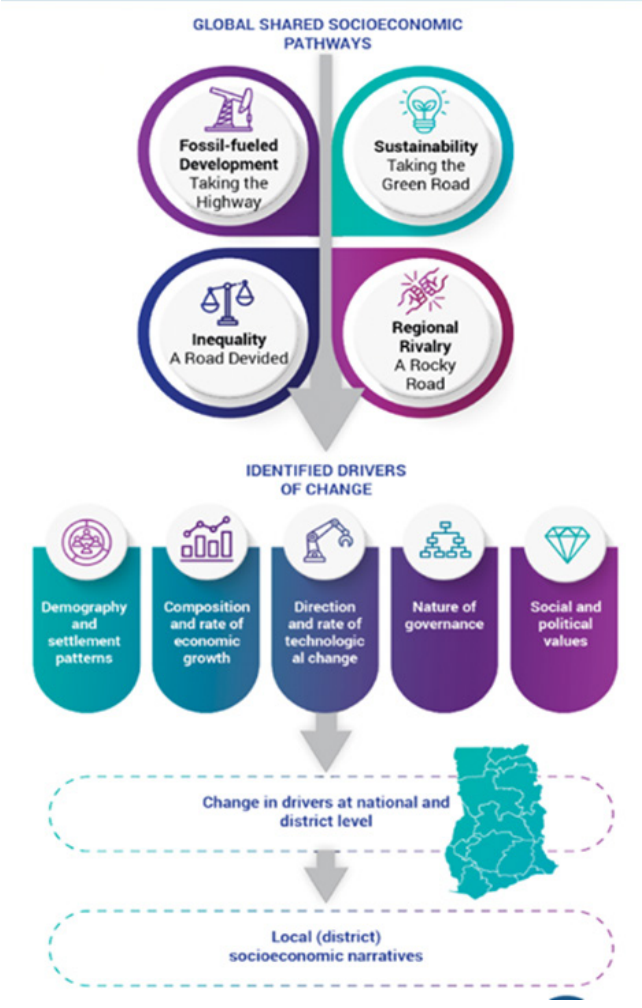

***Source: World Bank (2025) Climate Change Knowledge Portal***

while humidity is declining significantly especially in the forest zone. The Sudan Savannah experiences the worst extreme heat conditions followed by guinea savannah and the forest zones, making them the most vulnerable to heat-related impacts. Seasonally, heat risks are highest from late dry season to early wet season (November – May with peak in March-April) (Adjei, et al., 2025).

### 3.4 Socio-Economic Scenarios

In addition to the different climate projections for the future, it is also important to understand how pathways for socio-economic development in Ghana may differ and can impact on

**Figure 20: Socio-Economic Scenarios**




***Source: EPA (2023) Summary for Decision Makers: Climate Projections and Climate Risks for Ghana***

the risks and vulnerabilities of the population and economy. Socio-economic development scenarios for Ghana were developed based on the four Shared Socio-economic Pathways (SSPs) used by the Intergovernmental Panel on Climate Change (IPCC). The four SSPs, the identified drivers of change and the methodology for localizing these narratives in the Ghana context are outlined in the following figure.

**Table 5: Economic Sectors of Development in Ghana under Localised Socioeconomic Scenarios**

| Sectors | Narratives for the future of Ghana's five economic sectors of development based on three socio-economic scenario pathways |
|---|---|
| **Agriculture** | Description: Agriculture is the largest employer of the labour force in Ghana. The sector is predominantly rainfed and characterized by subsistence and by smallholder farmers. Impacts of climate change through changes in rainfall and temperature leads to decline in yields.<br>1. Ghana High Road: government prioritizes adaptation actions that are either nature based or technology-based solutions to mitigate impacts of climate change in the sector<br>2. Business as Usual: The sector faces low productivity due to climate risks associated with floods and droughts, pest and disease, increased soil erosion and land degradation. The overreliance in inorganic fertilizer remains unsustainable low productivity and increased mitigation of youth to urban centres for jobs leaving aging workforce in the sector<br>3. Ghana Low Road: the negative impacts of climate change in the sector will be exacerbated lack of government oversight and support, leading to efficiencies in the food systems while the government considers adopting either nature based or technology-based solutions for mitigation causing uncertainty to the private investors |
| **Energy** | **Description:** source of energy/ or electricity in Ghana is hydrothermal fuelled by crude oil, natural gas, diesel and solar. The rapid population, urbanization and rising temperatures will result in increased energy demand. The hydropower will be at risk due to declining water levels to power the electricity turbines Ghana High Road: Government faces two policy options to address these challenges: nature-based solutions like solar, wind, biomass and hydro power or technological based solutions (solar, nuclear power and energy efficient technologies. The challenge is corruption, lack of transparency, favouritism, and regional imbalances hinder the success of these initiatives, affecting energy production and pricing of electricity<br>1. Business as Usual: Government Continues to prioritize thermal power plant ignoring sustainable energy solutions such as solar or wind leading to expensive renewable energy due to subsidies or unsustainable sources fostering public outcry and increased reliance on firewood or charcoal and worsening of pollution as energy demand grows jeopardizing the country efforts on climate change<br>2. Ghana Low Road: The reactiveness of government may lead to energy crisis in the short term and without adequate preparation, the impacts of climate change will affect the different sources of energy in the country |

| Sectors | Narratives for the future of Ghana's five economic sectors of development based on three socio-economic scenario pathways |
|---|---|
| **Health** | **Description:** impacts of climate change increases the vector borne and water borne diseases presenting a challenge to the health infrastructure and the impact will be influence by the available policy options<br>1. Ghana High Road: The government of Ghana considers nature or technological based solutions to address the health challenges through adequate planning leading to improved health outcome, hiring of ore health care works on use on new health care technologies, either nature based, or technology based<br>2. Business as Usual: GoG remains reactive which exposes healthcare to poorly prepared health systems that react to emergencies leading to the country's high prevalence to water and vector borne diseases due to limited healthcare infrastructure and low awareness to meet the population health needs<br>3. Ghana Low Road: Adoption of green spaces, urban greening, application of technologies in healthcare and precision medicine, telemedicine. However, corruption, hinders access to government healthcare services, limited regional and global integration preventing information sharing on access to vaccines and proactive management options |
| **Water Resources** | **Description:** Water resources face climate risks associated with floods and droughts, thus the need for sustainable management of water sources for quality and quantity including development of new water sources and proper water disposal<br>1. Ghana High Road: GoG explores nature or technology-based solutions leading to protection of water and implementing new technologies to manage water effectively, thus reduced vulnerability of water resources<br>2. Business as Usual: GoG takes minimal action to protect the water resources leading to depletion of water resources through unsustainable practices and destruction of water reservoirs and wetland<br>3. Ghana Low Road: Nature or technological based solutions enhancing wetland and coastal ecosystem rehabilitation and restoration, water storage, promotion of water efficient technologies, recycling and reuse, smart water networks. However, corruption, weak low enforcement, conflicting policies, limited regional and global integration exacerbate the impacts of climate change on water resources. |

| Sectors | Narratives for the future of Ghana's five economic sectors of development based on three socio-economic scenario pathways |
|---|---|
| **Infrastructure** | **Description:** The infrastructure and transport sectors face climate risks associated with flooding washing away critical infrastructure or road networks affecting the transport and communication system<br>1. Ghana High Road GOG employs proactive measures to climate proof the infrastructure systems through technological based solutions, regional integration cross country projects, collaborative projects, sensitization enhancing the infrastructure resilience<br>2. Business as Usual: Limited action to enhance the resilience of the infrastructure and road networks, thus increasing the vulnerability of the infrastructure to impacts of climate change<br>3. Ghana Low Road: The government of Ghana adopts Nature or technological based solutions to enhance the resilience of the infrastructure systems including planning, implementation of climate resilient infrastructure projects. However, corruption, weak or low enforcement, conflicting policies, limited regional and global integration exacerbates the impacts of climate change on the infrastructure. |

***Source: EPA (2023), Socioeconomic Scenarios at the National and Sub-National Levels for Ghana***

# 4

# Sectoral Climate Risks, Vulnerabilities, Impacts and Adaptation Actions in Ghana

Conducting climate risk assessments is one of the critical steps in understanding the vulnerabilities, risks and hazards associated with the impacts of climate change. Between 2023 and 2024, various climate risk assessments, as part of the NAP process in Ghana, were carried out for key sectors and in several districts.

Climate hazards and vulnerabilities are critical aspects for understanding and addressing the impacts of climate change. Vulnerability refers to the susceptibility of a system, community, or individual to harm due to exposure to climate hazards, which include events such as floods, droughts, storms, and heat waves. Key factors influencing vulnerability include:

i. Exposure – The degree to which people or assets are in harm's way;

ii. Sensitivity – Extent to which a system is affected by climate hazards; and

iii. Adaptive Capacity – The ability to respond and recover from climate impacts.

Effective strategies to reduce vulnerabilities therefore often involve enhancing resilience, improving infrastructure, fostering sustainable development and supporting safe and planned human mobility options including climate-induced displacement management. Ghana's adaptation options therefore focus on strengthening resilience at both the national and local levels.

A comprehensive economic appraisal, that quantifies financial and economic costs and benefits, was done for the prioritized adaptation options for each of the focal sectors: biodiversity and ecosystems, agriculture, water, health, and cities/disaster risk reduction. It emphasizes the complementary nature of adaptation actions to inform sustainable financing, policy integration, and implementation. Drawing on prior sectoral vulnerability assessments, the analysis evaluates adaptation investments' potential to avert climate-induced losses, using a framework that links stressors, impacts, and economic outcomes (e.g., mangrove restoration to mitigate coastal erosion).

The primary objective is to identify viable adaptation strategies, compute cost-benefit streams, and prioritize options based on efficiency metrics such as Benefit-Cost Ratio (BCR), Net Present Value (NPV), and Internal Rate of Return (IRR).

This section explores Ghana's risk profile and the key vulnerabilities that influence national adaptation efforts in the priority sectors. The assessments inform the integration of climate risk management into national adaptation plans through an evaluation of the physical, socio-economic, and environmental vulnerabilities. It outlines the proposed adaptation actions designed to address the vulnerabilities and enhance the resilience of key sectors, and at local level. Further, it highlights the exponential reduction in economic losses from climate effects through targeted investments, while acknowledging residual risks. Gender, youth, and indigenous knowledge are cross-cutting themes, ensuring inclusive and equitable adaptation.

## 4.1 Agriculture

### 4.1.1 Risks, Vulnerabilities and Impacts for the Crops Sub-Sector

The projected intensification of hazards such as extreme rainfall, droughts and rising temperatures threaten crop production **(Table 6)**. Heavy rainfall events increasingly cause river overflows, flash floods, soil erosion and waterlogging of crops, reducing yields and heightening food insecurity, especially among subsistence farmers. On the other hand, prolonged dry spells and higher temperatures lower soil fertility, increase pest and disease outbreaks, and reduce water availability for crops (Abubakari and Abubakari, 2015; C. Kyei-Mensah et al., 2019). These impacts are particularly severe for smallholder rain-fed farming systems, which dominate crop production in Ghana (Kyei-Mensah et al., 2019). A summary of the risks and vulnerabilities and resultant impacts for the crop sub-sector of agriculture are summarized in the table below.

**Table 6: Risks, Vulnerabilities, and Impacts in the Crop Sub-Sector**

| Risks and Vulnerabilities | Impacts |
|---|---|
| **Erratic Rainfall Patterns**<br><br>Unpredictable rains delay planting and reduce crop yields (e.g cacao, maize and yam). | • Disrupts traditional planting calendars, leading to late planting or staggered planting schedules<br><br>• Inconsistent water supply during critical growth stages such as germination and vegetative growth can stunt plant development. |

| Risks and Vulnerabilities | Impacts |
|---|---|
| **Flooding**<br><br>Heavy rains in areas such as Volta and Greater Accra Regions waterlog farms an=d destroy crops. | • Floodwaters wash away nutrient-rich topsoil, leading to reduced soil fertility.<br>• Prolonged saturation of fields inhibits plant respiration and nutrient uptake, stunting crop growth.<br>• Standing water fosters the proliferation of pests like stem borers and diseases such as root rot and fungal infections.<br>• Increased frequency and severity of extreme weather events like floods can damage crops and degrade soil quality, making land less suitable for agriculture. |
| **Increasing temperature**<br><br>Higher temperatures stress crops, reducing yields and crop failures. | • Increases evaporation rates and reduces water availability for irrigation.<br>• Shifts planting and harvest times.<br>• Extreme heat events can lead to crop loss due to wilting and drought.<br>• Warmer temperatures foster the growth of pests and pathogens.<br>• Higher temperatures can lead to heat stress on crops, reducing their yields. |
| **Droughts**<br><br>Prolonged dry periods in the Savannah Region inhibit crop growth. | • Reduces the availability of water for irrigation, affecting crop growth.<br>• Critical growth stages, such as flowering and fruiting, are disrupted, leading to smaller or fewer yields.<br>• Reducing the soil's water retention capacity, making it harder for crops to recover even after rains resume.<br>• Causes the buildup of salts in soil, which harms crop growth and soil fertility.<br>• Increased frequency and severity of extreme weather events like droughts can damage crops and degrade soil quality, making land less suitable for agriculture. |

| Risks and Vulnerabilities | Impacts |
|---|---|
| **Heat stress**<br><br>Occurs when temperatures exceed optimal levels, damaging plant tissues and hindering growth. | • Heat stress causes cellular breakdown, leading to permanent damage in plant tissues.<br>• Crops mature too quickly under heat stress, reducing yield potential<br>• Impairs root development, limiting nutrient and water absorption.<br>• Unlike drought, heat stress causes excessive water loss from both soil and plant surfaces. |
| **Pests and Diseases**<br><br>Fall armyworm infestations and cocoa black pod disease reduce harvests. | • Lower the productivity of plants by affecting growth and fruiting stages.<br>• Increased production costs as Farmers must spend more on pesticides, fungicides, and labour for pest and disease management.<br>• Reduced harvests lead to lower sales, affecting household livelihoods, especially for cocoa-dependent farmers.<br>• Warmer temperatures and changing precipitation patterns can expand the range of agricultural pests and diseases, which can damage crops and reduce the amount of productive land. |
| **Soil Degradation**<br><br>Continuous farming, bush burning, and deforestation degrade soils, especially in the Upper East Region | • Continuous farming depletes essential nutrients, while bush burning and deforestation destroy organic matter critical for soil health.<br>• It also reduces water infiltration and root penetration. |
| **High Input Costs**<br><br>Rising fertilizers, seeds, and pesticide costs limit smallholder farmers' productivity. | • Suboptimal fertilizer applications lead to weaker plants being more prone to pest damage and diseases.<br>• Many smallholder farmers cannot afford improved or high-yield seed varieties, relying instead on lower-quality traditional seeds.<br>• Farmers may forgo pest and disease management, resulting in increased losses from infestations like fall armyworm or fungal diseases. |

| Risks and Vulnerabilities | Impacts |
|---|---|
| **Sea Level Rise** | • Rising sea levels can lead to the salinization of coastal agricultural lands, making them unsuitable for crop production. This can reduce the productivity of these lands and force farmers to abandon them or switch to salt-tolerant crops.<br>• Coastal erosion, driven by rising sea levels, can lead to the loss of valuable agricultural land. This reduces the total area available for farming, which can impact food production and security.<br>• Sea level rise can contaminate freshwater sources with saltwater, affecting irrigation systems. This can make it difficult for farmers to access the freshwater needed for crop cultivation, further reducing agricultural productivity.<br>• Increased sea levels can lead to more frequent and severe coastal flooding. Floodwater can damage crops, erode soil, and wash away nutrients, leading to lower crop yields and increased costs for farmers to restore their fields. |
| **Post-Harvest Losses**<br>Poor storage facilities cause losses in crops like maize and tomatoes. | • Post-harvest losses reduce the availability of marketable produce, impacting both farmers and consumers.<br>• Unreliable harvests discourage investment in agriculture, particularly among younger farmers.<br>• Seasonal unemployment increases as farming activities become less predictable. |

***Source: EPA CRVA-Agriculture Sector, 2024***

### 4.1.2 Risks, Vulnerabilities and Impacts for the Fisheries Sub-Sector

The food production industry in Ghana also includes fishing. Statistics indicate that 10% of Ghana's population was supported by the fishing industry as of 2019 (Climate Reality Project, 2023); however, it faces challenges including the rising water temperatures in fish migratory and reproductive paths. Projections indicate that by 2050 climate change could deplete fish catch by 26% (World Bank Group, 2019). Aquaculture, especially in Volta Lake and river, is one of the fastest growing animal food producing sectors offering employment and food security to the ever-increasing human population in Ghana (Asiedu et al., 2015). Aquaculture production in Ghana has increased from 5,000 tons in 2000 to 38,547 tons in 2017 with annual per capita fish consumption of 28 kg (Asiedu, et al., 2017). Aquaculture production systems in Ghana include earthen ponds, tanks, cages, pens and raceways depending on the culture system being adopted and can also be in the freshwater and marine environs (Asiedu et al., 2015). Climate change impact can negatively affect these ventures as water availability becomes challenged or that the constituents of the water bodies are varied due to climate change (Asante and Amuakwa-Mensah, 2015). The main

impacts resulting from identified risks and vulnerabilities on the fisheries sub-sector are outlined in **Table 7** below.

**Table 7: Risks, Vulnerabilities, Impacts and Adaptation Actions in the Fisheries Sub-Sector**

| Risks and vulnerabilities | Impacts |
|---|---|
| **Sea Level Rise**<br>Approximately 30% of Ghana's population lives in coastal areas, making them highly vulnerable to sea level rise. | • Erode land, threatening homes, infrastructure, and farmland in coastal areas.<br>• Sea level rise threatens coastal ecosystems like mangroves and wetlands, disrupting biodiversity and fishing resources. |
| **Floods**<br>Occur from heavy rains, often causing widespread waterlogging in fishing areas. | • Pollutants from floodwaters harm fish populations.<br>• Fish are swept away from their habitats during floods.<br>• Floods destroy fishing gear and boats, disrupting operations. |
| **Storms**<br>Storms in Ghana bring strong winds and heavy rainfall, affecting coastal and inland fishing activities. | • Results in coastal erosion reducing available fishing grounds along the coast.<br>• Storms prevent access to fishing areas, affecting catch.<br>• Storms damage boats and equipment, halting fishing activities. |
| **Rising Sea Temperatures**<br>Changes in sea temperature disrupt fish breeding and migration, reducing availability. | • Interfere with the reproductive cycles of fish, reducing population growth.<br>• Force fish to migrate to cooler areas, making them less accessible to local fisheries.<br>• Lead to lower fish catches, affecting food security and income for fishing communities. |
| **Droughts**<br>Result from prolonged dry spells, reducing water levels in rivers and lakes. | • Low water levels limit fishing areas and habitats.<br>• Leads to higher temperatures and reduced oxygen levels in water.<br>• Fish may move to other areas, reducing local fish populations. |

| Risks and vulnerabilities | Impacts |
|---|---|
| **Heatwaves**<br>Heatwaves in Ghana cause unusually high temperatures, raising water temperatures in aquatic environments. | • Slow down fish growth rates, as higher temperatures affect metabolic functions.<br>• Alter aquatic ecosystems, damaging the delicate balance of habitats for fish.<br>• Elevated water temperatures during heatwaves encourage the growth of harmful algal blooms, which deplete oxygen and poison aquatic life. |
| **Overfishing**<br>Excessive fishing along Ghana's coastlines depletes fish stocks, especially sardines and mackerel. | • Depletion of fish stocks reduces livelihoods for thousands of artisanal fishers and their families.<br>• Fishermen face income loss as fish stocks declines, impacting local economies dependent on fishing.<br>• Disturbs the balance of marine ecosystems, affecting biodiversity and the health of coastal environments. |
| **Coastal Erosion**<br>Communities in the Western and Central Regions lose fishing sites due to rising sea levels and erosion. | • Eliminates vital fishing grounds, reducing access to marine resources for local communities.<br>• Rising sea levels force coastal communities to relocate, either temporally or permanently, disrupting livelihoods and increasing poverty. |
| **Illegal Fishing Practices**<br>The use of light and chemicals damages marine ecosystems and reduces fish populations. | • Illegal fishing practices reduce long-term fish availability, affecting future generations of fishers.<br>• Undermines sustainable practices, leading to income losses for legitimate fishers and harming the fishing industry. |
| **Pollution**<br>Water bodies like the Pra and Ankobra Rivers are contaminated by mining and industrial waste, killing aquatic life. | • Contaminated water bodies affect drinking water supplies, agricultural irrigation, and fishing activities.<br>• Reduces fish catch and damage industries dependent on clean water, leading to financial losses.<br>• Harm breeding grounds for fish, leading to reduced fish populations and lower yields for local fisheries. |
| **Decreased Water Quality** due to higher temperatures and runoff from intense rainfall | • Leads to oxygen depletion, harming fish and other aquatic species.<br>• Reduces fish populations, affecting catch rates and the livelihoods of fishermen.<br>• Foster the growth of pathogens, leading to disease outbreaks in fish and other aquatic organisms. |

| Risks and vulnerabilities | Impacts |
|---|---|
| **Shifts in Fish Distribution**<br><br>As marine some fish species may migrate to cooler or deeper waters, making them less accessible to local fishers. | • Forces fishermen to travel farther, increasing costs and reducing the efficiency of traditional fishing methods.<br>• As fish become less accessible, fishing communities face income loss and increased financial pressure due to reduced catches<br>• Affects the availability of popular fish species, disrupting local markets and food supply chains forcing most of the able youth to migrate to cities.. |

***Source: EPA (2024), CRVA-Agriculture Sector.***

### 4.1.3 Risks, Vulnerabilities and Impacts in the Livestock Sub-Sector

The livestock sector which contributed over 8% of the nation's GDP in 2020 is similarly affected by unpredictable rainfall and heat stress. These climatic factors have led to reduced availability of both fodder and water, increasing competition for resources and thus compelling herders to change their mobility patterns. While livestock numbers have steadily increased over the past decade as on **Table 8**, in the long-term, the numbers are projected to reduce due to erratic climate conditions (EPA, 2024; Amoah, 2022).

**Table 8: Trends of Livestock Population ('000)**

| Livestock Type | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Cattle** | 1,543 | 1,590 | 1,657 | 1,734 | 1,815 | 1,901 | 1,943 | 2,032 | 2,109 | 2,174 |
| **Sheep** | 4,019 | 4,156 | 4,335 | 4,522 | 4,522 | 4,978 | 5,102 | 5,333 | 5,544 | 5,695 |
| **Goat** | 5,435 | 5,751 | 6,044 | 6,352 | 6,740 | 7,151 | 7,366 | 7,764 | 8,180 | 8,411 |
| **Pig** | 602 | 638 | 682 | 730 | 777 | 816 | 845 | 894 | 946 | 785 |
| **Poultry** | 57,885 | 63,732 | 68,511 | 71,594 | 73,885 | 75,363 | 76,870 | 79,391 | 81,769 | 81,487 |

***Source: Ghana MoFA, 2022***

The sensitivity of livestock production to climate change and extremes is more pronounced in rural areas characterized by extensive and free-range livestock keeping systems. Pastoral households and other livestock keepers in these systems experience complex and localized impacts of climate change, mainly because of their constrained adaptive capacities. Further climate change and variability is anticipated to increase the susceptibility of the livestock industry and exacerbating impacts on livestock systems, incomes and food security in Ghana (Thornton et al., 2015; Sarkwa et al., 2016). **Table 9** provides a summary of the climate risks, vulnerabilities and impacts in the livestock sub-sector.

**Table 9: Risks, Vulnerabilities, and Impacts in the Livestock Sub-Sector**

| Risks and vulnerabilities | Impacts |
|---|---|
| **Heat Stress** – Rising temperatures in northern Ghana reduce livestock productivity and fertility. | • Reduces appetite, slowing growth rates in cattle, sheep, goats, and poultry.<br>• Affects hormone regulation in livestock, leading to lower conception rates in cattle, sheep, and goats.<br>• Rising temperatures can cause heat stress in animals, leading to reduced growth rates, lower milk production, and decreased fertility. This can affect the overall productivity and profitability of livestock farming. |
| **Drought** – Limited water and pasture during the dry season affect cattle, sheep, and goats. | • Leads to dehydration, reducing livestock productivity and increasing mortality risks.<br>• Reduces forage availability, leaving cattle, sheep, and goats with inadequate nutrition.<br>• Reduces fertility rates leading to lower birth rates among cattle, sheep, and goats. |
| **High temperatures** – Stress livestock, leading to reduced productivity and health issues. | • Livestock experience discomfort, reducing feeding and growth rates.<br>• Weakens immunity, making animals more prone to infections.<br>• Increase water demand, straining available resources.<br>• Reduces lactation in dairy animals. |
| **Erratic rainfall** – Unpredictable rainfall patterns disrupt feed availability and water supply, stressing livestock. | • Uneven rainfall affects pasture growth, limiting food for livestock.<br>• Reduces water supply, stressing animals and increasing costs.<br>• Inadequate nutrition from poor grazing reduces livestock weight gain. |
| **Flooding** – Excessive rainfall causes water accumulation, affecting livestock and their environment. | • Submerges pastures, reducing available feed.<br>• Flooded areas create conditions for waterborne diseases to spread.<br>• Floods can drown livestock or cause injury, leading to higher death rates.<br>• Floodwaters destroy barns and animal enclosures, exposing livestock to harsh conditions. |
| **Disease Outbreaks** Livestock diseases such as anthrax and Newcastle disease kill animals, particularly in rural areas. | • Farmers lose revenue from the sale of livestock, milk, eggs, and other animal products.<br>• Farmers incur higher costs for veterinary services, vaccines, and treatments to manage outbreaks.<br>• Death of breeding stock reduces future herd or flock sizes, affecting long-term productivity. |

| Risks and vulnerabilities | Impacts |
|---|---|
| **Lack of Veterinary Services** – Inadequate access to veterinary care leaves livestock vulnerable to infections. | • Farmers lose potential earnings from the sale of livestock and animal products due to disease-related deaths and productivity losses.<br>• Without veterinary services, farmers cannot obtain essential vaccines, dewormers, or antibiotics.<br>• Farmers lack guidance on early detection of diseases, leading to delayed responses and more severe outbreaks. |
| **Feed availability** - The accessibility and sufficiency of feed resources necessary for livestock nutrition. It includes the quantity and quality of forage, grains, and other feedstuffs that animals consume to maintain health and productivity. | • Climate change can affect the availability and quality of feed. Droughts and extreme weather events can reduce the growth of pasture and forage crops, leading to feed shortages. This can increase the cost of feed and reduce the nutritional intake of livestock.<br>• Climate change can lead to unpredictable weather patterns, such as prolonged droughts and erratic rainfall, which can reduce the growth of pasture and forage crops. This results in lower feed availability and quality, affecting livestock nutrition and productivity.<br>• With reduced natural forage, farmers may need to rely more on purchased feed, which can be expensive. This increases the cost of livestock production and can reduce profitability.<br>• Poor feed availability can lead to nutritional deficiencies in livestock, affecting their growth, reproduction, and overall health. This can result in lower milk yields, reduced meat production, and higher mortality rates.<br>• As climate change affects crop yields, there may be increased competition between human food needs and livestock feed production. This can further strain feed resources and impact livestock farming.<br>• Farmers may need to adopt new practices, such as growing drought-resistant forage crops or improving feed storage techniques, to cope with changing feed availability. These adaptations can be costly and require technical knowledge and support. |

| Risks and vulnerabilities | Impacts |
|---|---|
| **Water Scarcity** - The lack of sufficient available water resources to meet the demands of water usage within a region. | • Changes in rainfall patterns and increased frequency of droughts can lead to water shortages. Livestock require substantial amounts of water for drinking and maintaining body functions, and water scarcity can lead to dehydration and increased mortality rates.<br>• Water scarcity affects the growth of feed crops like corn, soy, and alfalfa, which are essential for livestock nutrition. Reduced feed availability can lead to higher feed costs and lower nutritional intake for animals.<br>• In hot climates like that of Ghana, water is crucial for cooling livestock. Without adequate water, animals can suffer from heat stress, which can decrease their growth rates, milk production, and reproductive efficiency.<br>• The combined effects of water scarcity can increase the costs of livestock production. Farmers may need to invest in alternative water sources or reduce herd sizes, leading to decreased market availability and higher prices for meat and dairy products.<br>• Limited water resources can increase the risk of contamination and the spread of diseases among livestock. Animals may be forced to drink from the same dwindling water sources, which can become breeding grounds for pathogens. |

**tion Actions for the Agriculture Sector**

acts on a critical sector for Ghana's economy and the well-being of the

***Source: EPA (2024), CRVA-Agriculture Sector.***

population, a sectoral adaptation plan for Agriculture was developed with goal of reducing the sector's vulnerability to the adverse impacts of climate change by building adaptive capacity and resilience. It aims to facilitate the integration of climate change adaptation into existing and future fiscal, regulatory, and development policies, programs, and activities. The plan supports sustainable agricultural development by promoting practices that enhance productivity while conserving natural resources. It focuses on strengthening the capacity of farmers, agricultural institutions, and other stakeholders to adapt to climate change through training, education, and access to climate-resilient technologies. **Table 10** is a summary of the priority actions identified for the agriculture sector. A full adaptation plan for the agriculture sector is available on the NAP website and provides further details on the proposed actions, gender considerations and a Monitoring and Evaluation framework.

### 4.1.5 Economic Analysis of Agriculture Adaptation Actions

## Table 10: Summary of Agriculture Sector Adaptation Actions

| Sub-Sector | Priority Adaptation Actions |
|---|---|
| Crop sub-sector | • Ensure women's legal rights to landownership for climate-resilient farming.<br>• Train female extension officers to provide climate-smart farming advice.<br>• Promote women's leadership roles in agricultural decision-making bodies.<br>• Integrate gender considerations into the planning and budgeting processes of government and NGO projects.<br>• Employ rainwater harvesting systems for irrigation during dry periods.<br>• Promote the adoption of drought- and pest-resistant crop varieties<br>• Promoting integrated crop pest management practices<br>• Adoption of efficient irrigation systems<br>• Livelihood diversification<br>• Planting of drought-resistant varieties of crops<br>• Adjustment of farming schedules to align with changing climate patterns<br>• Promotion of vertical gardening techniques<br>• Encourage the use of crop varieties<br>• Crop diversification<br>• Use of improved seeds<br>• Use of climate-smart agricultural practices<br>• Promotion of farming practices to restore degraded ecosystems<br>• Provision of technical services to farmers<br>• Implement conservation agriculture techniques<br>• Implement crop insurance schemes |

| Sub-Sector | Priority Adaptation Actions |
|---|---|
| Livestock sub-sector | • Training and capacity building<br>• Develop heat-tolerant livestock breeds that can withstand increasing temperatures in tropical regions.<br>• Create drought-resistant pasture and fodder crop varieties to ensure consistent animal feed.<br>• Introduce silvopastoral systems integrating trees and livestock for enhanced environmental resilience.<br>• Implement rotational grazing strategies to prevent land degradation and maintain pasture health.<br>• Implement improved animal housing designs with better ventilation and cooling systems.<br>• Develop portable shade structures for livestock during extreme heat conditions.<br>• Develop precision livestock farming technologies using digital monitoring systems.<br>• Implement water harvesting and efficient water management techniques for livestock farming<br>• -Develop lightweight, breathable animal gear for temperature management.<br>• Establish community-based livestock insurance schemes to protect farmers against climate-related losses.<br>• Train farmers in climate-adaptive livestock management techniques and best practices.<br>• Develop mobile veterinary services with real-time disease monitoring and early warning systems.<br>• Establish regional fodder banks to ensure consistent feed during prolonged dry seasons.<br>• Create localized livestock disease resistance breeding programs.<br>• Develop early warning systems for climate-related livestock health risks.<br>• Establish community-based animal health worker training programs.<br>• Create market linkages that incentivize climate-resilient livestock production.<br>• Access to weather forecasts and early warnings |

| Sub-Sector | Priority Adaptation Actions |
|---|---|
| Fisheries sub-sector | • Capacity building and training<br>• Implement marine protected areas to preserve critical fish breeding and nursery habitats.<br>• Promote aquaculture and diversify fish species for climate resilience.<br>• Develop climate-adaptive fish breeding programs focusing on temperature-resistant species.<br>• Establish regional fish gene banks to preserve genetic diversity.<br>• Create comprehensive marine ecosystem restoration strategies targeting critical coastal zones.<br>• Develop marine biodiversity conservation strategies targeting vulnerable fish species.<br>• Establish community-based fish breeding and restocking programs.<br>• Enhancement of Biodiversity<br>• Develop advanced marine monitoring systems to track fish population changes due to climate shifts.<br>• Create climate-resilient aquaculture technologies for sustainable fish production.<br>• Implement precision aquaculture technologies using satellite and drone monitoring.<br>• Introduce advanced fish tracking and migration pattern technologies.<br>• Develop early warning systems for marine ecosystem temperature changes.<br>• Implement advanced coastal zone management techniques to protect marine habitats.<br>• Develop innovative fish processing technologies that reduce post-harvest losses.<br>• Implement sustainable fishing gear technologies that minimize environmental impact.<br>• Educate communities on climate-smart fishing practices.<br>• Strengthen regulations against overfishing and illegal fishing practices.<br>• Monitor water quality and implement pollution control measures.<br>• Develop artificial reefs and habitat structures |

***Source: EPA (2024), Climate Change Adaptation Action Plan.***

The agriculture sector in Ghana shows substantial economic gains from adaptation investments. However, these benefits are not evenly distributed across all subsectors or climate scenarios. While adaptation investments generate substantial economic benefits for the sector as a whole, these gains are not distributed evenly across all subsectors or climate scenarios. Crops and fisheries stand out as consistently strong and resilient in terms of economic returns, regardless of the scenario. In contrast, livestock adaptation becomes increasingly difficult and less profitable under high-emission futures, such as the SSP 8.5 scenario.

From a policy standpoint, the analysis underscores the need for a differentiated approach. Crops should remain the backbone of agricultural adaptation, with continued investments in irrigation, improved seed systems, and farmer training. Fisheries are highlighted as a particularly high-value and resilient area, where even modest investments can yield significant benefits. Scaling up aquaculture and strengthening inland fisheries management are recommended strategies for building climate-resilient food and nutrition security. Livestock, while profitable under less stressful climate conditions, is vulnerable under more severe scenarios. This vulnerability calls for transformative interventions, such as the development of climate-resilient feed systems, improved disease management, and diversification of protein sources to buffer against climate shocks.

The economic analysis additionally emphasizes gender-sensitive adaptation, advocates for mandatory female representation in farmer training, extension services, and local adaptation committees through targeted policy interventions.

Beyond the direct financial metrics, the analysis points out that agricultural adaptation actions deliver significant non-market co-benefits. These include stabilizing national food supplies, reducing hunger risks, improving dietary diversity, supporting poverty reduction and rural livelihoods, empowering women, and promoting ecosystem health through sustainable practices. While these non-market benefits are not fully captured in standard economic indicators like the Benefit-Cost Ratio (BCR) and Internal Rate of Return (IRR), they greatly strengthen the overall justification for sustained and scaled investment in agricultural adaptation as a central pillar of the GNAP.

## 4.2 Water Sector

Climate change is expected to worsen Ghana's water security problems, and this will have socioeconomic consequences. Agriculture and access to safe and reliable drinking water will be impacted. Reduced water supply will have a negative impact on hydropower, which provides 54% of the country's electricity capacity. Additionally, Ghana will likely see a rise in diseases such as malaria, dengue fever and cholera due to changes in water conditions (Awuni, et al., 2023).

The Volta Basin flows could also be reduced by as much as 24% by mid-century and by as much as 45% by end of the century due to reduced rainfall and increased evaporation. Clean water and sanitation are a challenge for some areas and communities in Ghana, where approximately 25% of the population lacks access to clean water. Declining rainfall, increased levels of drought and rising temperatures in addition to increased pressures from a growing population, urbanization, and industrialization are likely to further compound this issue. The reduced quantity and quality of water will be a significant challenge for human

consumption as well as use in the agriculture, industry and hydropower sectors. Rising sea levels are already increasing salinization in coastal water sources and wells.

A study by Kankam-Yeboah et al (2013) on stream flow in two river basins namely White Volta and Pra projected reduction in stream flow by 50 and 46 % respectively by 2050. Surface runoff is said to be sensitive to changes in rainfall distribution and amount as well as temperature. Thus, a reduction in annual river flows will result in reduction in annual total runoff. If the runoff from rainfall flows into rivers and streams is affected by changes in temperature, so too is the water underground storage will be impacted. According to a study by Water Research Institute, 30-40% reduction is projected for river flow and underground water recharge by 2050 (WRI, 2000). An assessment of the impacts of projected climate change on water availability and crop production in the Volta Basin and the southwestern and coastal basin systems of Ghana show that all water demands (municipal, hydropower, and agriculture) cannot be simultaneously met currently, or under any of the climate change scenarios used, including the wet scenarios Amisigo et al. (2015).

Per capita water availability will decline by 2080 mostly due to population growth as almost no change is expected in overall precipitation levels. Model projections indicate that water saving measures will become especially important after 2050 in the north of Ghana.

### 4.2.1 Risks, Vulnerabilities and Impacts for the Water Sector

Recent studies show that Ghana's rainfall season is changing, with delayed onset and early cessation, which negatively impacts agriculture. To adapt, short-duration and drought-resistant crops are being bred. Rainfall distribution is declining due to human activities like deforestation and poor farming practices. Water quality studies reveal sporadic sampling, making it hard to track long-term changes, though some regular studies show increased bacterial contamination during rainy seasons. Mining and urbanization have led to chemical and biological contamination in water sources, with coastal aquifers threatened by saltwater intrusion from rising sea levels. **Table 11** summarizes these risks, vulnerabilities and impacts.

### 4.2.2 Priority Adaptation Actions for the Water Sector

**Table 11: Risks, Vulnerabilities, and Impacts in the Water Sector**

| Risks and vulnerabilities | Impacts |
|---|---|
| • Surface and Ground Water Quality | • Pollution (sources include refuse dumps and latrines). In White Volta Basin 20, 48.8 and 33.2 % of the basin showed low, moderate and high risks while Atankwidi catchment area showed moderate to high risk of groundwater pollution.<br>• Mining areas exhibit high levels of mineralization for example predominant heavy metals that were arsenic in water bodies in Newmont Gold Mining concession areas. |

| Risks and vulnerabilities | Impacts |
|---|---|
| • Rainfall, Evapotranspiration (ET) and Relative Humidity | • Changes in length of rainfall season, with delayed onset and early cessation of rains which affects agricultural production.<br>• General decline in distribution of rainfall in the entire country.<br>• Crop evapotranspiration for rice, tomato, and pepper is estimated at 697 mm, 533 mm, and 427 mm per season, respectively. Since evapotranspiration represents a major component of water loss in the hydrological cycle, increases in ET due to higher temperatures and prolonged dry spells intensify water demand for irrigation. This places additional stress on already scarce water resources, creating risks for food production and making smallholder farmers particularly vulnerable to water shortages. (Lower yields, reduced water availability and potential food insecurity) |
| • Floods<br>• Urban settlements especially Accra, with almost yearly (17) events in 20 years; poorly planned communities; populations living flood-prone areas. | • Displacement, loss of homes, loss of lives and increased dependency on relief support.<br>• Damage to roads and drainage systems.<br>• Water pollution from runoff and soil erosion.<br>• Losses estimated at USD 200 million annually due to floods and droughts. GDP growth at risk with projected increase in floods.<br>• Seasonal unemployment, disruption of livelihoods and widening inequalities on already vulnerable populations. |
| • Droughts<br>• Risks are reduced water availability, declining river flows, uncertainty in drought frequency and duration. | • Potential transboundary tensions over shared water resources.<br>• Crop failures reduced yields and compromised food security due to inadequate irrigation water.<br>• Increased socio-economic stress especially for rural communities dependent on rain-fed farming. |

| Risks and vulnerabilities | Impacts |
|---|---|
| • Sea Level Rise<br>• Saltwater intrusion into coastal aquifers contaminate freshwater supplies; damage to water-related infrastructure; loss of arable land; increased flooding and storm surges | • Contamination on freshwater aquifers, reduced safe drinking water and scarce water for irrigation.<br>• Decline in crop yields and reduced land productivity from soil salinization.<br>• High costs of coastal protection, infrastructure damage, reduced property values and disruption of livelihoods.<br>• Displacement of populations and increased water insecurity.<br>• Stress on coastal wetlands and fisheries and loss of natural storm protection functions. |

***Source: EPA (2024), CRVA- Water Sector.***

Recognizing the serious risks to water security for Ghana posed by climate change, a sectoral adaptation plan for the water sector was developed that identifies adaptations actions to address water challenges in the face of climate change. The plan covers a wide array of solutions including nature-based solutions for healthy and resilient functioning water and ecosystem; a robust flood risk management and monitoring system; protection for critical infrastructure and vulnerable settlements; increased early warning, response and recovery systems; improved urban rainwater harvesting to reduce vulnerability to urban flood disasters and increased water availability for domestic use; increased accessibility to clean and safe water; implementation of climate-resilient irrigation infrastructure; and ensuring sustainable water supply and availability of hydropower generation.

Implementation of these adaptation actions for the water sector requires collaboration with at least one other sector to ensure sustainability. For instance, all irrigation projects requires the active participation of MoFA for effective implementation and adoption by farmers in Ghana. A summary of the water sector adaptation actions are shown on **Table 12** and the full plan is available on the NAP website.

### 4.2.3 Economic Analysis of Water Sector Adaptation Actions

**Table 12: Summary of Water Sector Adaptation Actions**

| Adaptation Actions |
|---|
| Restoration and conservation of wetlands and watersheds |
| Restoration of buffer zones |
| Watershed management |
| Promotion of Indigenous knowledge and practices in water conservation |
| Strengthen research on water resource management including groundwater resources |
| Management plans for River basins |
| Real-time monitoring and forecasting of the flows |

| Adaptation Actions |
|---|
| Climate-smart River Management System |
| Provide climate-resilient infrastructure in critical areas of disaster risk reduction |
| Strengthen capacity in designing and developing climate-resilient infrastructure |
| Monitoring of extreme rainfall events that could cause flood |
| Comprehensive Disaster Management (DM) Plans |
| Improved drought and flood forecasting, preparedness and response system |
| Enhance awareness of communities on water-related hazards |
| Harvesting rainwater for domestic use |
| Adoption of Green roofing in cities |
| Ensuring proper monitoring, planning and supply of drinking water |
| Strengthen drinking water quality monitoring and surveillance |
| Strengthen database on drinking water supply schemes |
| Improve planning, designing and implementation of climate-resilient irrigation infrastructures and systems |
| Integrate watershed management in hydropower planning |

***Source: EPA (2024), Water Sector CRVA***

The water sector analysis highlights both the economic and broader societal implications of adaptation investments. From an economic perspective, groundwater consistently outperforms surface water across all climate scenarios. Its strong BCRs, positive net benefits, and compound annual growth rate (CAGR) underscore its role as a low-cost, high-return adaptation pathway. Surface water, however, is increasingly challenged by escalating infrastructure and management costs, particularly under high-emission scenarios (SSP8.5). Without substantial innovation, efficiency gains, or financial support, large-scale surface water investments risk becoming fiscally unsustainable.

From a policy perspective, these findings suggest that groundwater is the most economically favourable adaptation option, consistently outperforming surface water across all climate scenarios. It offers strong BCRs positive net benefits, and a high CAGR making it a low-cost, high-return pathway. Surface water faces increasing infrastructure and management costs, especially under high-emission scenarios (SSP8.5). Without significant innovation, efficiency improvements, or financial support, large-scale surface water investments may become fiscally unsustainable. The policy implication is that based on the economic argument, groundwater development and protection should be prioritized, while carefully reconsidering the scale and design of surface water projects to ensure economic viability.

The non-market benefits include improved public health where access to safe drinking water reduces the incidence of waterborne diseases. Secure water supply also strengthens the

livelihood resilience of urban populations and industries. Further gender equity is gained from reduced time spent by women and girls collecting water which enhances educational and economic opportunities. There are also benefits from ecosystem services with well-managed water resources that support aquifer recharge, watershed protection, and biodiversity. Finally, disaster risk reduction is achieved through investments in resilient infrastructure and groundwater buffering help mitigate the impacts of droughts and floods.

Water sector adaptation should be viewed not only a cost-benefit lens but also as a strategic enabler of human development, public health and climate resilience. Balancing investments between groundwater expansion, surface water efficiency and ecosystem-based measures is essential for long-term sustainability.

## 4.3 Cities and Disaster Risk Reduction (DRR) Sector

Ghana has experienced rapid population growth since 1960 together with increased urbanization and migration, placing significant pressure on city planning authorities (GSS, 2021; Damte et al., 2023). Urban areas face challenges in providing safe and affordable housing, reliable water supply, sanitation, energy and liveable communities, which are further exacerbated by climate-related hazards and disasters (UNDRR, 2019).

### 4.3.1 Risks, Vulnerabilities, and Impacts in the Cities and DRR Sector

The recurring occurrence of disasters, including floods, heatwaves, and storms has significant social, economic and environmental consequences, highlighting the need to build resilient cities capable of adapting to climate change while maintain social stability and promoting low-carbon development (Pinto 2014, Kelly & Addo, 2023). Vulnerability and risk assessments at the city level help identify projected climate impacts, enabling tailored DRR intervention that reduce exposure and enhance resilience (Nadkarni et at., 2012; OECD, 2020).

Urban DRR in Ghana focuses on four key sectors including housing, infrastructure, public health and waste management. Over 40% of urban residents live in informal settlements with poorly constructed homes, particularly in Accra and Kumasi, increasing susceptibility to floods, fires and heatwaves. Gender and socio-economic inequalities limit access to secure land and climate-resilient housing (UN-Habitat, 2020; Antwi-Ageyi et al., 2015). On infrastructure, inadequate drainage, poorly maintained roads and unreliable energy supply amplify disaster risks, as was seen in Accra floods of 2015. Floods and poor sanitation increase outbreaks of waterborne diseases such as cholera and malaria, disproportionately affecting women, children and the elderly (WBG, 2021). Overburdened health systems together with inadequate healthcare facilities hinder urban resilience and disaster response (Ayumah et al., 2020). Gender-specific vulnerabilities presents additional health risks during disasters, such as limited access to maternal healthcare and sanitation facilities (Antwi-Agyei et al., 2015). Improper waste disposal contributes to blocked drains and urban flooding. Enhancing municipal waste collection, promoting recycling initiatives, and integrating women into formal waste management systems reduce disaster risks and create economic opportunities (KCCI, 2023; UNDP, 2022). A summary of the risks, vulnerabilities and impacts of climate change on cities is provided below in **Table 13**.

### 4.3.2 Priority Adaptation Actions for Cities and DRR

To address vulnerabilities in this sector, a range of adaptation strategies to enhance urban

**Table 13: Risks, Vulnerabilities, and Impacts in the Cities and DRR Sector**

| | |
|---|---|
| **Extreme weather** (heatwaves, floods and droughts) | • Damage to infrastructure such as roads, bridges, drains and housing.<br>• Disruption of transport, water and electricity services. |
| **Sea level Rise and Coastal Flooding** | • Increased erosion in cities such as Accra, Cape Coast, Takoradi and Keta.<br>• Displacement of coastal populations<br>• Salinization of aquifers. |
| **Urban drainage failures and flash flooding** | • Frequent flash floods in Accra.<br>• Property destruction<br>• Displacement of households<br>• Sanitation failures leading to cholera outbreaks. |
| **Socioeconomic vulnerability (poverty, informal settlements** | • Potential transboundary tensions over shared water resources.<br>• Crop failures, reduced yields and compromised food security due to inadequate irrigation water.<br>• Increased socio-economic stress especially for rural communities dependent on rain-fed farming. |
| **Economic shocks and rising disaster costs**<br>Saltwater intrusion into coastal aquifers contaminate freshwater supplies; damage to water-related infrastructure; loss of arable land; increased flooding and storm surges | • Estimated USD 200 million annual losses from floods and droughts<br>• Reduced GDP growth<br>• Heavy reliance on emergency response funds |

***Source: EPA (2024), CRVA- Cities and DRR Sector***

resilience and disaster preparedness were proposed in the Cities and DRR Adaptation Action Plan. The plan encompasses a range of targeted interventions which prioritize inclusive approaches that address the vulnerabilities of women, youth, and marginalized groups while aligning with national policies and frameworks.

The Cities and DRR sector adaptation options are grounded in the principles of the Sendai Framework (UNISDR, 2015). The sector's adaptation options thus encompasses four key priorities for action to enhance urbanisation, while preventing new and reducing existing disaster risks:

i. Understanding disaster risk

ii. Strengthening disaster risk governance to manage disaster risk.

iii. Investing in disaster reduction for resilience and

iv. Enhancing disaster preparedness for effective response, and to "Build Back Better" in recovery, rehabilitation and reconstruction.

Proposed interventions, such as flood risk management, climate-resilient housing, and ecosystem-based adaptation, aim to mitigate climate impacts while fostering inclusive urban development. Their costing analysis adopts a bundled approach. This means actions **(see Table 14)** are grouped into coherent packages that are complementary, reinforcing one another to address interconnected vulnerabilities while maximizing economic, ecological, and social co-benefits. For example, flood risk management measures (e.g., drainage upgrades and early warning systems) are inherently linked to housing and transport resilience, while ecosystem restoration supports both water supply reliability and coastal protection.

A full adaptation plan for the Cities/DRR sector is available on the NAP website and provides further details on the proposed actions, gender considerations and related Monitoring and Evaluation framework.

### 4.3.3 Economic Analysis of Cities and DRR

Adaptation in the cities and DRR sector is essential for building resilient urban environments

**Table 14: Summary of Adaptation Actions for Cities and DRR Sector**

| Sub-sector | Adaptation Actions |
|---|---|
| **Urban and Rural Flood Risk Management & Resilience** | • Community-based flood risk mapping<br>• Hydrological model development<br>• Flood risk management committees<br>• Zoning regulation enforcement<br>• Drainage system upgrades<br>• Retention basins & green infrastructure<br>• Early warning systems for floods<br>• Community evacuation training & drills |

| Sub-sector | Adaptation Actions |
|---|---|
| **Improving Water Supply & Sanitation in Communities** | • Water resource vulnerability assessments<br>• Urban water distribution upgrades<br>• Enforcement against galamsey (illegal mining)<br>• Community-led water source protection<br>• Watershed rehabilitation<br>• Public awareness on sanitation & illegal mining<br>• Housing law enforcement (toilets)<br>• Emergency water storage systems<br>• PPPs for sustainable infrastructure |
| **Strengthened Disaster Preparedness & Emergency Response** | • Inclusive vulnerability assessments<br>• Hazard and risk profiles for all districts<br>• Resilient shelters construction<br>• GNFS fire tenders & hydrants<br>• Ambulance services expansion<br>• DRR funds & local committees<br>• Coastal protection & monitoring systems |
| **Climate-Resilient Housing & Infrastructure** | • Housing/infrastructure vulnerability assessments<br>• Enforcement of resilient building codes<br>• Retrofitting public buildings<br>• Disaster-resilient housing reconstruction<br>• Zoning enforcement (removal of illegal structures in waterways) |
| **Sustainable Transport Systems for Urban & Rural Mobility** | • Transport network vulnerability assessments<br>• Elevated roads & bridges<br>• Road reconstruction with resilient materials<br>• Expanded urban/rural mobility systems<br>• Public transport expansion (bus/train)<br>• Road drainage maintenance<br>• Energy-efficient transport (electric buses) |

| Sub-sector | Adaptation Actions |
|---|---|
| **Drought-Resilient Agricultural Practices & Urban Food Security** | • Irrigation, improved seeds, & storage facilities<br>• Drought vulnerability maps & early warning<br>• Small-scale irrigation & reservoirs<br>• Agroforestry & drought-resistant crops<br>• Drought contingency funds<br>• Urban food banks & cold storage hubs<br>• Soil conservation & farmer training |
| **Ecosystem-Based Adaptation (EbA) for Urban & Rural Communities** | • Ecosystem vulnerability mapping<br>• Awareness campaigns on EbA<br>• Restoration of degraded ecosystems<br>• Community-led conservation & incentives |
| **Coastal Resilience Against Sea-Level Rise & Erosion** | • Coastal protection (sea walls, mangroves, buffer zones)<br>• Resilient coastal building standards<br>• Relocation of vulnerable communities<br>• Coastal defences construction/maintenance<br>• Research into nature-based solutions<br>• Community awareness & engagement |

***Source: EPA (2024) CRVA- Cities and DRR Sector.***

and safeguarding communities against climate extremes. Investments in resilient roads and buildings are particularly impactful, as they sustain economic activity, public services and national connectivity. Roads serve as the backbone for adaptation, consistently delivering larger revenues and net benefits compared to buildings, although both subsectors face rising costs as climate pressures intensify.

Beyond financial metrics, the cities sector generates substantial non-market benefits. Resilient roads reduce disaster-related disruptions, support emergency evacuation and relief operations, and protect trade and service connectivity. Similarly, resilient buildings ensure the continuity of essential services such as schools, hospitals, and administrative centres, protect households from climate shocks, and contribute to public safety and welfare. These social and equity gains are critical to national adaptation objectives, even if they are not fully captured in traditional cost–benefit analyses.

The effectiveness of adaptation in cities is closely linked to other sectors. Ecosystem-based measures like mangrove restoration and coastal green infrastructure provide natural buffers that reduce urban flood and coastal risks. Investments in watershed management

and resilient water supply directly improve urban sanitation and flood risk reduction, while strengthened disaster preparedness in the health sector amplifies the impact of resilient transport and housing investments.

The cities and DRR sector remain a strategic priority for adaptation planning. Even when financial returns weaken under harsher climate scenarios, the broader co-benefits such as reduced disaster losses, improved health and education outcomes, enhanced social equity and greater urban system resilience justify sustained and innovative investment in roads and buildings as cornerstones of climate resilient development.

## 4.4 Biodiversity and Ecosystems Sector

Ghana's diverse ecosystems, from forests to mangroves, support many plant and animal species and provide vital services such as water purification, climate regulation and food production. These systems are crucial for biodiversity, livelihoods and economic development. Understanding how ecosystems and biodiversity are affected by climate change is key to planning effective adaption and mitigation. The different categories of biodiversity and ecosystems in Ghana are; forests, marine, aquatic and wetland with each area facing unique climate risks. Forests suffer from drought and deforestation, coastal zones from sea level rise and warming seas, and wetlands from water shortages and pollution.

### 4.4.1 Risks, Vulnerabilities and Impacts for the Forest Sub-Sector

Ghana's forests are categorized into distinct vegetation belts and are critical for biodiversity conservation, climate regulation and community livelihoods. Wet evergreen forests in the Western regions hosts unique species like forest elephants and pygmy hippos, alongside valuable timber such as Odum and mahogany. Moist evergreen forests in Bono and Ahafo serve as ecological transition zones, rich in medicinal plants and wildlife like pangolins and primates. Moist deciduous forests in Ashanti, Central and Eastern Regions provide high-quality timber, pollination services and habitats for diverse fauna. In the north, dry-semi-deciduous forests and savannahs, including Mole National Park support large mammals and supply non-timer products such as shea and dawadawa. Along the coast, swamp forests and mangroves sustain fisheries, protect shoreline and provide breeding grounds for migratory birds, underscoring the ecological and economic importance of Ghana's varied forest ecosystems. **Table 15** illustrates the risks, vulnerabilities and impacts of climate change on forests, while **FIgure 21** shows the different forest vegetation belts.

### 4.4.2 Risks, Vulnerabilities and Impacts for the Wetlands Ecosystems Sub-Sector

Ghana's wetlands including Ramsar sites, inland and coastal types play key roles in

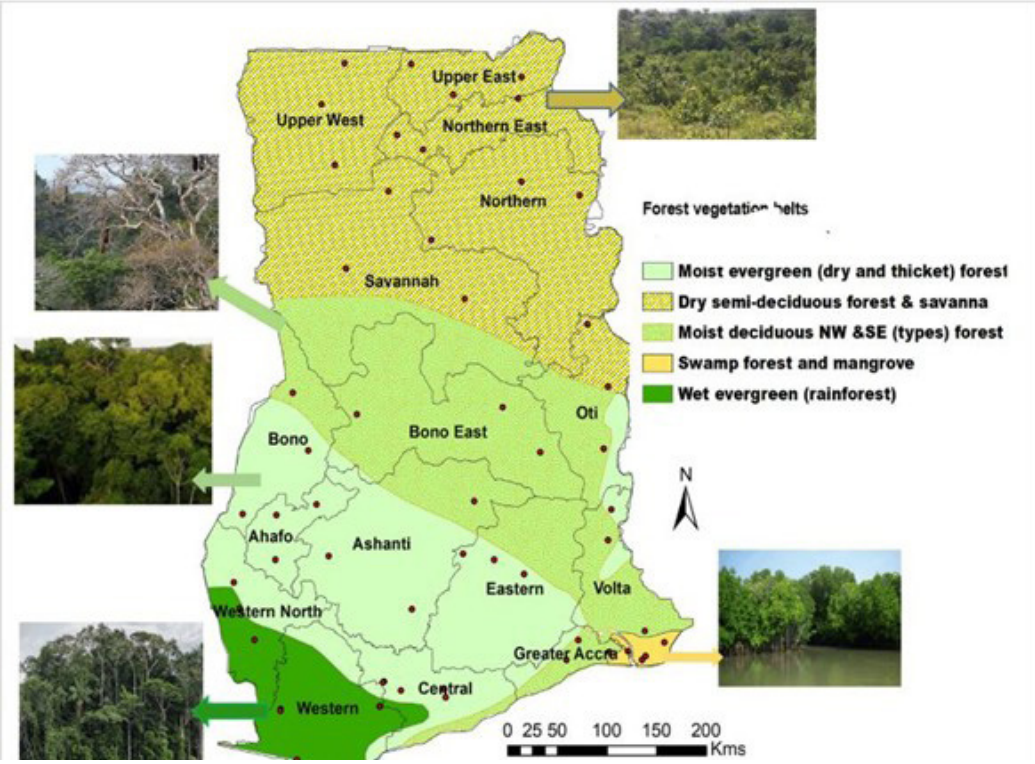
**Table 15: Risks, Vulnerabilities, and Impacts in the Forests Sub-Sector**

| Risks & Vulnerabilities | Impacts |
|---|---|
| **Rising Temperatures** | Forest drying reduces moisture levels, threatening regeneration and habitats for key species. Rising temperatures in the Ankasa Conservation Area (Western Region), have led to the drying of streams, affecting aquatic life and the forest elephant population. |

| Risks & Vulnerabilities | Impacts |
|---|---|
| **Erratic Rainfall** | Reduced precipitation limits growth of timber species like Ofram (Terminalia superba) and Wawa (Triplochiton scleroxylon), affecting biodiversity for example irregular rainfall in Tano Offin Forest Reserve in Ashanti Region hampers tree regeneration hence reduced habitat for pigs. |
| **Flooding** | Increased sedimentation and waterlogging degrade riparian habitats, affecting aquatic and terrestrial biodiversity. |
| **Strong Winds** | Tree uprooting and canopy loss lead to habitat destruction and microclimate changes. |
| **Deforestation and Illegal Mining (Galamsey)** | Habitat destruction and contamination endanger endemic species and reduce forest ecosystem services. Illegal mining in Atiwa Forest (Eastern Region) has degraded critical habitats for the white-naped mangabey. |
| **Fragmentation and Agricultural Expansion** | Loss of connectivity impacts species movement and reduces genetic diversity. |

***Source: EPA (2024) CRVA- Biodiversity and Ecosystem Sector***

**Figure 21: Forest-vegetation belts. Image of the forest features/layers, regions.**




***Source: EPA (2024) CRVA- Biodiversity and Ecosystem Sector***

biodiversity, water regulation and supporting local livelihoods. These habitats face threats from climate change and human activity, endangering their ecological value and sustainability (Table 16). **4.4.3 Risks, Vulnerabilities and Impacts for the Marine Ecosystems Sub-Sector**

**Table 16: Risks, Vulnerabilities, and Impacts in the Wetlands Ecosystems Sub-Sector**

| Risks & Vulnerabilities | Impacts |
|---|---|
| **Rising Temperatures** | Accelerates evaporation, reducing water levels and affecting species like tilapia and flamingos for example at Keta Lagoon |
| **Erratic Rainfall Patterns** | Disrupts seasonal flooding, affecting mangroves and aquatic species. |
| **Flooding** | Inundates wetlands, altering salinity and damaging vegetation. Saltwater intrusion at Sakumo Lagoon reduces habitat quality for freshwater species. |
| **Sea Level Rise** | Submerges habitats and increases salinity, degrading mangroves and fish breeding grounds. |
| **Deforestation and Land Conversion** | Reduces wetland size and functionality, affecting biodiversity and ecological services. |
| **Pollution** | Leads to eutrophication and invasive species growth, harming native biodiversity. For example, the invasive hyacinth at Sakumo Lagoon due to agricultural runoff. |

***Source: EPA (2024) CRVA- Biodiversity and Ecosystem Sector***

Ghana's marine ecosystems are essential to both the nation's economic and ecological resilience, providing critical resources such as fish, crustaceans, and molluscs while sustaining livelihoods through fisheries and coastal activities. Extending across the Exclusive Economic Zone (EEZ), continental shelf, and coastal waters, these biodiverse systems play a key role in climate regulation. Nevertheless, they face mounting threats from climate change and anthropogenic activities, such as overfishing, pollution, and habitat degradation.

**4.4.4 Risks, Vulnerabilities and Impacts for the Aquatic Ecosystems Sub-Sector**

**Table 17: Risks, Vulnerabilities and Impacts in the Marine Ecosystems Sub-Sector**

| Risks & Vulnerabilities | Impacts |
|---|---|
| **Rising Sea-Surface Temperatures** | Alters species distribution, reduces fish stocks, and causes coral bleaching. |
| **Sea Level Rise** | Submerges coastal habitats, increases salinity, and degrades mangroves. |

| Risks & Vulnerabilities | Impacts |
|---|---|
| **Overfishing and Habitat Degradation** | Depletes fish stocks, disrupts food webs, and damages benthic habitats. |
| **Pollution** | Harms marine biodiversity and introduces toxins into the food chain. |
| **Ocean Acidification** | Reduces survival rates of calcifying organisms like molluscs and crustaceans. |
| **Storm Surges and Extreme Weather Events** | Damages coral reefs and mangroves, leading to habitat loss and displacement. |

***Source: EPA (2024) CRVA- Biodiversity and Ecosystem Sector***

Ghana's aquatic ecosystems including rivers, lakes and reservoirs are pivotal for freshwater biodiversity, water supply, irrigation and hydropower generation. They sustain rich flora and fauna, and support agriculture and fisheries, and hold significant cultural and spiritual value. However, their ecological integrity and productivity are increasingly threatened by climate change and human-induced pressures.

### 4.4.5 Priority Adaptation Actions for the Biodiversity and Ecosystems Sector

**Table 18: Risks, Vulnerabilities and Impacts in the Aquatic Ecosystems Sub-Sector**

| Risks & Vulnerabilities | Impacts |
|---|---|
| **Rising Temperatures** | Accelerates evaporation, reducing water levels and affecting fish populations for example Lake Volta experiences fluctuating water levels, disrupting fish breeding cycles in Akosombo and Kpando. |
| **Erratic Rainfall Patterns** | Disrupts hydrological balance, affecting water availability and biodiversity. Reduced inflows into Akosombo Dam impacts hydropower and fisheries. |
| **Flooding** | Increases sedimentation and degrades water quality. |
| **Drought** | Reduces water availability, stressing aquatic ecosystems. |
| **Pollution** | Harms aquatic biodiversity and introduces toxins into the water supply. |
| **Erosion and Sedimentation** | Degrades water quality and disrupts aquatic habitats.<br>Black Volta suffers from sedimentation, reducing water quality for communities in Wa and Tumu (UNFCCC, 2020). |

***Source: EPA (2024) CRVA- Biodiversity and Ecosystem Sector***

The Action Plan for the sector sets out a package of mutually reinforcing actions across the four ecological subsectors: forest, wetland, marine, and aquatic systems. These actions resulting from national consultations, stakeholder workshops, and literature reviews are summarized in **Table 19** and the full sectoral plan is available on the Ghana NAP website.

### 4.4.6 Economic Analysis of Biodiversity and Ecosystems Sector Adaptation Actions

**Table 19: Summary of Biodiversity and Ecosystems Sector Adaption Actions**

| Subsector | Key Adaptation Actions |
|---|---|
| **Forest Ecosystems** | • Reforest using native and climate-resilient species<br>• Establish Forest restoration corridors<br>• Promote sustainable non-timber forest product (NTFP) harvesting<br>• Strengthen monitoring and enforcement against illegal logging/ mining<br>• Encourage agroforestry in forest-fringe communities |
| **Wetland Ecosystems** | • Restore degraded mangroves and swamp forests<br>• Develop alternative livelihoods (e.g., aquaculture)<br>• Support community-led wetland monitoring and conservation<br>• Establish buffer zones to prevent encroachment<br>• Promote ecotourism in Ramsar sites<br>• Introduce wetland-compatible agriculture<br>• Apply floodplain zoning to protect habitats |
| **Marine Ecosystems** | • Establish marine protected areas (MPAs)<br>• Enforce seasonal fishing bans<br>• Reduce marine pollution via coastal waste management<br>• Support sustainable artisanal fishing practices<br>• Build capacity for biodiversity monitoring and research<br>• Replant mangroves along coastal zones<br>• Develop coastal green infrastructure (e.g., dunes, sea walls) |

| Subsector | Key Adaptation Actions |
|---|---|
| **Aquatic Ecosystems** | • Rehabilitate riparian zones (e.g., Volta and Pra Rivers)<br>• Remove invasive species like water hyacinths<br>• Implement watershed management programs<br>• Create biodiversity-rich artificial reservoirs<br>• Promote integrated water resource management (IWRM)<br>• Establish fish sanctuaries in key river habitats<br>• Encourage ecotourism linked to biodiversity conservation |

***Source: EPA (2024) CRVA- Biodiversity and Ecosystem Sector***

The biodiversity and ecosystem sector demonstrates strong economic and resilience benefits from adaptation investments across forestry, marine, aquatic and wetlands subsectors. Actions in the forestry subsector, especially restoration and carbon revenue initiatives, are the most efficient, offering high returns over time. Marine and aquatic interventions, while requiring higher upfront costs, provide consistent long-term benefits, particularly through habitat recovery. Wetlands, though smaller in scale, are highly cost-effective due to their low investment needs.

A key insight is that cost drivers vary by subsector: forestry faces persistent personnel and monitoring costs, marine and aquatic systems are dominated by habitat restoration expenses, and wetlands incur mainly monitoring costs with steady, modest benefits. This diversity underscores the need for tailored adaptation strategies rather than a one-size-fits-all approach.

Beyond direct financial returns, non-market benefits significantly enhance the value of biodiversity investments. Forest restoration supports carbon sequestration, water regulation, and pollination, which are vital for agriculture. Marine and aquatic actions protect fish nurseries and water quality, bolstering food security and coastal resilience. Wetlands provide flood mitigation, groundwater recharge, and serve as biodiversity refuges, offering critical disaster risk reduction and livelihood support even when not reflected in direct revenues.

The biodiversity and ecosystems sector's adaptation portfolio is economically efficient and delivers substantial co-benefits, confirming its central role in climate resilience strategies. Investments in this sector not only yield measurable financial returns but also secure the ecological foundations necessary for agriculture, fisheries and human-wellbeing.

## 4.5 Health Sector

Ghana's health sector is fundamental to the nation's human development, economic productivity, and social equity, delivering essential services that protect public health, manage disease outbreaks, and support vulnerable populations. However, this sector is increasingly strained by climate change, which exacerbates direct and indirect health impacts through rising temperatures, erratic rainfall, and extreme weather events, leading to increased burdens

of vector-borne diseases like malaria, waterborne illnesses such as diarrhoea, and respiratory conditions. These climate-induced risks are amplified by factors such as inadequate surveillance systems, limited institutional coordination, and vulnerabilities among women, children, and rural communities, who bear a disproportionate share of the health consequences.

### 4.5.1 Risks, Vulnerabilities, and Impacts for the Health Sector

### 4.5.2 Priority Adaptation Actions for Health

**Table 20: Risks, Vulnerabilities and Impacts for the Health Sector**

| Risks & Vulnerabilities | Impacts |
|---|---|
| **Rising Temperatures and Heatwaves**<br>• Limited capacity of health facilities to maintain cold chains for vaccines and blood supplies under higher temperatures.<br>• Health systems not adequately equipped to manage heat-related illnesses.<br>• High poverty levels limit access to cooling, safe housing, and clean water | • Increased heat stress, dehydration, and cardiovascular strain.<br>• Higher incidence of meningococcal meningitis in hot northern regions.<br>• Disruption of vaccine storage and cold-chain systems. |
| **Erratic Rainfall Patterns**<br>• Increased heat stress, dehydration, and cardiovascular strain.<br>• Higher incidence of meningococcal meningitis in hot northern regions.<br>• Disruption of vaccine storage and cold-chain systems. | • Increased incidence of diarrhoeal diseases.<br>• Heightened risk of cholera outbreaks.<br>• Malnutrition from reduced food availability, especially for children |
| **Flooding**<br>• Health infrastructure located in flood-prone areas.<br>• Poor drainage and sanitation systems.<br>• Weak capacity to manage climate-related disease outbreaks. | • Flooded health facilities disrupt service delivery.<br>• Increased malaria transmission due to stagnant water.<br>• Damage to roads and infrastructure delaying emergency response.<br>• Increased displacement leading to overcrowding and disease transmission in shelters |

| Risks & Vulnerabilities | Impacts |
|---|---|
| **Drought**<br>• High dependence on rain-fed agriculture affecting food security.<br>• Vulnerable rural populations, especially in northern regions.<br>• Inadequate health system preparedness for nutrition-related emergencies | • Increased malnutrition, stunting in children.<br>• Reduced availability of safe drinking water, worsening hygiene-related conditions.<br>• Increased poverty amplifying health inequities. |
| **Changes in vector ecology (mosquitoes, pathogens)**<br>• Limited vector-control capacity.<br>• Inadequate integration of climate data into disease early warning systems.<br>• Ghana is among the 15 highest-burden malaria countries in the world (Severe Malaria Observatory, 2023) | • Increased malaria incidence in new geographic areas.<br>• Spread of dengue, meningitis and other climate-sensitive diseases.<br>• Higher public health burden and pressure on health facilities. |
| **Water scarcity**<br>• Limited water infrastructure and reliance on surface water.<br>• Poor waste management increases contamination risks.<br>• Vulnerable populations lack access to potable water. | • Increased waterborne diseases (cholera, typhoid).<br>• Increased household air pollution due to reliance on firewood/charcoal for cooking.<br>• Greater gender burden as women spend more time fetching water. |
| **Sea level rise and coastal intrusion**<br>• Coastal health facilities located near vulnerable shorelines.<br>• High population density in coastal regions | • Saltwater intrusion contaminates freshwater sources.<br>• Damage to coastal health facilities and sanitation systems |

***Source: EPA, (2024), Ghana Health NAP***

Health adaptation actions are bundled to leverage synergies, address multiple vulnerabilities, and maximize co-benefits across health, social, and economic dimensions. In the health sector, adaptation measures were organized into three coherent bundles: Health Facilities, Health Workforce, and Monitoring and Response Systems. These bundles capture both hard and soft measures, ranging from infrastructure retrofitting and renewable energy integration to workforce training, institutional strengthening, and digital monitoring systems. The design of these bundles reflects a systems-based approach to building a climate-resilient health system, where infrastructure, human capacity, and information systems reinforce one another (HNAP, 2024).

### 4.5.3 Economic Analysis for Health Adaptation Actions

**Table 21: Summary of Adaptation Actions for the Health Sector**

| Subsector | Key Adaptation Actions |
|---|---|
| **Health Facilities** | • Upgrade health facilities to climate-resilient standards (e.g., flood-proofing, heat-resistant designs)<br>• Integrate climate risk assessments into facility planning and maintenance<br>• Enhance energy reliability through solar-powered systems for critical operations<br>• Retrofit existing facilities to withstand extreme weather events |
| **Health Workforce** | • Conduct gender-sensitive training on climate-health risks (e.g., heat stress, vector-borne diseases)<br>• Build capacity for emergency response to climate-induced health crises<br>• Increase recruitment and deployment of health workers in climate-vulnerable areas<br>• Develop training modules on climate-adaptive healthcare delivery |
| **Monitoring and Response Systems** | • Develop a comprehensive HNAP M&E framework with climate-health indicators<br>• Mainstream HNAP indicators into DHIMS2 and health M&E systems<br>• Create and maintain an operational climate-health database<br>• Establish reporting structures for sectoral, national, and international levels<br>• Adopt digital tools for real-time monitoring of climate-health risks<br>• Strengthen institutional capacity for M&E through training |

***Source: EPA, (2024), Ghana Health NAP***

Adaptation actions in the health sector encompass a range of strategies designed to enhance resilience and ensure continuity of essential health services in the face of climate change. Upgrading and retrofitting hospitals and clinics to be climate-resilient stands out as a highly effective measure, delivering economic returns by safeguarding service delivery and reducing the burden of climate-sensitive diseases, even under severe climate scenarios. Strengthening disease surveillance and early warning systems is another critical adaptation, consistently providing high benefit-cost ratios and proving to be a cost-effective investment for public health.

Investments in workforce adaptation are also essential for maintaining service delivery. However, these are more susceptible to rising costs in high-emission futures. To address this, policy support should focus on leveraging digital health solutions, innovative training methods, and task-shifting to manage costs and sustain workforce resilience.

A cross-cutting approach is recommended with health integrated as a priority in national adaptation strategies. This not only enhances resilience within the health sector but also supports adaptation efforts in agriculture, water and ecosystems. Beyond direct economic benefits, health sector adaptation delivers extensive non-market value, including improved population health, reduced morbidity and mortality, stronger community resilience and increased public trust in the health system. These investments further contribute to employment, capacity building, gender equity and social stability, reinforcing the central role of health in national climate adaptation planning.

## 4.6 Infrastructure Sector

Infrastructure systems consist of interconnected networks of assets, including natural assets or green infrastructure, that deliver essential services for both individuals and the economy. These networks facilitate the provision of inputs such as electricity and water to households and businesses, manage solid waste and wastewater disposal, and enable connectivity through transport and digital communications. Social infrastructure, including hospitals and schools, is also dependent on these networks to deliver health, education, and other key social and economic services to communities and society at large.

In addition to physical assets, infrastructure systems incorporate operational organizations and regulatory authorities tasked with overseeing service delivery within the country. However, numerous infrastructure systems and their constituent assets have not been designed to withstand the effects of climate change. Phenomena such as rising sea levels, flooding rivers, landslides, wildfires, droughts, and various extreme weather events contribute to damage to both physical and natural infrastructure assets, disrupting the delivery of social and economic services and imposing considerable human costs. Persistent cycles of acute and chronic climate impacts create substantial risks to economic growth and threaten progress toward the SDGs. These challenges also impose significant strain on public finances.

Adapting infrastructure and enhancing resilience to climate change are directly linked to national sustainable development objectives. Women, girls, and vulnerable groups often experience a disproportionate impact from the loss of services when climate-related disruptions occur in infrastructure systems. These populations are more likely to face difficulties in rebuilding their homes, communities, and livelihoods, and may be particularly affected by health and other consequences resulting from interruptions in basic services.

### 4.6.1 Risks, Vulnerabilities and Impacts for the Infrastructure Sector

Climate change increases the risk of extreme events, threatening infrastructure resilience and the livelihoods they support. **(Table 22)**. Impacts can be acute, like floods or landslides, causing immediate shocks that disrupt multiple sectors and may have long-term effects on communities. Chronic impacts involve gradual shifts in climate variables such as precipitation and temperature, leading to unpredictable weather and changing demand for infrastructure services. Buildings and systems must adapt to withstand new environmental conditions.

**Table 22: Risks, Vulnerabilities and Impacts for the Infrastructure Sector**

| Risks & Vulnerabilities | Impacts |
|---|---|
| **Flooding**<br>• Vulnerability to damage from pluvial and coastal flood due to inadequate drainage.<br>• Regular flooding and inundation of the power equipment and infrastructure result in shutdowns, loss of power supply, and physical damage to assets.<br>• Can cause power disruption<br>• Increases sedimentation and reduces reservoir capacity, causing physical damage to assets and increasing risk of downstream floods.<br>• During periods of high rainfall, the Weija dam and the river are overwhelmed with storm water, exposing the Weija Township downstream to flood hazards and threatening the function of water supply infrastructure. | • Energy supply at risk due to disruptions from high flood scenarios<br>• Energy supply for over 4.2 million people at risk<br>• Estimated asset damage repair cost of 1.9 billion USD<br>• Loss of wildlife and biodiversity in Bui National Park<br>• Flooding of infrastructures i.e. transport infrastructure, water infrastructure, energy infrastructure at Weija township downstream settlement resulting in disruptions in service.<br>• Disruptions of lives and livelihoods at the Weija downstream settlement. |
| **Drought**<br>• Decreased urban water supply due to drought periods.<br>• Affects the regeneration capacity of forests. It also increases their susceptibility to wildfires, pests, and disease.<br>• Drought conditions can result in reduced plant efficiency and generation capacity<br>• Reduced river flow and reservoir capacity reduces generation capacity | • Reduced access to firewood for several remote rural communities needed to provide basic household services.<br>• Energy supply for millions of people at risk<br>• Energy sector revenue loss |

| Risks & Vulnerabilities | Impacts |
|---|---|
| **Landslides**<br>• Landslides threaten the electricity transmission system that can cause power disruptions to whole communities and districts as a result of a localised hazard event. This may affect critical functions such as health and emergency services. | • Energy supply for over 6.9 million people at risk due to disruptions from landslide hazard scenarios |

***Source: Ghana Roadmap for Resilient Infrastructure in a Changing Climate, 2022.***

### 4.6.2 Priority Adaptation Actions for Infrastructure

To address these critical risks, Ghana has identified priority interventions for adaptation of infrastructure that are outlined in the table below.

**Table 23: Priority Adaptation Actions for Infrastructure**

| Subsector | Key Adaptation Actions |
|---|---|
| **Energy** | • Retrofitting adaptation measures in the Akosombo Dam<br>• Natural flood adaptation of Bui dam<br>• Coastal flood defense of thermal power plants in the Western region<br>• Coastal flood protection of the Sunon-Asogli power plant<br>• Safeguarding vulnerable substations against floods and landslides<br>• Resilient cooling systems for thermal and solar plants<br>• Resilient and green energy access in drought-prone districts<br>• Capacity development and regulatory frameworks to support local renewable energy generation to enhance resilience of remote, vulnerable communities<br>• Update energy sector design standards to incorporate climate adaptation risk |
| **Water** | • Natural flood adaptation of the Weija Dam through greening and vegetation along the Densu River<br>• Flood resilience improvements to the Weija dam through release scheduling and spillway improvements<br>• Natural restoration around Tono and Vea dams<br>• Slope stabilization, forestation, and terracing at Barekese dam<br>• Catchment-level water management in the Accra plains<br>• Water supply resilience through regional harvesting and storage solutions<br>• Climate adaptation alignment across water ministries and planning mechanisms to ensure integrated water resource management<br>• Proactive risk-informed asset management |

| Subsector | Key Adaptation Actions |
|---|---|
| **Transport** | • Urban drainage measures in Accra<br>• Green recreative areas and riparian vegetation to protect exposed road and rail between urban centres<br>• Built and natural coastal defense options for Tema Port<br>• Natural and built slope stabilization measures along major highways<br>• Airport flood resilience through elevation of runways and other vulnerable components<br>• Bridges and underpasses to ensure community access to services<br>• Nature-based adaptation through creation of intertidal habitat at Takoradi<br>• Temporary barriers to protect railway lines during construction<br>• Risk-informed, multi-modal transport master plan and investment plan<br>• Supporting resilient design and construction of roads through research, capacity building, and the creation of a design manual<br>• Climate-risk informed asset management system and operations and maintenance practices for roads |
| **Cross-sectoral** | • Upstream afforestation of the Volta River reservoir to build resilience to flood and drought<br>• Sponge City measures to provide ecosystem-based urban adaptation to climate change<br>• Consider human mobility strategies, including planned relocations, migration support, and reintegration to address climate-induced displacement effectively.<br>• Centralized climate-risk data management system<br>• Risk-resilient land management system<br>• Mainstream resilience through climate risk assessments and EPA permitting process and strengthen enforcement for all infrastructure projects<br>• Gender mainstreaming in adaptation planning, implementation and management<br>• Prioritize nature-based solutions in planning, design and operation of infrastructure |

***Source: Ghana Roadmap for Resilient Infrastructure in a Changing Climate, 2022.***

## 4.7 Youth

About 73% of Ghana's population is under 35, with roughly 11 million youth aged between 15 and 34. The number is expected to rise in coming decades. This demographic trend brings both challenges, such as youth unemployment and gaps in climate education, technical skills, and funding, as well as opportunities for development, especially in climate resilience and risk management.

Ghanaian youth can drive change at all levels by leading awareness efforts, educational programs, training, research, and community initiatives if they have the necessary resources and support. The inclusion of youth into climate processes is crucial to achieving resilience and sustainable development. It is in this light that a youth engagement strategy that positions the youth as active contributors to climate action was developed as part of the NAP process. It identifies the youth as agents of change, strengthens inclusivity, seeks to build their capacity and enhance their participation in decision-making. The strategic areas of engagement include; policy and governance, skills development and innovation, climate-smart agriculture and food security, and ecosystem restoration.

### 4.7.1 Risks, Vulnerabilities and Impacts on Youth

**Table 24: Risks, Vulnerabilities and Impacts on Youth**

| Risks & Vulnerabilities | Impacts |
|---|---|
| **Rising temperatures and heatwaves**<br>• High exposure for youth in outdoor work (agriculture, construction, street vending) | **Health:**<br>• Heat stress, dehydration, reduced concentration in school.<br>• Higher risk of chronic health issues such as respiratory illnesses (bronchitis, asthma); heat rashes, hyperhidrosis; and mental stress over time<br>**Socio-economic:**<br>• Productivity loss and income instability for working youth<br>**Education:**<br>• Increased absenteeism and lower academic performance. |
| **Drought and water scarcity**<br>• Dependence on climate-sensitive livelihoods (youth farmers, herders)<br>• Limited access to irrigation, credit, and drought-resistant technologies | • Increased food insecurity and malnutrition<br>• School dropouts as youth search for work or migrate.<br>• Psychological stress and sense of hopelessness<br>• Longer walking distances to fetch water mainly by girls |

| Risks & Vulnerabilities | Impacts |
|---|---|
| **Erratic Rain and Floods**<br>• Many youth reside in informal settlements prone to flooding<br>• Inadequate drainage and WASH systems | • Injury, loss of property and displacement<br>• Physical danger, trauma and mental health implications.<br>• Higher prevalence of waterborne diseases<br>• Young women face heightened GBV risks during disaster.<br>• Disruption of schooling and exam calendar |
| **Sea level rise and coastal erosion**<br>• Youth in coastal fishing communities dependent on declining fish stocks | • Loss of livelihoods in fisheries<br>• Loss of small enterprises and assets |

***Source: EPA (2024) Ghana National Youth Climate Adaptation Strategy; MMDA CRVA reports (2024)***

### 4.7.2 Recommendations for Engagement of Youth in Adaptation Actions

1. **Institutionalize youth participation in adaptation governance:** Establish youth representation on climate-related national and subnational platforms such as the Cross-Sectoral Planning Groups (CSPGs), District Planning Coordinating Units (DPCUs), and sectoral adaptation task teams.
2. **Develop youth-focused climate adaptation skills and livelihoods programmes:** Support technical and vocational training institutions to integrate climate-smart agriculture, renewable energy, green construction, and disaster-risk management into their curricula. Expand youth entrepreneurship schemes to include green jobs, climate services, and ecosystem restoration enterprises.
3. **Enhance youth access to climate finance resources:** Allocate specific percentages of adaptation financing windows (e.g., GCF readiness, local climate funds, district climate budgets) to youth-led initiatives. Facilitate microcredit, grants, and guarantee schemes to enable young people, particularly young farmers to adopt climate-resilient technologies, efficient irrigation, and drought-resistant crops.
4. **Strengthen youth capacity for climate risk awareness and early warning response:** Integrate climate education into basic, secondary, and tertiary curricula, including practical modules on risk preparedness, health impacts, and adaptation technologies. Train youth groups as community climate information ambassadors to support dissemination of early warning messages, hazard monitoring, and community preparedness.
5. **Empower youth in community-based adaptation and ecosystem management:** Involve youth in afforestation, mangrove restoration, watershed protection, and plastic pollution management schemes through the Forestry Commission, EPA, and District Assemblies. Establish youth-led Environmental Stewardship Brigades

to support local adaptation actions such as flood control, fire management, and climate-smart water conservation.

6. **Leverage technology and innovation to drive youth-led adaptation:** Support youth innovators through climate-tech accelerators, hackathons, and incubators centred on GIS mapping, climate data analytics, drought monitoring tools, and mobile extension services. Expand access to digital climate information platforms and provide capacity building for youth in remote and underserved communities.
7. **Address youth-specific vulnerabilities in adaptation planning:** Ensure that adaptation plans explicitly address youth challenges such as unemployment, migration, exposure to climate-related diseases, and disruptions to education. Incorporate mental health and psychosocial support services for youth affected by extreme weather events and displacement.
8. **Promote inclusive youth engagement with attention to gender and marginalization:** Ensure equitable participation of young women, young persons with disabilities, and rural youth in all adaptation activities. Provide dedicated support for girls' education, safe youth participation spaces, and targeted empowerment programmes in climate-vulnerable districts.
9. **Strengthen youth-led research, innovation and knowledge generation:** Support universities and youth research networks to conduct applied climate research, vulnerability assessments, and community-level adaptation diagnostics. Facilitate knowledge exchange between youth groups and local authorities, private sector, and traditional authorities.
10. **Recognize youth as communication and advocacy partners:** Collaborate with youth organizations to design and deliver behaviour-change communication, climate-health awareness, and disaster-risk education campaigns. Utilize social media, theatre productions, community radio, and digital storytelling platforms to amplify youth voices and highlight youth-led solutions

# 5

# District Level Vulnerability and Risk Assessments and Adaptation Priorities

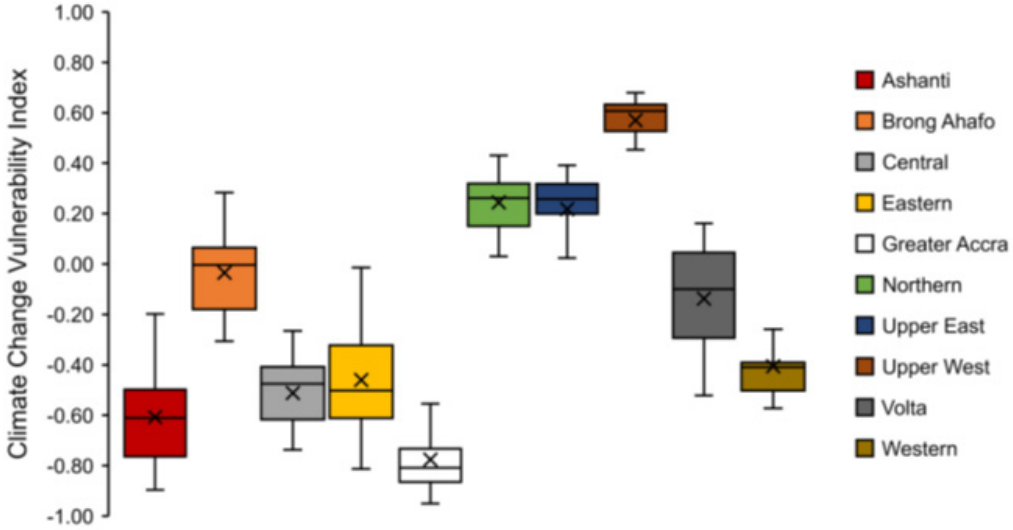
## 5.1 Overview of District and Subnational Vulnerability Assessments

Ghana's climate vulnerability is shaped by multiple, interlinked challenges; rising aridity, and temperature, rainfall variability, rising sea levels, and the growing frequency of extreme events. Particularly vulnerable regions include the Northern Savannah belt, which is prone to droughts and floods, and coastal zones facing storm surges, erosion, and sea level rise. While floods have been discussed in detail in **3.3.1 Flooding**, it is important to note that historical flood events, such as the 2010 White Volta River Basin flood, underscore the need for localized vulnerability assessments. Urban flooding, compounded by rapid urbanization, poor drainage, and environmental degradation, remains a persistent concern for major cities.

A climate vulnerability assessment was undertaken to determine the overall climate vulnerability for each of the 216 MMDAs under the Fourth National Communication (NC4) reporting. The national level vulnerability assessment undertaken for the NC4 was based on the original AR4 definition of Climate Change Vulnerability (CCV) as (Exposure x Sensitivity) – Adaptive Capacity. Sensitivity and exposure indicate the potential severity of climate impacts while adaptive capacity reflect ability to cope with and adapt to these changes. The results from the CCV assessment revealed that the vulnerability of Ghana's districts generally increases from the coast into the transition zone and the northern savannas **(Figures 22 and 23).**

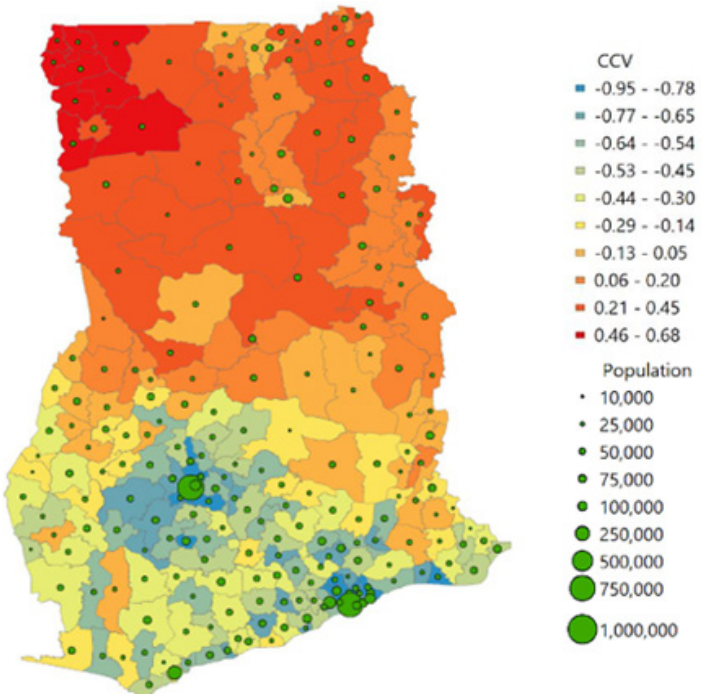
Tema, Keta and Sekondi-Takoradi (coastal) are ranked 14 (-0.81), 66 (-0.51) and 93 (-0.40) respectively, (out of 216 districts) in terms of climate change vulnerability; compared to Tamale (0.03; Northern) at 150 (EPA, NC4, 2020). The negative CCV scores suggest a relatively strong capacity to handle climate risks, whereas positive CCV scores point to greater vulnerability. These findings do not, however, reflect the expected impacts and risks associated with sea level rise.

**Figure 22: District climate vulnerability scores aggregated at the level of administrative regions (Xs are mean values)**




***Source: EPA (2020), NC4.***

**Figure 23: Climate change vulnerability scores for Ghana's 216 districts.**




***Source: EPA (2020), NC4.***

The assessments identified flooding, pests and diseases, bushfires, drought, and water scarcity as the major climate-related hazards affecting the districts. These challenges are closely linked to each district's socio-economic conditions, worsening vulnerabilities, especially for marginalized groups like women, youth, and smallholder farmers.

The assessments reported a similar trend in climatic parameters with respect to current and future scenarios in five regions namely Bekwai, Assena-Nankana Bibiani and Kintampo, Cape Coast and New Juabeng South experiencing increased rainfall amounts & variability, increased occurrence of floods, reduced frequency of cold days & night and increase in daytime & nighttime impaling on agriculture, forestry and biodiversity, water resources, transportation and infrastructure, trade and commerce' and gender with tourism as an additional sector for Kintampo, which experiences drought and floods, reducing the water levels of the waterfall while heavy rainfalls and floods cause a discoloration of the waterfall, thereby affecting its attractiveness. The impact manifestations were also similar in all five regions. However, for Cape Coast, in addition to cross cutting climate extreme events such as floods, the municipality was impacted by experienced additional extreme climate events including storms, tidal waves and landslides.

In recent years, climate adaptation planning and vulnerability assessments were done in twenty-six Metropolitan, Municipal and District Assemblies (MMDAs), some of which were; Sekondi-Takoradi (coastal), Tamale (drought), Bekwai, (semi-deciduous), Bibiani (Rain Forest), Assena-Nankana (Sudan-Savannah), Kintambo (Transition Zone), Cape Coast (Coastal Savannah) and New Juabeng South (Semi-Deciduous Forest). Of the 26, the Green Climate Fund conducted ten (10) rapid vulnerability risk assessments in ten (10) MMDAs, specifically; Aowin, Ellembelle, West Mamprusi, Asuogyaman, Kumasi, Wenchi, Keta, Tema, Tamale and Sekondi-Takoradi. These risk and vulnerability assessments were guided by: district-specific need; gender-inclusivity; leveraging on existing structures and resources as stipulated in the GNAP; and national priorities. All of these MMDAs currently have annual temperatures between 26°C and 30°C with Tamale registering the highest annual temperatures of 29°C in the hottest months of March to May. Tamale and Sekondi-Takoradi's projected temperature increase is between 1.5°C to 4°C. The potential changes in annual rainfall could be up to +/- 20% under RCP 4.5. The assessments also found that the MMDAs presented mostly similar risks and hazards.

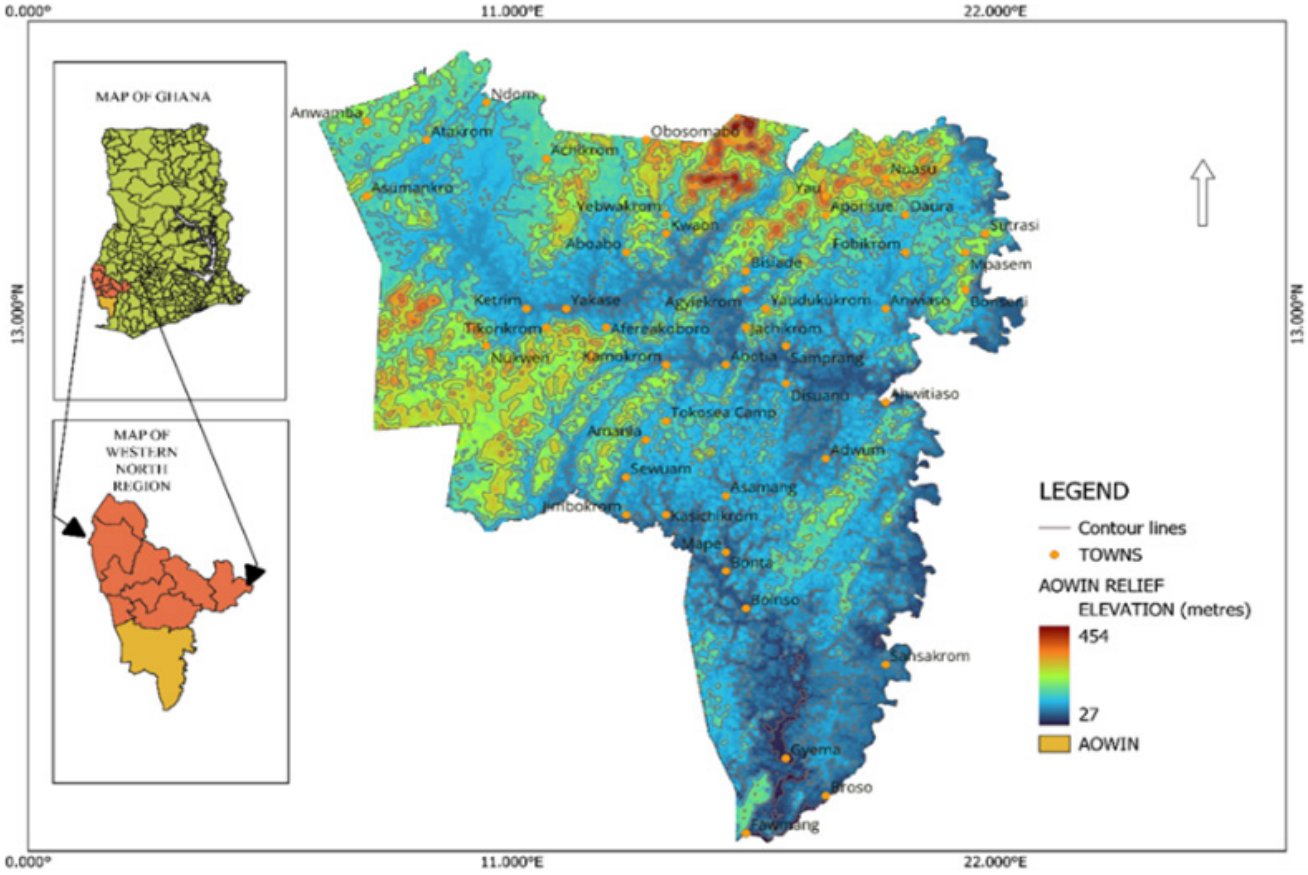
Differences in risks and hazards were associated with context specific vulnerabilities that inform socio-economic development. For example, Sekondi-Takoradi and Keta are coastal areas prone to sea level rise and coastal erosion while Tamale in northern Ghana faces climate risks linked to declining water resources such as drought, hence the need to prioritize different adaptation options. However many of the impacts of climate change across municipalities in the agricultural, health and water sectors are similar. Observed impacts are decline in agriculture production and increase in food insecurity, water scarcity and changes in livelihoods and high rates of migration and change in rainfall patterns and water availability due to drought, particularly in rural areas.

An overview of the risk assessments and identified adaptation priorities for the ten GCF-funded MMDAs is provided below. Full risk assessments and adaptation plans for each of these districts are available on the Ghana NAP website.

## 5.2 Aowin Risk Assessments and Adaptation Priorities

The Aowin Municipal Assembly, formerly known as Aowin Suaman Municipal, is strategically situated in the Mid-western region of the Western North of Ghana. It is characterized by its diverse topography and favourable climate, which play a crucial role in shaping the economic and ecological landscape of the region. The municipal area, covering approximately 2,610.301km², features a predominantly lowland terrain interspersed with a few hills, the highest points rising over 366 meters above sea level, particularly to the east of Enchi where they align from North-Northwest to South-Southwest.

**Figure 24: Map showing the Aowin municipal assembly coverage**




***Source: EPA (2024), Aowin Municipal CCRA***

The climate in Aowin is classified as Wet-Semi Equatorial, marked by high temperatures and substantial rainfall. Aowin's rich geographical layout is complemented by numerous water bodies, including the Disue, Boin, Tano, Bia, and Susan rivers, alongside various streams. The Tano River notably serves as a natural boundary between Aowin Municipal and the Wassa Amenfi West Municipal. These rivers and streams are vital for domestic use in many communities and contribute significantly to the municipal's agricultural and forestry sectors.

### 5.2.1 Risks, Vulnerabilities and Impacts in Aowin

**Table 25: Risks, Vulnerabilities and Impacts in Aowin Municipality**

| Risks & Vulnerabilities | Impacts |
|---|---|
| **Risk of Water Scarcity and Insecurity** | • Rivers Boin, Sui, and Tano could dry up, are essential sources of water for the community, and their depletion drastically reduces water availability.<br>• Concentrated pollutants in the remaining water poses severe health risks as the community relies on these contaminated sources for drinking, cooking, and bathing.<br>• More intense rainy season which heightens risk of severe flooding. Floodwaters, laden with toxins from 'galamsey' sites and other contaminants, can spread to previously unaffected areas.<br>• Rivers serving as vital irrigation sources, their pollution or depletion directly affects agricultural productivity and food security.<br>• Prolonged dry spells and heavy floods disrupt traditional farming cycles, leading to crop failures and economic instability for farmers reliant on agriculture.<br>• Children and women, who often bear the burden of collecting water, face increased hardships such as need to travel greater distances to find clean water sources, which impacts education and economic activities, deepening the social and economic rifts within the community. |
| **Risk of Decline in Agricultural Viability** | • **Environmental challenge:** severe droughts and floods, which directly affect crop yields. Pests and diseases become more rampant and destructive, exacerbated by the warmer and more humid conditions. Cocoa plants are particularly susceptible to pests like the cocoa pod borer and diseases such as black pod disease.<br>• **Economic Impacts:** Cocoa yields decrease, farmers face reduced incomes, which affect their ability to invest in farm improvements or diversify their crops, creating a cycle of diminishing returns.<br>• **Land Degradation:** Illegal mining activities, or 'galamsey', degrade agricultural land. used for agriculture. Chemical runoff contaminates soil and water sources, making them unfit for agricultural use. Physical disruption of landscapes for mining creates craters and diverts water courses, leading to soil erosion and loss of fertile topsoil essential for cocoa cultivation.<br>• **Socioeconomic Consequences:** Reduction in viable agricultural land and the decrease in productivity force many farmers to abandon agriculture, seeking alternative livelihoods, often in the same illegal mining that is partly responsible for the degradation of their farming land. Loss of traditional agricultural knowledge and a decrease in the farming population. |

| Risks & Vulnerabilities | Impacts |
|---|---|
| **Risk of Health Hazards from Water Pollution** | • Water pollution from use of heavy metals such as mercury and cyanide in the mining process.<br>• Consumption of or exposure to contaminated water cause acute problems such as gastrointestinal infections from pathogens and chronic conditions like mercury poisoning, which can affect neurological development of children and reproductive health for women.<br>• Economic burden from hospitalizations.<br>• Community and social impacts in school closures and reduced workforce productivity. |
| **Risk of Infrastructural Instability from Environmental Degradation** | • Excavation from 'galamsey', disrupts the soil structure and undermines the foundation of nearby structures.<br>• Roads may become impassable due to erosion or the collapse of surfaces, isolating communities and disrupting the flow of goods and services.<br>• Bridges can be weakened or destroyed by the increased water flow and sediment load in rivers, posing serious safety risks.<br>• Buildings and homes, especially those built near mining sites, are at risk of structural failures due to the unstable ground.<br>• Costly repairs and replacements for infrastructural damage,<br>• Lack of reliable transport and communications networks.<br>• Delays in the supply chain, affecting local businesses and farmers who rely on these routes to market and sell their products.<br>• Reduction in access to essential services such as healthcare and education, as roads and transportation are crucial for reaching hospitals, schools, and other community services |
| **Risk of Loss of Biodiversity** | • 'Galamsey', often involves clearing of large areas of forest land, directly leading to habitat destruction.<br>• Reduced wildlife populations.<br>• Less effective natural systems, potentially leading to crop failures, increased pestilence, and greater vulnerability to climate extremes |
| **Risk of Socioeconomic Disruption** | • **Economic Shifts from Agriculture to Mining:** More individuals engage in mining, the agricultural sector experiences a drain of skilled labour, leading to decreased productivity and increased food insecurity. |

| Risks & Vulnerabilities | Impacts |
|---|---|
| **Gender -specific risks and vulnerabilities** | • Women in charge of water collection face acute challenges during droughts, impacting ability to provide for households.<br>• Youth in agricultural sector face uncertain economic future forcing a significant portion of them to migrate.<br>• PwDs struggle with mobility and access to emergency services during floods and storms.<br>• Malaria and other climate induced sickness affect physical cognitive development of children. |

***Source: EPA (2024), Aowin Municipal CCRA***

### 5.2.2 Adaptation Priorities in Aowin Municipality

Through a consultative process in the municipality and drawing on the climate risk assessment, the following adaptation priorities in **Table 26** were identified.

**Table 26: Adaptation Priorities in Aowin**

| Sector | Adaptation Actions |
|---|---|
| **Agriculture and food security** | • Capacity-Building Workshops<br>• Agroforestry Practices<br>• Diversified Cropping Systems<br>• Advanced Weather Forecasting Tools<br>• Soil Conservation Measures<br>• Irrigation and Atmospheric Water Harvesting |
| **Community Health** | • Watershed Restoration<br>• Vector Control Technologies<br>• Public Health Regulations<br>• Community Education and Awareness Programs<br>• Improved Sanitation Infrastructure<br>• Water Treatment Systems<br>• Flood Mitigation Infrastructure<br>• Community Health Networks |

| Sector | Adaptation Actions |
|---|---|
| **Infrastructure and Human Settlement** | • Community Engagement and Awareness Programs<br>• Green Infrastructure Development<br>• Flood-Resilient Urban Planning<br>• Retrofitting Existing Structures<br>• Regular Maintenance and Infrastructure Audits<br>• Infrastructure Upgrades and Reinforcement<br>• Disaster Preparedness Training for Communities |
| **Forestry and Biodiversity** | • Sustainable Forest Management Software<br>• Afforestation and Forest Degradation Reduction<br>• Controlled Logging Practices<br>• Community Engagement and Education<br>• Sustainable Tourism Development |
| **Water Supply and Security** | • Increase Access to Potable Water Supply<br>• Community-Based Rainwater Harvesting Systems<br>• Enhanced Water Purification and Safety Programs<br>• Gender-Sensitive Water Management Training<br>• Ensure Environmentally Sustainable Mining Activities |
| **Gender Responsiveness in Adaptation Options** | • **Community Health:** Strengthen community health resilience through equitable healthcare services and preventive measures tailored to diverse needs, including women and the elderly.<br>• **Infrastructure and Human Settlements:** Build resilient infrastructure and settlements through eco-friendly construction, flood resilience projects, and inclusive land use planning.<br>• **Forestry and Biodiversity:** Enhance biodiversity and support conservation through gender-inclusive strategies, fostering sustainable eco-tourism and local livelihoods.<br>• **Agriculture and Food Security:** Strengthen agricultural resilience with gender-sensitive approaches addressing the specific needs of women, youth, differently abled, and elderly farmers.<br>• **Water Supply and Security:** Improve water security and resilience through eco-friendly strategies like rainwater harvesting and accessible water facilities. |

***Source: EPA (2024), Aowin Municipal CCRA***

## 5.3 Asuogyaman District Assembly Risk Assessments and Adaptation Priorities

The Asuogyaman District spans a total surface area of about 1,507m² which accounts for 5.7% of the total area of the Eastern Region. It is located between the Volta and Eastern Regions, sharing eastern borders with the Kpando, North Dayi, Ho, and North Tongu districts of the Volta Region. The district features a mix of mountainous regions and low-lying plains. To the west and east, the terrain is interspersed with ridges and valleys, contributing to the district's varied elevation. The most notable geographic feature is the Volta River, which cuts through these ridges to form a gorge. This geographic formation was ideal for constructing the Volta Dam at Akosombo, a significant infrastructure landmark in the district. The highest peaks in the district reach elevations between 700 and 800 meters above sea level.

The major water body in the Asuogyaman District is Volta Lake, formed by the construction of the Akosombo Dam. This district encompasses the critical area of the Volta gorge, where the lake flows through well-defined channels before expanding upstream into a vast expanse near Gyakiti and Boso, forming the largest man-made lake in the world. At Atimpoku, the lake becomes heavily braided as it traverses the district's low-lying areas and begins its journey to the sea at Ada. The Volta's passage through the district's undulating landscape creates an extensive lakefront, offering significant potential for tourism development.

### 5.3.1 Risks, Vulnerabilities and Impacts in Asuogyaman

**Table 27: Risks, Vulnerabilities and Impacts in Asuogyaman**

| Sectors | Risks & Vulnerabilities | Impacts |
|---|---|---|
| **Agriculture & Biodiversity** | River flooding | • Due to its proximity to the Volta Lake and various rivers, parts of Asuogyaman District are susceptible to flooding, particularly during heavy rainfall in areas like Kudikope,Meyekpo, Aboaso, Abuma, Dodi Island , Frankadua & Ankyeasa |
| | Flooding | • Flooding has destroyed crops, eroded soil, and washed away seeds and nutrients necessary for agriculture<br>• Flooding has posed a threat to livestock through the spread of waterborne diseases and loss of grazing land |
| | Drought | • Drought conditions have severely impacted towns like: Small London, Ampanawu, Apeguso especially given its agricultural reliance.<br>• Drought has led to reduced water availability for irrigation, affecting crop yields and increasing the vulnerability of crops to diseases and pests. This has led to Fluctuations in agricultural productivity leading to increased food prices<br>• For biodiversity, droughts have reduced the habitat quality and availability of water resources for wildlife, leading to decreased biodiversity and disrupting ecological balances. |

| Sectors | Risks & Vulnerabilities | Impacts |
|---|---|---|
| | Changes in rainfall patterns | • Changes in rainfall patterns, including unpredictable seasonal shifts and intensity of rainfall, has disrupted planting and harvesting cycles of main staple crops such as cassava, maize, yam, and plantain in the district. |
| | Extreme rainfall | • Crops may be planted too early or too late, leading to poor yields. Additionally, intense rainfall has led to soil erosion, nutrient leaching, and damage to crops, which further reduces agricultural productivity<br>• For aquatic systems like those in the Volta Lake, increased runoff has led to eutrophication, adversely affecting water quality and aquatic life in areas like Mpakadam Quarter, Dodi Asantekrom |
| | Increased temperatures | • For wildlife, increased temperatures have led to changes in migration patterns of birds like the vultures and herons, breeding cycles, and habitat suitability, thus affecting the overall biodiversity of the towns closer to the lake . |
| | Extreme weather events such as storms and heatwaves. | • The frequency and intensity of extreme weather events such as storms and heatwaves have caused the immediate and severe damage to agricultural infrastructure (such as irrigation systems and storage facilities), leading to crop failures, and disturb ecological systems |
| **WASH** | Drought | • Extended periods of drought, which are becoming more frequent and severe. It has reduced water availability. This scarcity affects the ability to meet domestic, agricultural, and industrial water demands |
| | Flooding, particularly during periods of heavy rainfall | • Given its location near Volta Lake and the numerous rivers and streams in the area, the district frequently experiences seasonal flooding, particularly during periods of heavy rainfall<br>• Floodwaters often carry pollutants, waste, and pathogens, contaminating water bodies that are sources of drinking water. This contamination leads to waterborne diseases, posing serious health risks. |
| | Higher temperatures | • Higher temperatures promote the growth of harmful algae in water bodies, which toxify water and hinder its usability for drinking and sanitation. |

| Sectors | Risks & Vulnerabilities | Impacts |
|---|---|---|
| | Prolonged dry periods | • Prolonged dry periods lead to reduced water levels in the Volta Lake and other water bodies, impacting water availability for drinking, agriculture, and other uses. This scarcity exacerbates hygiene issues, as less water is available for cleaning and sanitation. |
| | Heavy rains. | • Heavy rains lead to increased erosion, resulting in more sediments in water bodies, which complicates water treatment and reduces the quality of water.<br>• Fluctuating weather patterns also influence the breeding patterns of disease vectors such as mosquitoes (malaria), increasing the risk of vector-borne diseases |
| | Changes in rainfall Patterns | • Changes in rainfall have led to water scarcity, affecting clean water supply and sanitation, which are crucial for maintaining health standards in the district |
| | Increasing temperatures | • Increasing temperatures worsen heat-related illnesses and influence the spread of diseases sensitive to heat, leading to symptoms such as headaches, dizziness, weakness, cramping, and nausea in warmer conditions. |
| | Heatwaves | • Heatwaves contribute to heat exhaustion and heatstroke, particularly among vulnerable populations such as the elderly, children, and those with pre-existing health conditions |
| | Extreme weather events such as severe storms and prolonged flooding | • Expected changes in rainfall patterns are likely to increase river flooding and erosion along riverbanks. Shifting rainfall patterns, together with higher average yearly temperatures, could raise the chances of droughts occurring.<br>• Severe storms or prolonged flooding cause displacement, that often leads to overcrowded living conditions, straining existing health facilities and increasing the transmission of communicable diseases.<br>• Unpredictable rainfall patterns, droughts, and flooding lead to crop failures, reducing food availability and leading to malnutrition and related health issues.<br>• Floods or storms damage infrastructure, disrupt power supplies, and impede access to healthcare |

| Sectors | Risks & Vulnerabilities | Impacts |
|---|---|---|
| **Disaster and Infrastructure** | Extreme weather events such as floods<br><br>Intense rainfall<br><br>Flooding<br><br>Severe storms<br><br>High winds and heavy rainfall.<br><br>Strong winds | • The Floods wash away roads, bridges, and other critical infrastructure, disrupting transportation and access to services in the district and impacting both emergency response efforts and community resilience.<br><br>• The district experiences periods of intense rainfall, especially during the rainy seasons leading to the overflowing of the Volta Lake and rivers, causing floods that damage homes, farmland, and roads, schools etc<br><br>• The Volta Lake's levels fluctuate dramatically, especially in response to heavy rains and the operational management of the Akosombo Dam and high water levels lead to flooding of nearby communities and infrastructure<br><br>• Displaced communities, leading to the need for temporary shelters and aid.<br><br>• High winds and heavy rainfall during storms damage buildings, power lines, and communication infrastructure, leading to service disruptions.<br><br>• Strong winds lead to accidents on Volta Lake primarily through their impact on water conditions and boat stability.<br><br>• Strong winds and lightning pose direct safety risks to the population and lead to accidents and casualties. |
| **Gender (cross cutting)** | Floods<br><br>Droughts<br><br>Higher temperatures<br><br>Heat increase<br><br>Extreme weather<br><br>Erratic rainfall | • Resource degradation leads to reduced fish stocks and less fertile farming lands, directly impacting the livelihoods that many men in the district depend on, hence economic instability and increased competition for resources, potentially leading to conflicts.<br><br>• Biodiversity loss affects herbal medicines and local plants that women often use for health care and nutrition. Losing these resources impact family health and increase dependency on external markets.<br><br>• Flooding and droughts damage school infrastructure and lead to school closures, interrupting children's education.<br><br>• Extreme weather events lead to outbreaks of waterborne diseases, which are especially dangerous for children who are more susceptible to dehydration and malnutrition.<br><br>• Inconsistent rainfall led to crop failures, reducing food availability and leading to malnutrition among children, which have long-term effects on their physical and cognitive development |

***Source: EPA (2024), Asuogyaman CCRA***

### 5.3.2 Adaptation Priorities in Asuogyaman

Based on the climate risk assessment for the district and further consultations with stakeholders, an adaptation plan was developed with sectoral adaptation options and details on the institutional arrangements and Monitoring and Evaluation Framework presented. **Table 28** provides a summary of the identified adaptation priorities by sector.

**Table 28: Adaptation Priorities in Asuogyaman**

| Sector | Adaptation Actions |
|---|---|
| **Agriculture** | • Encourage the adoption of more flexible cropping calendars that allow farmers to adjust their planting and harvesting times according to weather predictions and current climate conditions.<br>• Climate-Resilient Agricultural Practices: Promote the use of drought -resistant crop varieties that can survive in lower water conditions, reducing the vulnerability of agricultural production to drought<br>• Diversify crop systems through intercropping and agroforestry practices.<br>• Encourage the adoption of more flexible cropping calendars that allow farmers to adjust their planting and harvesting times according to weather predictions and current climate conditions.<br>• Implement soil conservation techniques such as mulching, use of cover crops, and reduced tillage to improve water retention and soil fertility<br>• Develop and support alternative livelihood programs such as aquaculture, small-scale agriculture, or eco-tourism.<br>• Conduct regular training and workshops for local fishers on adaptive fishing methods, sustainable fishing practices, and water management<br>• Plant trees and other vegetation along the shores of rivers and the lake to create natural buffer zones |
| **Gender** | • Integrate climate change education into the school curriculum to teach children about the causes, effects, and adaptation strategies related to climate change.<br>• Implement systems at community and household levels to collect and store rainwater.<br>• Improve access to healthcare with mobile clinics and community health workers who can reach remote areas, ensuring women and men have equal access to health services, including those related to climate-induced health risks.<br>• Implement school-based nutrition programs that provide meals fortified with essential nutrients to combat malnutrition, exacerbated by crop failures due to erratic weather patterns |

| Sector | Adaptation Actions |
|---|---|
| **Water Resources** | • Develop a comprehensive water management framework that involves all stakeholders, including local communities, industries, and agricultural sectors, in managing water resources holistically.<br>• Explore alternative water sources such as groundwater, where feasible, to reduce dependency on surface water.<br>• Promote rainwater harvesting in communities to increase water storage capacity.<br>• Build additional reservoirs, improve dam facilities.<br>• Implement stricter pollution control measures, restore wetlands that naturally filter pollutants, and manage agricultural runoff to reduce nutrient loads entering water bodies<br>• Strengthen and upgrade water infrastructure to withstand extreme weather events, such as reinforcing embankments, enhancing flood defences, and using more durable materials for water transport and storage systems. |
| **Health and Sanitation** | • Improve and maintain access routes to healthcare facilities to ensure they remain accessible during emergencies.<br>• Conduct continuous public health education campaigns focusing on hygiene practices, especially during climate-induced emergencies like floods and droughts.<br>• Establish mobile health units to reach remote areas quickly during outbreaks |
| **Biodiversity** | • Empower local communities to manage and protect their natural resources through participatory approaches.<br>• Encourage local communities to participate in habitat restoration projects, such as tree planting and wetland restoration.<br>• Remote Sensing and GIS: Implement remote sensing technologies and Geographic Information Systems (GIS) to monitor changes in habitat quality, water availability, and biodiversity in real time. This data can inform timely interventions and adaptive management strategies.<br>• Establish community conservation areas where locals have the authority and responsibility to enforce conservation rules and practices. |
| **Disaster Risk & Infrastructure** | • Encourage tree planting to act as windbreaks to reduce the wind speed and mitigate its impact<br>• Educate the community on emergency preparedness for flooding, including safe shelters and necessary precautions during severe weather.<br>• Implement an advanced early warning system that can alert communities to flooding or severe weather conditions. Enhance local disaster response capacities |

***Source: EPA (2024), Asuogyaman CCRA***

## 5.4 Ellembelle District Assembly Risk Assessments and Adaptation Priorities

Ellembelle District in Ghana's Western Region, is situated in the southern portion of Ghana's Western Region. The district features a 70-kilometer Atlantic coastline to the south and forested areas in the north, creating a diverse ecological landscape. Major towns include Aiyinase, Asasetre, Nkroful (the district capital and birthplace of Ghana's first president, Dr. Kwame Nkrumah), Awiebo, Esiama, Kikam, and Atuabo. The terrain is mostly undulating, with elevations up to 450 feet, and is underlain by mineral-rich rocks, supporting deposits of kaolin, silica, gold, and sandstone. Fertile ferric acrinols dominate the soils, making the area suitable for crops like cocoa, coffee, coconut, oil palm, plantain, and cassava. The district experiences a semi-equatorial climate with year-round rainfall, high humidity, and average temperatures around 29.4°C, supporting lush vegetation and vibrant agricultural activity.

### 5.4.1 Risks, Vulnerabilities and Impacts in Ellembelle

Participants across diverse sectors, including local government, agriculture, fisheries, health, and community groups, collaboratively identified key climate hazards, their impacts, and priority areas for intervention. The findings highlight the interconnected nature of climate risks across ecosystems, livelihoods, and infrastructure, providing a clear foundation for targeted and inclusive adaptation strategies.

**Table 29: Risks, Vulnerabilities and Impacts in Ellembelle**

| Systems and Assets Exposed to Hazard | Climate Hazard | Climate Risk and Potential Impacts |
|---|---|---|
| **Coastal Ecosystem and Fisheries** | Sea Level Rise | • Sea level rise can lead to the inundation of coastal zones, including mangrove forests and beaches, crucial for the district's ecology and fisheries, potentially displacing communities and disrupting marine habitats.<br>• Loss of coastal areas can impinge on tourism, a vital economic contributor, and lead to the erosion of lands that are essential for the sustenance of local fisheries and livelihoods. Loss of coastal habitats, including mangroves and beaches, directly affects biodiversity and disrupts the lifecycles of marine species crucial for fishing industries.<br>• Erosion also threatens infrastructure and settlements along the coast, including key economic areas in towns like Essiama, Asanta and Sanzule. The economic livelihoods of communities reliant on tourism and fisheries are jeopardized, leading to increased poverty and displacement of populations. |

| Systems and Assets Exposed to Hazard | Climate Hazard | Climate Risk and Potential Impacts |
|---|---|---|
| | Irregular Rainfall Patterns | • Altered rainfall can disrupt the traditional fishing patterns, with shifts leading to uncertainty in fish populations and affecting the timing and success of breeding seasons.<br>• Increased rainfall can cause freshwater dilution and sedimentation in coastal waters, leading to reduced salinity, which affects species composition and fishery productivity.<br>• Alterations in freshwater inflow into coastal ecosystems can lead to changes in salinity levels, adversely affecting fish breeding grounds and aquatic biodiversity.<br>• Pollution from agricultural runoff and illegal mining activities compounds these effects, degrading water quality and marine habitats.<br>• Water pollution exacerbates health risks for communities, impacting public health systems<br>• Reduced fish stocks and biodiversity loss lead to decreased incomes for fishermen and increased food insecurity. |
| | Water Pollution | • Pollution from chemicals used in fishing, as well as run-off from land-based sources due to mining and agriculture, can degrade water quality and contaminate aquatic life, impacting the health of fisheries and the communities that depend on them.<br>• Accumulation of toxins in the water can also have direct public health implications and on women and girls who are mostly exposed during fish processing. |
| **Water Supply** | Extreme Rainfall, Flooding | • Heavy rains and subsequent flooding can overwhelm drainage systems, resulting in the contamination of freshwater sources and the destruction of water supply infrastructure, leading to shortages and public health crises. |
| | Drought | • Prolonged periods of drought decrease river and groundwater levels, impacting water availability. |
| | Deforestation | • The removal of forest cover exacerbates the impact of both floods and droughts on water supply. Deforestation can lead to decreased water quality and increased vulnerability to water scarcity. |

| Systems and Assets Exposed to Hazard | Climate Hazard | Climate Risk and Potential Impacts |
|---|---|---|
| **Agriculture** | Flooding | • Flooding can lead to the submersion and destruction of crops, resulting in the loss of yield and income for farmers. Flooding can also cause soil erosion and nutrient loss, making land less arable and reducing agricultural productivity over time. |
| | Irregular Rainfall | • Variability in rainfall can cause periods of drought and excessive rain, both of which are detrimental to crop yields. Drought can lead to crop failure and water scarcity for irrigation, while excessive rainfall can cause waterlogging and facilitate the spread of plant diseases. |
| | Water Pollution | • The runoff from agricultural lands can contribute to the pollution of water bodies, affecting both the quality of the water for irrigation and the health of the ecosystems within.<br>• Pollution from agrochemicals can lead to bioaccumulation of harmful substances in the food chain. |
| **Forestry** | Bushfires | • Bushfires can destroy large swaths of forest, degrading biodiversity and the forest's ability to sequester carbon, which is vital for climate regulation. The destruction also affects the soil quality and the forest's role in the hydrological cycle. |
| | Deforestation and Land Degradation | • Clearing forest lands for agricultural expansion or mining activities can lead to loss of biodiversity, reduced carbon sequestration capacity, and increased soil erosion. |
| **Community Health** | Air and Water Pollution | • Contaminated air from bushfires and mining activities can lead to respiratory illnesses, while water pollution can increase the prevalence of waterborne diseases thus greater economic burden on communities. |
| | Flooding | • Spread of waterborne diseases such as cholera and typhoid, and damage health infrastructure, reducing access. |

***Source: EPA (2024), Ellembelle CCRA.***

### 5.4.2 Adaptation Priorities in Ellembelle

Sectoral adaptation measures were tailored to address the unique climate vulnerabilities of the Ellembelle District as shown in **Table 30**.

**Table 30: Adaptation Priorities in Ellembelle**

| Sector | Adaptation Actions |
|---|---|
| **Coastal Ecosystems and Fisheries** | • Implementation of Closed Seasons and Enforcement of No Fishing Days<br>• Mangrove Reforestation Plan<br>• Community Sensitization Programs<br>• Integrated Coastal Zone Management (ICZM)<br>• Sustainable Fisheries Management Program<br>• Disaster Preparedness and Response Training<br>• Promotion of Sustainable Agroforestry<br>• Infrastructure Maintenance and Retrofitting<br>• Flood Management Measures |
| **Agriculture and Food Security** | • Implementation of Climate-Smart Agriculture (CSA)<br>• Soil Conservation Measures<br>• Agroforestry<br>• Enhanced Weather Forecasting |
| **Community Health** | • Enhanced Water and Sanitation Infrastructure<br>• Public Health Campaigns<br>• Infrastructure Resilience Against Flooding<br>• Innovative Health Monitoring Technologies<br>• Strengthening Community Health Networks |
| **Water Resources** | • Community-Based Rainwater Harvesting<br>• Enhanced Water Storage Facilities<br>• Robust Water Quality Monitoring Programs<br>• Community Engagement in Water Monitoring<br>• Water-Efficient Agricultural Practices<br>• Water Recycling in Urban and Industrial Sectors |

| Sector | Adaptation Actions |
|---|---|
| **Infrastructure and Human Settlements** | • Climate-Resilient Construction<br>• Flood Management Measures<br>• Land Use Planning<br>• Reforestation and Green Buffers<br>• Infrastructure Maintenance and Retrofitting |
| **Gender Responsiveness in Adaptation Options** | • Enhance resilience of coastal ecosystems and fisheries through gender-responsive strategies, promoting diversified livelihoods and conservation.<br>• Strengthen agricultural resilience with gender-sensitive approaches addressing the specific needs of women, youth, differently abled, and elderly farmers.<br>• Strengthen community health resilience through equitable healthcare services and preventive measures tailored to diverse needs, including women and the elderly.<br>• Improve water security and sustainability through gender-responsive strategies like rainwater harvesting and accessible water facilities.<br>• Build resilient infrastructure and settlements through eco-friendly construction, flood resilience projects, and inclusive land use planning. |

***Source: EPA (2024), Ellembelle CCRA.***

## 5.5 Keta Municipal Assembly Risk Assessments and Adaptation Priorities

The Keta Municipality is located east of the Volta estuary, about 160 km from Accra, bordered by Akatsi South (north), Ketu North and South (east), South Tongu (west), and the Gulf of Guinea (south). It covers 446 km², with nearly 30% being aquatic, dominated by the expansive Keta Lagoon. The area is mostly low-lying coastal plain, with elevations up to 53 meters in the north and some areas below sea level. The River Tordzie and distributaries of the Volta River feed into interconnected lagoons, with islands like Seva and Dudu. The municipality is divided into three zones: Narrow Coastal Strip (prone to erosion and flooding but with irrigation potential), Lagoon Basin (marshy, with sandy-clay soils), and Northern Plains (gently undulating, higher elevation).

The climate is Dry Coastal Equatorial, with annual rainfall below 1,000 mm and two rainy seasons (March–July, September–November). Mean temperatures are high (around 30°C), with low humidity and high evapotranspiration, leading to water scarcity and increased salt production. Vegetation ranges from tall grasses and medium trees in the north to shorter grasses and palms in the centre, with coconut trees affected by disease. The area supports diverse fauna, including endangered turtles, antelope, fish, manatees, primates, pythons,

crocodiles, and migratory birds. The coastal Oyibi-Muni soils are sandy, good for coconuts and vegetables. The Ada-Oyibi lagoon basin has shallow, alkaline soils, supporting mangroves and sugarcane but is prone to flooding and not suitable for large-scale farming. The northern Toje-Alajo soils are deeper and better for crops like cassava, maize, and legumes.

### 5.5.1 Risks, Vulnerabilities and Impacts in Keta

**Table 31: Risks, Vulnerabilities and Impacts in Keta**

| Systems and Assets Exposed to Hazard | Climate Hazard | Climate Risk and Potential Impacts |
|---|---|---|
| **Fishery Industries** | Changes in sea temperatures and acidification | • The changes in temperature and PH level of the sea cause significant changes in the composition of fish populations, affecting the livelihoods of fishermen and the availability of seafood. The ocean's acidity can make it harder for some marine animals to build their protective shells or skeletons. The ocean's PH level can then impact the food chain and the economic viability of the fishery industries. Stakeholder's reported increase of alien species. |
| | Sea Level rise | • The sea level rise may lead to the loss of coastal habitats such as wetlands and estuaries, reduce fish populations, and impact the economic viability of fishery industries. The wetlands and estuaries can be inundated, losing essential spawning and nursery areas for fish and other marine species. |
| | Extreme climate events | • Extreme weather events, such as hurricanes, typhoons, and storms, can damage fishing infrastructure, affect coastal communities (safety) and disrupt fishing activities for extended periods. |
| | Variable rainfall | • Fishing patterns have changed, for instance, the Keta fishing industry has collapsed. Fishermen used to fish in wetlands or other areas which are now dry, affecting the livelihood of fishermen and fish processors. |

| Systems and Assets Exposed to Hazard | Climate Hazard | Climate Risk and Potential Impacts |
|---|---|---|
| **Settlements and infrastructure** | Sea Level rise | • Sea level rise will cause coastal flooding, storm surges, high tides and coastal erosion and all these hazards will damage infrastructure and disrupt operations and business activities. During stakeholder's engagements communities reported that some coastal roads that used to only occasionally (seasonally) be flooded and are now flooded daily at high tide.<br>• The Ghana gas pipeline is exposed in some areas due to coastal erosion.<br>• Many reports of beaches, houses and communities that have been washed away.<br>• The increased sea-level heights impede drainage system as there is more backwash. |
| | Flooding | • Increased coastal flooding can damage critical infrastructure such as roads, bridges, gas pipelines and buildings, disrupting transportation and business activities. Floods can also cause inundation of beach areas and ecosystems, landslides, and erosion, rendering roads impassable and difficult to access. |
| | Storms | • Storm surges can damage or destroy roads, bridges, and other critical infrastructure along the coast, causing disruptions to business activities, transportation and access to essential services.. |
| | High Temperatures | • High temperatures can cause roads to expand and contract, leading to cracking, potholes, and other types of damage. |

| Systems and Assets Exposed to Hazard | Climate Hazard | Climate Risk and Potential Impacts |
|---|---|---|
| **Agriculture** | Rising temperatures and more variable precipitation. | • Rising temperatures, more extreme weather events, and changing precipitation patterns all have adverse effects on crop yields and livestock health. Crops fail due to floods, water logging, drought, extreme heat, and storms. Potential change in crop suitability. |
| | Changing precipitation patterns (more frequent dry spells and floods) | • Heavy precipitation and increased frequency of floods can cause waterlogging and damage crops while dry spells and prolonged drought lead to water shortage and crop failure |
| | Storms | • Increased number of storms lead to crop failure. |
| | Pests | • Increasing temperatures and precipitation (i.e., more flooding) are likely to increase the risk of infestation of pest and diseases leading to crop failure and reduced livestock production. |
| | Hotter Temperatures | • Hotter temperatures will reduce livestock productivity. |
| **Health and sanitation systems** | Changes in temperature and precipitation | • Changes in temperature and precipitation can alter the distribution and abundance of malaria-carrying mosquitos, leading to a potential for increased risk of malaria. |
| | Flooding and heavy precipitation. | • Flooding and heavy precipitation can increase the risk of waterborne diseases such as cholera, typhoid, and diarrhea. Flooding can also damage critical health infrastructure and limit access to hospitals. |
| **Water Resources and Supply** | Extreme Rainfall, Flooding and Storms | • Extreme weather events, such as storms and floods can cause damage to water supply infrastructure and disrupt operations. |
| | Drought | • Droughts and changing precipitation patterns can affect the availability and the quality of the water for communities and businesses using both local sources and regional water sources. Prolonged dry periods can lead to lower river and stream flows. |
| | Flooding | • Flooding causes erosion, and increased sediment loads in rivers leading to the contamination of water resources. |

| Systems and Assets Exposed to Hazard | Climate Hazard | Climate Risk and Potential Impacts |
|---|---|---|
| **Coastal Ecosystems** | Sea Level rise | • Sea level rise will cause coastal flooding, inundation of coastal habitats, saltwater intrusion, and changes in species distribution. |
| | Extreme weather events | • Extreme weather events, such as hurricanes, storms, and tsunamis, can cause significant damage to coastal habitats leading to loss of biodiversity, degradation and loss of ecosystem services along the coastline |
| | Changes in sea temperatures and PH level | • Changes in sea temperatures and pH levels can cause changes in the distribution and abundance of marine species |
| | Heatwaves | • Extreme heat can cause coral bleaching, loss of seagrass beds and mangrove forests, distribution and abundance of marine species. Extreme heat also increases rate of evaporation causing the wetlands to dry quicker, impacting on fishing in the wetlands. |
| | Flooding | • Flooding can lead to coastal erosion and the loss of land, and significantly impact the livelihoods of coastal communities causing some of the able youth to migrate. Increases runoff from rivers into the ocean. The inlets affect the current and also release a lot more sediment into the ocean. |
| | Drought | • Drought leads to reduced freshwater flow into estuaries, which can alter salinity levels and affect the distribution and abundance of plant and animal species. Wetlands have dried up due to drought, affecting fishing within wetlands and related post-harvest fish processing and trading activities. |

***Source: EPA (2024), KETA CRVA Report.***

### 5.5.2 Adaptation Priorities in Keta

Through consultation with stakeholders and based on the risk assessment, the Keta adaptation plan was developed and the sectoral adaptation priorities are outlined below in **Table 32**.

**Table 32: Adaptation Priorities in Keta**

| Sector | Adaptation Actions |
|---|---|
| **Agriculture** | • Diversification of Livelihoods<br>• Organic Mulching for Soil Improvement<br>• Research & Development on Resilient Crop Varieties<br>• Implementation of Irrigation Systems<br>• Improved Vegetable Cultivation Practices<br>• Upgrade Weather Forecasting Infrastructure<br>• Improving Farmers' Access to Climate-Related Information<br>• Promotion of Climate-Resilient Agriculture<br>• Development of Early Warning and Response Mechanisms |
| **Fishing Industry** | • Effective Regulations and Local Enforcement of By-Laws<br>• Mangrove and Wetland Rehabilitation<br>• Diversification of Livelihoods<br>• Phasing Out or Improving Unsustainable Fishing Methods<br>• Financial Assistance Programs<br>• Promotion of Sustainable Aquaculture Development |
| **Health and Sanitation** | • Improve Early Warning and Response Mechanisms<br>• Restoring Wetlands and Floodplains<br>• Public Health Education Campaigns<br>• Enforcement of Public Health Regulations<br>• Redesign and Resilience of Sanitation Infrastructure<br>• Development and Strengthening of Health Facilities<br>• Expansion of Drainage Systems |

| Sector | Adaptation Actions |
|---|---|
| **Critical Infrastructure** | • Extension and Elevation of the Sea Defence Wall<br>• Construction and Rehabilitation of Resilient Market Structures and Schools<br>• Community Engagement and Awareness Programs<br>• Construction and Expansion of Drainage Systems<br>• Enhancement of Berms with Salt-Tolerant Vegetation<br>• Infrastructure Audit and Reinforcement<br>• Inspection and Maintenance of Infrastructure<br>• Implementation of New Architectural Designs and Building Codes |
| **Water Resources** | • Promote Rainwater Harvesting Systems<br>• Restore Natural Drainage Systems<br>• Inter-Agency Coordination for Water Management<br>• Community Education and Involvement<br>• Monitor and Improve Water Quality and Salinity Control<br>• Manage Water Levels and Address Lagoon Siltation<br>• Expansion of Mechanized Boreholes<br>• Development and Upgrading of Small-Town Water Systems |
| **Gender** | • Women's Sustainable Livelihood Programs<br>• Supporting Women's Climate Resilience<br>• Climate Educational Programs for Heat Stress Management<br>• Gender Mainstreaming in Disaster Risk Reduction<br>• Enhancing Healthcare Access for Pregnant Women<br>• Incorporating Native Tree Planting |

***Source: EPA (2024), KETA CRVA Report.***

## 5.6 Kumasi Metropolitan Assembly Risk Assessments and Adaptation Priorities

Kumasi Metropolitan Assembly (KMA ) is one of 261 Metropolitan, Municipal, and District Assemblies in Ghana, located in the Ashanti Region with Kumasi as its capital. It is about 270 km north of Accra. KMA covers 214.3 km² but accommodates about 36.2% of the region's

**Figure 25: Aerial View of Kumasi**

***Source: EPA (2024) Kumasi CCRA***

population. The metropolis has a wet sub-equatorial climate, with average minimum and maximum temperatures of 21.5°C and 30.7°C, respectively. The moderate climate has contributed to population growth and made Kumasi the second most populous city in Ghana.

As of the 2021 census, Kumasi Metropolis had 443,981 residents (51.9% female, 48.1% male). Population density was 6,542.6 people/km², much higher than the national average with an urbanization rate of 100%. About 66.5% of those aged 15+ are economically active; 91.4% of these are employed. Of the economically inactive, most are students (56.4%), with others performing home duties or unable to work. Employment is mainly in service/sales (38.9%), crafts/trades (22.8%), and elementary occupations (10.3%), with only 2.6% in skilled agriculture/forestry/fishery. Females are more likely to be in service/sales, males in crafts/trades. Nearly half the workforce is self-employed without employees (60.1% female, 37.9% male).

KMA lies on an undulating plateau, traversed by the Owabi river and streams like Subin, Wiwi, Sisai, Aboabo, and Nsuben. These water bodies are vital for drinking water but are threatened by pollution from urban development and agriculture, contributing to frequent flooding.

### 5.6.1 Risks, Vulnerabilities and Impacts in Kumasi

**Table 33: Risks, Vulnerabilities and Impacts in Kumasi**

| Systems and Assets Exposed to Hazard | Climate Hazard | Climate Risk and Potential Impacts |
|---|---|---|
| **Disaster Risk Reduction** | Flooding | • Essential infrastructure such as roads, bridges, and buildings at risk due to extreme weather events including floods.<br>• Loss of biodiversity and ecosystem services due to climate change has increased the vulnerability of the people in the metropolis to natural disasters and reduced the natural buffering capacity against such events |
| | Heavy Rainfall | • Flooding as a result of heavy rainfall strains the capacity of the DRR sector to respond effectively |
| | Prolonged dry periods | • Droughts strains the capacity of the DRR sector to respond effectively |
| **Agriculture** | Heat and Water Stress Level | • Decreased productivity and reduced crop yields.<br>• Delayed onset and length of growing seasons. |
| | Floods, droughts, and erratic rains | • Cause direct damage to crops.<br>• Fluctuations in agricultural productivity have led to increased food prices.<br>• Increased risk of crop diseases and pest infestations due to changing weather patterns. |
| **Health** | Changes in temperature and precipitation | • Changes in temperature and precipitation can alter the distribution and abundance of malaria-carrying mosquitos, leading to a potential for increased risk of malaria. |
| | Flooding and heavy precipitation. | • Flooding and heavy precipitation can increase the risk of waterborne diseases such as cholera, typhoid, and diarrhea. Flooding can also damage critical health infrastructure and limit access to hospitals. |

| Systems and Assets Exposed to Hazard | Climate Hazard | Climate Risk and Potential Impacts |
|---|---|---|
| **Water and Sanitation** | Low Rainfall and dry seasons | • Water scarcity |
| | Heavy Rainfall and Flooding | • Flooding damages water sources and sanitation facilities, carries runoff and waste into streams and rivers, and contaminates water supply.<br>• Unplanned urban expansion of Kumasi metropolis leading to the destruction of two rivers – Subin and Wiwi – through sewage, heavy metals, and chemical pollution. |
| | Flooding | • Flooding causes erosion, and increased sediment loads in rivers leading to the contamination of water resources. |
| **Gender specific vulnerabilities** | Erratic rainfall, increased temperatures | • Disproportionately impacts women, children, and the elderly. Women bear the brunt of water and food provision burdens, exacerbated by erratic rainfall and heat.<br>• Children and the elderly face health risks from waterborne diseases.<br>• Sea level rise will cause coastal flooding, inundation of coastal habitats, saltwater intrusion, and changes in species distribution. |
| | Extreme weather events, job market instability | • Extreme weather events disrupt education and job market stability for youth. |
| | Accessibility issues during extreme weather | • PLwD face considerable challenges during extreme weather events due to physical barriers and inadequate inclusive planning which increases their vulnerability, as they often lack resources and support systems to adapt effectively. |

***Source: EPA (2024) Kumasi CCRA***

### 5.6.2 Adaptation Priorities in Kumasi

The comprehensive climate change adaptation plan for Kumasi outlined and gathered specific adaptation strategies tailored to the metropolis. Identified stakeholders were engaged and consulted through participatory workshops that allowed for open and equal discussions of adaptation options based on climate scenarios and identified prevailing and future impacts and vulnerabilities. In total, 70 adaptation options were identified across the six sectors, with agriculture having the highest number of actions (17), followed by disaster risk reduction (14) **(Table 34)**.

**Table 34: Adaptation Priorities in Kumasi**

| Sector | Adaptation Actions |
|---|---|
| **Agriculture** | • Promotion of farming practices to restore degraded ecosystems<br>• Creation of green space<br>• Provision of technical services to farmers<br>• Provision of knowledge and skills to farmers<br>• Enhancement of Biodiversity<br>• Planting of drought-resistant varieties of crops<br>• Use of Integrated Pest Management Strategies<br>• Use of improved agricultural technology and CSA practices<br>• Access to agricultural credits<br>• Supporting agro-based development<br>• Use of drip or sprinkler irrigation<br>• Access to weather and climate information<br>• Adherence to land use planning<br>• Livelihood diversification<br>• Investment in climate-resilient infrastructure<br>• Adjustment of farming schedules to align with changing climate patterns<br>• Promotion of vertical gardening techniques |

| Sector | Adaptation Actions |
|---|---|
| **Gender** | • Investing in gendered tree planting and agroforestry practices in the metropolis<br>• Implementing locally based projects to benefit vulnerable groups<br>• Promotion of women-led small businesses<br>• Promoting gendered climate change policy framework in the metropolis<br>• Incorporating gender-specific indicators to monitor and evaluate climate adaptation strategies<br>• Access to capital resources<br>• Promoting gender-based research in climate change study<br>• Access to credits<br>• Investing in solar energy to promote entrepreneurs in the metropolis |
| **Trade** | • Green financing options to support businesses in adopting climate-resilient strategies<br>• Public-Private Partnerships (PPPs)<br>• Implementing strategies to enhance the city's resilience to climate change<br>• Promoting energy-efficient appliances and climate-smart agricultural products<br>• Policies that support businesses in adapting to climate change<br>• Enforcing regulations that promote trade development<br>• Trading climate-resilient products<br>• Diversifying supply chains to reduce dependency on climate-sensitive sectors |
| **Water and Sanitation** | • Planting trees along waterways<br>• Enforcing by-laws to prevent water pollution<br>• Investing in the establishment of water and sanitation infrastructure in the face of climate and weather changes<br>• Proper waste management<br>• Desilting<br>• Investing in wetlands infrastructure for the metropolis wastewater management<br>• Investing in rainwater harvesting in the metropolis |

| Sector | Adaptation Actions |
|---|---|
| **Health** | • Mainstreaming climate change risks into metropolis health sector policies framing<br>• Installing solar energy in health facilities<br>• Incorporating climate change in health education<br>• Creating community awareness of climate risks impacts on their health<br>• Proper waste management practices<br>• Desilting<br>• Encourage behavioural change<br>• Promote climate-smart health practices<br>• Promote flood control mechanisms<br>• Boost health systems to counteract climate-related diseases<br>• Cultivating medicinal plants in the communities |
| **Health Disaster Risk Reduction** | • Integrating Disaster risk reduction and climate change adaptation strategies into development planning with the metropolis<br>• Involving citizens within the metropolis in climate risk assessment and planning process<br>• Building the capacity of personnel to address climate risks<br>• Implementing measures to protect and restore ecosystems or vegetation<br>• Planting of trees along the banks of waterbodies in flood-prone areas<br>• Creation of green spaces<br>• Developing and implementing early warning systems for extreme climate events<br>• Establishing community emergency response teams to counter basic disasters in the metropolis<br>• Proper waste management<br>• Constructing of rain gardens in flood-prone areas<br>• Enhancing the resilience of critical infrastructure to withstand extreme climate/weather events<br>• Adherence to building codes<br>• Desilting<br>• Establishing bioswales to capture stormwater runoff |

***Source: EPA (2024), Kumasi Metropolitan Assembly CCRA.***

## 5.7 Tema Metropolitan Assembly Risk Assessments and Adaptation Priorities

Tema is the capital and is located within the Coastal Savannah Zone. The Greenwich Meridian (Longitude 0º) passes through Tema, intersecting with the equator in the Gulf of Guinea. Tema is 25 km east of Accra and has developed into Ghana's main industrial hub, significantly contributing to the country's industrial landscape.

Tema is generally flat, with elevations up to 35 meters above sea level, making it prone to flooding. Its coastal location and projection into the sea made it ideal for the construction of Tema Harbour in 1957, now a key gateway for international trade. The city's layout supports industrial activities, with a robust transportation network facilitating movement of goods. The Tema Industrial Area is central to Ghana's economic activities.

There are no major rivers, but several small, seasonal streams flow into lagoons (notably Gao, Chemu, and Sakumono) and then to the sea. The Sakumono Lagoon, a Ramsar site since 1992, is ecologically significant but dries up in the dry season. The Chemu Lagoon, near industrial areas, is highly contaminated. The main water supply is from the Kpong water works. Tema has a centralized sewage system, with pipes leading to pumping and ejector stations, eventually discharging into the sea.

Tema lies in the coastal savanna zone, with a mix of coastal and savanna landscapes. The Gulf of Guinea moderates temperatures and shapes the climate. The area features shrubland, grassland, and some semi-deciduous forests. Soils are a mix of sand, clay, humus, gravel, and stone—sandy soils support vegetable farming, while clay is good for brick-making but less ideal for general construction.

As of the 2020 census, Tema Metropolitan Assembly had 177,924 residents (50.8% female), with no rural settlements and a high population density (5,169.7 persons/km²). Average household size is 3.2. The 25–29 age group is the largest (11.4%). The dependency ratio is 50, meaning for every 100 working-age people, there are 50 dependents. There are more females than males overall, but males aged 20–29 are the largest single group, highlighting a youthful population.

### 5.7.1 Risks, Vulnerabilities and Impacts in Tema

**Table 35: Risks, Vulnerabilities and Impacts in Tema**

| Sector | Risks and Vulnerabilities | Impacts |
|---|---|---|
| **Biodiversity** | • Habitats threatened through deforestation, habitat loss, and encroachment on wetlands.<br>• Environmental disruptions destabilize ecosystems | • Diverse plant and animal species essential for ecological balance and human well-being endangered.<br>• Increased vulnerability to extinction<br>• Increasing flood risks in the region |

| Sector | Risks and Vulnerabilities | Impacts |
|---|---|---|
| **Gender and Trade** | • Erratic Rainfall<br>• Increased temperatures | • Health risks from smoke inhalation during fish smoking<br>• Weakened physical capacity among women and elderly populations.<br>• Youth exposure to urban climate hazards.<br>• Affected vulnerable groups include residents along the Sakumono basin, fishermen, coastal residents, porters, fishmongers, fish processors, the aged, persons with disabilities, women, children, and migrants |
| **Agriculture** | • Flooding contaminates water sources and destroys crops.<br>• Unpredictable weather patterns<br>• Higher temperatures escalate water demands and accelerate soil moisture evaporation.<br>• Floods leading to soil degradation and erosion | • Food security jeopardized<br>• Poverty exacerbated<br>• Disrupted traditional planting calendars<br>• Pests and diseases thrive in warmer conditions, further threatening agricultural productivity<br>• Farmlands and agricultural sustainability impacted. |
| **Cities and urban land use** | • Air pollution from industrial activities<br>• Coastal erosion jeopardizes infrastructure and homes along the coastline<br>• Urban expansion exacerbates these risks by encroaching on agricultural lands<br>• Heavy rains | • Public health and air quality affected<br>• Potential displacement and economic losses<br>• Farmers displaced<br>• Rise of informal settlements, lacking essential services like clean water.<br>• Compromised urban safety and resilience<br>• Damage to infrastructure, particularly along vital corridors such as the Tema motorway |

| Sector | Risks and Vulnerabilities | Impacts |
|---|---|---|
| **Disaster Risk Reduction** | • Heavy rainfall trigger flooding in lagoons and Ramsar sites, made worse by urban encroachments and inadequate drainage systems<br>• Rising sea levels during storm surges and extreme weather events heighten vulnerability in coastal areas | • Threatened lives and livelihoods due to expansion of informal settlements and slum areas.<br>• Increased vulnerability to fire outbreaks during dry seasons.<br>• Severe damage to housing infrastructure and community displacement. |
| **Health** | • Air pollution exacerbated during long humid and dry periods like harmattan.<br>• Exposure to pollutants from industrial emissions and vehicular exhaust<br>• Climate-related disasters | • Significant impact on resident health in Tema.<br>• Increased respiratory diseases and skin disorders<br>• Heightened community stress levels, potentially leading to increased incidences of anxiety, depression, and post-traumatic stress disorders among affected populations |
| **Water Resources and Systems** | • Dual threats of flooding and prolonged drought;<br>• Floods overwhelm infrastructure designed to manage storm water and sewage<br>• Droughts diminish water availability<br>• Rising temperatures alter precipitation patterns | • Contaminated water bodies with pollutants and compromising water quality for communities reliant on these sources<br>• Exacerbated competition among users and stressing already strained water supplies and agricultural production<br>• The quantity and timing of rainfall critical for water availability and quality is impacted. |

***Source: EPA (2024), Kumasi Metropolitan Assembly CCRA.***

### 5.7.2 Adaptation Priorities in Tema

According to stakeholder discussions, residents in Tema Metropolis have developed various adaptation strategies over time. These strategies include temporal relocation during floods, the use of indigenous technologies to fortify housing, and reliance on relief efforts from NADMO. Additionally, community members often turn to makeshift measures such as building barriers to protect their homes from floodwaters. These strategies underscore the community's resilience in facing recurrent climate challenges.

**Table 36: Adaptation Priorities in Tema**

| Sector | Adaptation Actions |
|---|---|
| **Agriculture** | • Conservation Agriculture<br>• Early warning and response mechanisms<br>• Diversification of livelihoods<br>• Irrigation systems<br>• Agroforestry<br>• Use Climate Resilient Crop Varieties<br>• Sensitization and training<br>• Afforestation |
| **Cities and Land Use** | • Construction of Improved Drainage Systems<br>• Improve zoning laws<br>• Early Warning and Response Mechanisms<br>• Improved Infrastructure<br>• Provision of accommodation<br>• Wetlands restoration<br>• Strict enforcement of by-laws |
| **Disaster Risk Reduction and Transport** | • Water Conservation Practices<br>• Afforestation<br>• Community Engagement and Awareness<br>• Early Warning and Response Mechanisms<br>• Expansion of Drainage Systems<br>• Relocation<br>• Construction of Improved Drainage Systems |

| Sector | Adaptation Actions |
|---|---|
| **Health** | • Public Health Regulations<br>• Construct and improve infrastructure<br>• Public Health Education Campaigns<br>• Afforestation<br>• Early warning systems<br>• Mangrove restoration<br>• Air quality monitoring |
| **Gender Mainstreaming** | • Climate Education programmes<br>• Sustainable livelihood programmes<br>• Diversification of livelihoods<br>• Improved fish smoking Infrastructure<br>• Gender Mainstreaming in Action Plans<br>• Provision of relief items<br>• Nature-base solution |
| **Water Resources** | • Enforce building regulations<br>• Water quality monitoring<br>• Community Education and involvement<br>• Construct and Improve Infrastructure<br>• Practice Afforestation |
| **Fisheries** | • Enforcement of urban planning and land use by-laws<br>• Educational Programs<br>• Early Warning and Response Mechanisms<br>• Using indigenous technology to bolster and reinforce resilient housing structure |

***Source: EPA, Tema Municipal Assembly CRVA, 2024.***

## 5.8 Wenchi Municipal Assembly Risk Assessments and Adaptation Priorities

**Figure 26: Aerial View of Wenchi Municipal**

***Source: EPA (2024) Wenchi CRVA.***

Wenchi Municipality is situated in the western part of the Bono Region, which was created in 2019. It is located at the northeast of the Bono Regional capital, Sunyani. To the west, the municipality shares a boundary with the Techiman Municipality and the newly created Bono East Region. The Wenchi municipality also shares boundaries with the Kintampo North Municipality to the northwest, the Tain District to the east, and the Sunyani Municipality to the south. Wenchi municipality's soils are mainly of the savannah ochrosol type, with some areas having lithosols. These soils are nutrient-rich and well-suited for growing tuber crops like cassava, yam, cocoyam, and maize. The area falls within the moist semi-deciduous forest and Guinea Savannah woodland zones. However, the original forest cover has been significantly depleted due to human activities such as bushfires, slash-and-burn agriculture, and logging. Common tree species in the area include Odum, Sapele, Wawa, and Mahogany, which are used for timber and fuelwood.

The Wenchi Municipality covers a land area of 3,494 km² and happens to be the largest of all the districts in the Bono Region. Wenchi town which is the capital of the municipality is about 56km from the regional capital Sunyani and about 29km from Techiman, the regional capital of the Bono East Region. This makes Wenchi Municipality strategically positioned due to its proximity to Techiman, which is an important national market. This presents the municipality with enormous opportunities in the areas of agricultural production, and agro-processing.

### 5.8.1 Risks, Vulnerabilities and Impacts in Wenchi

**Table 37: Risks, Vulnerabilities and Impacts in Wenchi**

| Systems and Assets Exposed to Hazard | Climate Hazard | Climate Risk and Potential Impacts |
|---|---|---|
| **Agriculture** | Droughts | • Periods of droughts including drying up of rivers such as the River Subin reduces water availability in the municipal, which leads to decreased soil moisture affecting crop growth and livestock health and results in reduced yields, food shortages, and increased food prices.<br>• Affected maize and yam production, sometimes causing economic hardship for farmers. |
| | Floods | • Floods caused by seasonal rains exacerbated by poor drainage systems affect several hundred residents, damaging homes and farmlands.<br>• Waterlogged areas became breeding grounds for mosquitoes, raising concerns about malaria outbreaks in Ahenfie, Nchiraa and Tromeso.<br>• Buoku, Koase and Wurompo communities cut off due to damaged roads from the June 2017 floods. Also caused damage to infrastructure and resulted in casualties.<br>• Loss of properties, submerged homes and displacement of residents.<br>• Damaged roads and other infrastructure, disrupting transportation and daily activities.<br>• Significant economic losses for farmers in Akrobi, Asuano Subinso, Nkonsia, Awisa and Branam. |
| | Extreme temperatures | • Significant losses in poultry farming, with many birds succumbing to heat stress.<br>• Discomfort and health issues among residents. Increased cases of heat-related illnesses such as dehydration reported.<br>• Some cashew and maize farmers face challenges as the high temperatures affected crop yields and water sources such as the River Atwenem. |
| | Erratic rainfall | • Shifting rainy seasons, making it difficult to time planting and harvesting, resulting in lower yields. |

| Systems and Assets Exposed to Hazard | Climate Hazard | Climate Risk and Potential Impacts |
|---|---|---|
| **Health** | Heatwaves | • Rise in cases of heat-related illnesses during peak temperature periods. |
| | Vector-borne and Water-borne diseases | • Increase in malaria cases in Wenchi, particularly after periods of heavy rainfall. Following flooding events, cholera outbreaks have occurred, putting pressure on the local health systems. |
| | Air quality deterioration | • Increased air pollution, exacerbating respiratory conditions like asthma and bronchitis. |
| **Biodiversity** | Habitat Loss | • Changes in land use and deforestation have reduced natural habitats, impacting local wildlife and plant species.<br>• Expansion of agricultural land especially for cashew farming in the Wenchi locality has led to deforestation, reducing habitats for local wildlife. |
| | Temperature and precipitation changes | • Shifts in climate patterns alter the distribution of species, disrupting ecosystems and leading to loss of biodiversity. Changes in local climate have affected the distribution of certain plant and animal species in the municipality. |
| **Water & Sanitation** | Drought | • Reduced water availability affects drinking water supplies and agricultural needs, leading to water rationing by inhabitants of local Wenchi communities. |
| | Flooding | • Heavy rains overwhelm sanitation facilities, contaminating water sources and spreading diseases. Infrastructure damage has led to long-term service disruptions. Flooding has led to the contamination of water sources including rivers found in the municipality, resulting in outbreaks of waterborne diseases such as cholera. |
| | Water Availability | • Farmers have faced challenges in irrigation planning due to unpredictable water availability, especially during periods of drought. |

| Systems and Assets Exposed to Hazard | Climate Hazard | Climate Risk and Potential Impacts |
|---|---|---|
| **Gender** | Flooding | • Women and girls often bear the brunt of increased household responsibilities during and after heavy flood events, including fetching water and caring for family members. |
| | Economic Disruptions | • Droughts have led to reduced agricultural income, disproportionately affecting women and the elderly who rely on farming. |
| | Resource Scarcity | • During water shortages, women and children report longer and more dangerous journeys to fetch water.<br>• Women, children, and the elderly faced increased workloads and longer travel times, often walking for hours to fetch water. Reports of verbal harassment and threats of physical violence during these journeys have been documented, heightening concern for their safety.<br>• Disabled individuals, especially those with mobility issues, found it nearly impossible to travel the increased distances required to fetch water. They became heavily reliant on family members or neighbors, which sometimes led to neglect due to the overwhelming burden on caregivers. |
| **Cities and Infrastructure** | Floods | • Heavy rainfall leading to overflow of local rivers.<br>• Floodwaters damage several homes, roads, and public facilities.<br>• Submerged key roads such as the Wenchi-Techiman highway, disrupt transportation and cut off access to essential services. Several bridges get affected, leading to prolonged travel delays and increased difficulty in accessing healthcare and educational facilities. |

| Systems and Assets Exposed to Hazard | Climate Hazard | Climate Risk and Potential Impacts |
|---|---|---|
| | Heatwaves | • Increased temperatures lead to heat stress in urban areas and put pressure on energy supplies due to higher demand for cooling.<br>• The extreme heat periods led to a surge in the use of cooling appliances such as fans and air conditioners in the municipal. This increased demand for electricity strained the local power grid, resulting in frequent power outages. The outages disrupted daily life, affecting businesses, schools, and households. People faced significant discomfort and health risks, particularly vulnerable populations such as the elderly and those with pre-existing health conditions. |
| | Infrastructure Degradation | • Potholes and cracks appear on many major and minor roads such as the Wenchi-Wa highway and the Wenchi-Offuman highway, following flooding, making them unsafe for use and increasing the need for frequent repairs.<br>• Damage to drainage systems also increases the risk of future flooding, prompting the municipality to invest in improved drainage infrastructure. |
| **Trade** | Flooding | • Flooding events caused severe disruptions in the supply chain, as trucks and other vehicles carrying goods to and from Wenchi, Techiman and Wa are unable to pass through flooded areas. This leads to delays in market supplies, particularly affecting perishable goods. Traders and businesses experience financial losses due to the increased cost of transportation and spoilage of goods. |
| | Reduced Agricultural Productivity due to drought | • Lower yields for staple crops such as maize and yam. This scarcity increases food prices and reduced income for farmers, affecting their livelihoods and economic stability |

| Systems and Assets Exposed to Hazard | Climate Hazard | Climate Risk and Potential Impacts |
|---|---|---|
| Energy | Drought | • Reduced water availability causes a significant drop in hydropower output. As a result, there are frequent power outages, hence reliance on diesel generators and other alternative sources, which are costlier and less environmentally friendly. This increases the operational costs for businesses and reduced the reliability of power supply for households. |
| | Higher Temperatures | • High heat leads to a sharp increase in the use of air conditioners, fans, and other cooling devices. This sudden spike in energy consumption overwhelms the local power grid, resulting in multiple blackouts. Residential areas, businesses, and critical facilities like hospitals face power interruptions, highlighting the vulnerability of the energy supply system during extreme temperature events. |

***Source: EPA Wenchi CCRA, 2024***

### 5.8.2 Adaptation Priorities in Wenchi

The 2021 Roadmap for Resilient Infrastructure assessed climate risks and offered targeted adaptation options. For Wenchi Municipal Assembly, a multi-faceted approach with immediate and long-term strategies is needed to reduce climate-related risks and boost resilience across sectors (Table 38).

**Table 38: Adaptation Priorities in Wenchi**

| Sector | Adaptation Actions |
|---|---|
| **Agriculture** | • Crop diversification<br>• Mulching<br>• Agroforestry<br>• Access to weather forecasts and early warnings<br>• Use of climate-smart agricultural practices<br>• Strengthening the capacity of agricultural extension officers<br>• Promote the availability of machinery<br>• Use of improved seeds<br>• Establishment of agricultural mechanization service provision<br>• Adoption of drip irrigation<br>• Rainwater harvesting |

| Sector | Adaptation Actions |
|---|---|
| **Biodiversity** | • Climate-smart practices<br>• Diversifying crops<br>• Developing and supporting community-based programs<br>• Restoration of degraded ecosystem<br>• Establishment of corridors and buffer ecological zones<br>• Tree planting<br>• Implementation of camera trap monitoring programs |
| **Health** | • National health control initiatives<br>• Continued education of local communities<br>• Development and implementation of public awareness campaigns<br>• Creating urban green space<br>• Upgrading health facilities<br>• Investing in telemedicine infrastructures<br>• Upgrading sewage systems and promoting proper waste management |
| **Cities and Infrastructure** | • Revising building codes to incorporate climate change<br>• Integration of infrastructure elements into urban planning<br>• Conducting climate risk assessment<br>• Incorporating climate considerations into urban planning<br>• Upgrading and maintaining the drainage system<br>• Collaborating with landscape architects and environmental NGOs |
| **Gender Mainstreaming** | • Integrating gender considerations into all climate change adaptations<br>• Developing disaster management plans that are gender-responsive<br>• Integrating climate change education in school curricula<br>• Disseminating weather forecasts and information<br>• Training programs and resources focused on women<br>• Integrating gender considerations into urban planning<br>• Supporting women entrepreneurs<br>• Women's land rights and reforms |

| Sector | Adaptation Actions |
|---|---|
| **Water and Sanitation** | • Investing in repairing and upgrading in existing water infrastructure<br>• Strengthening public awareness of water and sanitation<br>• Proper management of water and waste<br>• Improved vegetation<br>• Desilting of gutters<br>• Rainwater harvesting systems<br>• Establishment of riparian buffer zones<br>• Recycling of plastic waste<br>• Installation of green roofs and walls on buildings<br>• Upgrading and maintaining water harvest techniques |
| **Fisheries** | • Enforcement of urban planning and land use by-laws<br>• Educational Programs<br>• Early Warning and Response Mechanisms<br>• Using indigenous technology to bolster and reinforce resilient housing structure |

***Source: EPA (2024) Wenchi CCRA***

## 5.9 West Mamprusi Municipal Risk Assessments and Adaptation Priorities

The West Mamprusi Municipal Assembly (WWMA) is one of six administrative municipal assemblies in Ghana's North East Region, with Walewale serving as its administrative capital. The WWMA spans an area of 2,610.44 km² and shares a border with Builsa, Kasena-Nankana, and Bolgatanga Districts to the north (Upper East Region); North Gonja, Karaga, Kumbungu, and Savelugu Districts to the south (Northern Region); Sissala East and Wa East Districts to the west; and East Mamprusi Municipal Assembly to the east.

The local geology primarily consists of sandstone, arkose, mudstone, and shale from the Middle Lower Voltarian basin, key factors in determining underground water levels, which supply about 67% of Northern Ghana's domestic water. The White Volta and its tributaries, the Sissili and Kulpawn river, drain most of the district. Numerous smaller rivers are found at Nasia and Pwalugu, with additional streams in communities such as Gbimsi, Diani, Nayorku, Zangu-Vuga, Gbani, Wulugu, Wungu, Zangum, and Nabari.

Located within the Guinea Savannah woodland agroecological zone, West Mamprusi's vegetation consists mainly of scattered trees and light undergrowth. Economically valuable trees like shea, dawadawa, and baobab are common but face heavy harvesting for fuel, leading to widespread tree loss. Global Forest Watch reports an average emission of 615 tons per year due to tree cover loss between 2001 and 2022—a total of 13.5 kt of $CO_2e$ released during that time.

According to the 2020 Population and Housing Census, West Mamprusi Municipal has 175,755 residents, 51.2 percent of whom are women. The population is expected to grow annually at 2.9 percent. Over half (52%) live in rural areas—a decrease from 62% in 2010, reflecting increasing urbanization in the municipality.

**Figure 27: Map of West Mamprusi District**


***Source: EPA (2024), West Mamprusi CCRA.***

### 5.9.1 Risks, Vulnerabilities and Impacts in West Mamprusi

**Table 39: Risks, Vulnerabilities and Impacts in West Mamprusi**

| Systems Exposed to Hazard | Climate Hazard | Climate Risk and Potential Impacts |
|---|---|---|
| **Agriculture** | • Rainstorms<br>• Floods<br>• Drought<br>• Soil erosion<br>• Extreme temperatures<br>• Water Scarcity<br>• Rainstorms<br>• Dust Pollution | • Risks to public health and safety due to soaring temperatures, flooding etc.<br>• Diminished agricultural productivity.<br>• Affects crop yield.<br>• Increases hardship among smallholder farmers and pastoralists, influencing migration.<br>• Challenges to food security and economic stability of agricultural communities. |
| **Biodiversity** | • Bushfires Deforestation | • Reduced ecosystem stability and resilience |
| | • Floods<br>• Rainstorms<br>• Extreme heat<br>• Bushfires<br>• Drought<br>• Water scarcity | • Habitat destruction and biodiversity loss |
| **Trade** | • Floods<br>• Rainstorms<br>• Extreme heat<br>• Droughts | • Disrupted infrastructure and economic activities.<br>• Decreased market accessibility<br>• Disrupted supply chains<br>• Increased operational costs |

| Systems Exposed to Hazard | Climate Hazard | Climate Risk and Potential Impacts |
|---|---|---|
| **Gender** | • Floods<br>• Rainstorms<br>• Extreme heat<br>• Bushfires<br>• Droughts<br>• Water scarcity | • Exacerbate existing gender inequalities impacting livelihoods, health, and economic opportunities |

***Source: EPA (2024), West Mamprusi CCRA.***

### 5.9.2 Adaptation Priorities in West Mamprusi

The WMMA vulnerability assessment highlights agriculture as the most vulnerable sector, especially for small-scale farmers reliant on rain-fed methods. Proposed adaption measures for the sector include climate-smart practices, resilient crop varieties, improved technologies, and water-efficient methods to address unpredictable weather and boost productivity. Additional strategies, among others, target biodiversity restoration, community involvement, and alternative livelihoods, as deforestation, bush burning, and charcoal production pose significant threats to local ecosystems and species.

**Table 40: Adaptation Priorities in West Mamprusi**

| Sector | Adaptation Actions |
|---|---|
| **Agriculture** | • Conservation agriculture practices including CSA<br>• Early warning and response mechanisms<br>• Diversification of livelihoods<br>• Irrigation systems<br>• Improved agricultural production technologies<br>• Planting of drought-resistant varieties of crops<br>• Climate resilient agriculture on adaptive farming techniques and climate-smart agriculture |
| **Biodiversity and Ecosystem** | • Community-based management through anti-Bushfire law enforcement, and public sensitization<br>• Afforestation<br>• Formation of disaster volunteer groups<br>• Create Protected areas<br>• Diversification of Livelihoods |

| Sector | Adaptation Actions |
|---|---|
| **Disaster Risk Reduction and Transport** | • Protection of water bodies<br>• Formation of disaster information groups<br>• Community engagement on sensitization and awareness campaigns on disasters and information from early warning systems<br>• Provide incentives and support for NADMO officials<br>• Construct and improve infrastructure and drainage system<br>• Resettlement of flood prone communities<br>• Protection of roads / infrastructure by planting trees by the roadside to improve surface water retention<br>• Establishing community emergency response teams to counter basic disasters in the metropolis |
| **Water Resources** | • Increase access to potable water<br>• Enforce building regulations<br>• Protection of Water bodies by creating buffer zones along rivers to protect water quality and reduce erosion and to reduce disaster risks during flooding<br>• Community Education<br>• Construct dams and Improve Infrastructure<br>• Afforestation |
| **Health** | • Enhance and enforce Public Health Regulations<br>• Construct and Improve Infrastructure<br>• Public Health Education Campaigns<br>• Afforestation<br>• Use heat resilient gadgets e.g. fans, air conditions, etc |
| **Gender** | • Climate Education programmes<br>• Sustainable livelihood programmes<br>• Diversification of livelihood<br>• Improved Infrastructure such as installation of solar-powered water pumping and borehole systems in communities to reduce drudgery for women |

***Source: EPA (2024), West Mamprusi CCRA.***

## 5.10 Sekondi-Takoradi Metropolitan Assembly Risk Assessments and Adaptation Priorities

Sekondi-Takoradi Metropolitan Assembly STMA is the administrative capital of Ghana's Western Region, comprising Sekondi, Takoradi, and Essikado Ketan. It covers about 65 km², bordered by Mpohor, Shama, Effia-Kwesimintsim, and the Gulf of Guinea. The central area is very low-lying (6 m above sea level), making it highly vulnerable to coastal flooding, especially during heavy rains, which strain stormwater drainage and infrastructure.

According to the 2021 census, STMA had 245,382 residents (48.6% male, 51.4% female), with a high density of about 3,800 people/km². The population declined by over 81,000 from 2010 to 2021 (a -2.27% annual growth rate), but broader urban agglomeration estimates show growth, reaching over 1 million by 2023. The population pyramid indicates a decline in youth under 15, reflecting a general slowdown in growth, which could reduce climate risk but may challenge long-term economic sustainability.

The economy is driven by services, agriculture, and industry. Infrastructure improvements attract migrants, increasing density and market size. However, a large informal sector (market/street vendors) makes tax collection difficult, limiting internally generated revenue. Water is supplied by two main treatment plants (Daboase Headworks and Inchaban Headworks), serving STMA and nearby districts. Sanitation and waste management are managed by the Metropolitan Assembly, with four service providers using a polluter-pay principle. Electricity access is high (97% of urban households), but reliability is an issue due to transmission problems, low hydropower dam levels, and gas supply interruptions.

### 5.10.1 Risks, Vulnerabilities and Impacts in Sekondi-Takoradi

**Table 41: Risks, Vulnerabilities and Impacts in Sekondi-Takoradi**

| Asset / System | Risks and Vulnerabilities | Climate Risk and Potential Impacts |
|---|---|---|
| **Fishery industry** | • Changes in temperature, sea level rise.<br>• Extreme weather events such as hurricanes, typhoons, and storms. | • Loss of coastal habitats such as wetlands and estuaries<br>• Reduced fish populations which impact the economic viability of fishery industries. |
| **Water Supply Systems and Infrastructure** | • Extreme weather events, such as storms, floods, droughts and changing precipitation patterns | • Reduced availability and quality of water for communities and businesses.<br>• Damage to water supply infrastructure and disrupted operations.<br>• Prolonged dry periods lead to lower river and stream flows.<br>• Flooding causes erosion, and increased sediment loads in rivers leading to the reduced flow of water and quality of water resources. |

| Asset / System | Risks and Vulnerabilities | Climate Risk and Potential Impacts |
|---|---|---|
| **Critical Infrastructure** | • Sea level rise is causing all these hazards damage The Extreme weather events such as erratic rainfall and flooding. | • Coastal flooding, storm surges, high tides and coastal erosion that damage infrastructure and disrupt operations and business activities.<br>• Some roads that used to only seasonally be flooded are now flooded often at high tide or during heavy precipitation.<br>• Storm surges damage or destroy roads, bridges, and other infrastructure along the coast.<br>• High temperatures cause roads to expand and contract, leading to cracking, potholes, and other types of damage.<br>• Flash floods, leading to displacement and other social disruptions. |
| **Agriculture** | • Rising temperatures, extreme weather events, changing precipitation patterns, water logging, drought, extreme heat, and storms | • Adverse impact on agriculture production<br>• Increased risk of infestation of pest and diseases leading to crop failure and reduced livestock production. |
| **Health Systems** | • Floods, stagnant waters, increased temperatures, and other extreme climate events | • Negative impact on human health and health systems<br>• More cases of malaria reported during the rainy season |
| **Coastal Ecosystems** | • Changes in temperature, sea level rise, extreme weather events, such as hurricanes, typhoons and storms | • Loss of coastal habitats such as wetlands and estuaries, and reduced fish populations<br>• Losses of species habitat and diversity.<br>• Degradation of ecosystem functions.<br>• Increased runoff from rivers into the ocean |

***Source: EPA (2023), Sekondi-Takoradi CCRA***

### 5.10.2 Adaptation Priorities in Sekondi-Takoradi

Adapting to future climate uncertainty requires investing in various activities in the energy, water, transport and urban planning sectors, to boost their resilience to climate change. These are as summarized below.

**Table 42: Adaptation Priorities in Sekondi-Takoradi**

| Sector | Adaptation Actions |
|---|---|
| **Energy** | • Coastal flood defence of thermal power plants in the Western region<br>• Safeguarding vulnerable substations against floods and landslides<br>• Capacity development and regulatory frameworks to support local renewable energy generation to enhance resilience of remote, vulnerable communities<br>• Update energy sector design standards to incorporate climate adaptation risk |
| **Water** | • Water supply resilience through regional harvesting and storage solutions<br>• Climate adaptation alignment across water ministries and planning mechanisms to ensure integrated water resource management<br>• Proactive risk-informed asset management |
| **Transport** | • Airport flood resilience through elevation of runways and other vulnerable components<br>• Bridges and underpasses to ensure community access to services<br>• Nature-based adaptation through creation of intertidal habitat at Takoradi<br>• Supporting resilient design and construction of roads through research, capacity building, and the creation of a design manual.<br>• Climate-risk informed asset management system and operations and maintenance practices for roads |
| **Urban Planning** | • Review and update the 2005 Drainage Master Plan<br>• Coordination among the various government departments both vertically and horizontally as well as linking to other programmes such as West Africa Coastal Areas Management Program (WACA).<br>• Develop, broadcast, and enforce zoning guidelines or other local regulations, to ensure encroachment on flood prone areas is avoided. |

| Sector | Adaptation Actions |
|---|---|
| **Health** | • Enhance and enforce Public Health Regulations<br>• Construct and Improve Infrastructure<br>• Public Health Education Campaigns<br>• Afforestation<br>• Use heat resilient gadgets e.g. fans, air conditions, etc |
| **Cross Sectoral** | • Sponge City measures to provide ecosystem-based urban adaptation to climate change<br>• Centralised climate-risk data management system<br>• Risk-resilient land management system<br>• Mainstream resilience through climate risk assessments and EPA permitting process and strengthen enforcement for all infrastructure projects<br>• Gender mainstreaming in adaptation planning, implementation and management<br>• Prioritise nature-based solutions in planning, design and operation of infrastructure<br>• Ecosystem based adaptation to address coastal erosion risks. |

***Source: EPA (2023), Sekondi-Takoradi CCRA***

## 5.11 Tamale Metropolitan Assembly Risk Assessments and Adaptation Priorities

Tamale Metropolitan Assembly (TaMA) is in the Northern Region of Ghana, covering roughly 650 km² and borders Sagnarigu District to the north west, Mion District on the east, East Gonja to the south and Central Gonja (south west). It is part of Ghana's Northern Climate Zone, with average annual temperatures around 28°C and annual rainfall averages 1100 mm over 95 days, mainly as intense tropical showers.

As of the 2021 census, TaMA's population was about 374,744 (49.4% male, 50.6% female), representing 16.2% of the regional and 1.2% of the national population. The region is Ghana's "breadbasket," but within TaMA, the largest employment sectors are services and sales (33%), crafts and trades (21.5%), skilled agriculture/forestry/fishery (17.6%), and manufacturing (12.5%). Wholesale, agriculture, retail, and manufacturing make up 64.1% of the industrial base. In 2010, 63.3% of the population was economically active, with a 92.6% employment rate.

The main water source is pipe-borne water, but the network is old and doesn't reach all communities, especially elevated areas. Other sources include municipal systems, boreholes,

wells, dams, and dugouts. About 65% of the population has access to piped water, but supply is threatened by sand mining and land degradation near the Nawuni abstraction point and Dalun Water Treatment Plant. TaMA's 2022 action plan focuses on infrastructure (roads, drains, streetlights), economic growth (agro-processing center, modern abattoir, investment promotion), trade (new market complex), revenue generation (improved property rates collection and electronic billing), and governance (community information centres, regular town hall meetings).

### 5.11.1 Risks, Vulnerabilities and Impacts in Tamale

Tamale is facing rapid population growth, failing infrastructure, and climate change impacts, which increase its vulnerability and reduce its adaptive capacity. Its semi-arid climate and reliance on farming and trading make it especially susceptible to climate change effects on agriculture and food security. Poverty in the region further increases vulnerability. The city experiences Harmattan winds, soil erosion, limited water resources, and seasonal rivers. Water supply is threatened by upstream activities and poor catchment management. Flooding during the rainy season, worsened by dam releases and poor stormwater management, damages infrastructure and degrades water quality. Population growth strains water and land resources, pushing farmers into less favourable areas and increasing food insecurity. Poverty and limited infrastructure hinder effective adaptation. Strengthening social systems, institutions, and awareness about climate risks and adaptation options is needed to improve resilience. See **Table 43** for a summary of risks, vulnerabilities and impacts of climate change in Tamale.

**Table 43: Risks, Vulnerabilities and Impacts in Tamale**

| Asset / System | Risks and Vulnerabilities | Climate Risk and Potential Impacts |
|---|---|---|
| **Damage to water treatment plant** | • Variability in rainfall and higher temperatures | • Loss of coastal habitats such as wetlands and estuaries<br>• Reduced fish populations which impact the economic viability of fishery industries. |
| **Water supply system** | • Water scarcity due to drought.<br>• Damage to supply infrastructure due to storms and floods | • Increased risk of waterborne diseases (i.e. cholera<br>• Outbreaks).<br>• Higher rate of evaporation, exacerbating water scarcity issues. |

| Asset / System | Risks and Vulnerabilities | Climate Risk and Potential Impacts |
|---|---|---|
| **Water resources** | • Flooding, riverbank erosion | • Damage to infrastructure from fluvial flooding which is costly to repair and has disrupted lives of the communities, livelihoods, and transportation. Homelessness and other social disruptions from when people were forced to leave their homes due to flash floods. |
| **Communities living along riverbanks** | • Fluvial flooding | • Damaged infrastructure and property around the riverbanks, leading to financial losses for individuals and communities and disrupting people's livelihoods |
| **Urban stormwater management** | • Flash floods | • Damaged roads, bridges and other critical infrastructure.<br>• Children, PwDs and elderly among the most affected. |
| **Road infrastructure** | • Urban flooding, river flooding | • Impact in accessibility.<br>• Damaged roads, bridges and other critical infrastructure.<br>• Children, PwDs and elderly among the most affected. |
| **Agricultural land- crop productivity** | • Heavy precipitation causing waterlogging, changes in patterns of rainfall and increased dry spells | • Decline in agricultural production due to waterlogging, causing food insecurity, affecting the most vulnerable groups within society, making migration attractive to the able youth |
| **Fisheries, rivers** | • Submerged farms and increased sedimentation | • Decline in fish production, affecting livelihoods and increasing poverty among the vulnerable especially the youth. |
| **Health systems** | • Increased numbers of stagnant water bodies and temperatures | • Increase in reports of malaria cases |

| Asset / System | Risks and Vulnerabilities | Climate Risk and Potential Impacts |
|---|---|---|
| **Forestry** | • Bushfires<br>• Deforestation | • Severe impact of gusts/strong winds on settlements due to lack of trees to buffer.<br>• Bushfires threaten human life and has resulted in<br>• Injuries to people. |
| **Human Health** | • Disease susceptibility.<br>• Air pollution due to bushfires, causing respiratory diseases. | • Increased cases of malaria and respiratory diseases have increased, affecting people with chronic illnesses, and children. |
| **Education** | • Heavy Rainfall and flooding | • Disruption of education programmes due to heavy rains. |
| **Settlements** | • Strong winds: deforestation has removed natural buffers | • Increased winds that destroy property, together with more dust and respiratory/ health issues |

***Source: EPA (2023) TaMA CCRA.***

### 5.11.2 Adaptation Priorities in Tamale

Investing in capacity building, and education on climate risks, as well as the dissemination of information, was found to be a crucial component for a successful climate change adaptation strategy for Tamale. Adaptation actions needed to address priority risks and vulnerabilities due to climate change were identified in various studies as shown on **Table 44.**

**Table 44: Adaptation Priorities in Tamale**

| Sector | Adaptation Actions |
|---|---|
| **Transport** | • Supporting resilient design and construction of roads through research, capacity building, and the creation of a design manual<br>• Climate risk-informed asset management system and operations and maintenance practices for roads<br>• Airport flood resilience through elevation of runways and other vulnerable components<br>• Bridges and underpasses to ensure community access to services |

| Sector | Adaptation Actions |
|---|---|
| **Agriculture** | • Ensure affordability and financial sustainability of crop and livestock insurance products such as weather index insurance.<br>• Invest in improved post-harvest management systems.<br>• Improve water management and explore potential for irrigation upscaling, including by upscaling the use of solar irrigation.<br>• Facilitate setting up of rainwater harvesting structures for small-scale irrigation by building on existing maps, to identify potential areas for groundwater development for small-scale irrigation.<br>• Increase investment in local breeding of improved crop varieties and improve dissemination of higher quality/robust seeds.<br>• Improve land and soil management strategies, including integrated soil fertility management to reduce erosion and degradation of soils. |
| **Urban Planning** | • Develop an overall drainage plan that is consistent with the Greater Tamale Structure Plan and that identifies the low-lying areas and the locations of outfalls and main drains, and considers future population and land use<br>• Develop, broadcast, and enforce zoning guidelines or other local regulations, to ensure encroachment on flood prone areas is avoided |
| **Energy** | • Resilient and green energy access in drought-prone districts<br>• Capacity development and regulatory frameworks to support local renewable energy generation, including solar energy, to enhance resilience of remote, vulnerable communities<br>• Update energy sector design standards to incorporate climate adaptation risk |
| **Water** | • Water supply resilience through regional harvesting and storage solutions<br>• Climate adaptation alignment across water ministries, and planning mechanisms to ensure integrated water resource management<br>• Proactive risk-informed asset management |

***Source: EPA (2023) TaMA CCRA.***

# 6

# Implementation and Institutional Framework

## 6.1 Institutional Framework and Governance

### Overview

This section covers the current institutional arrangements for implementation of climate change programmes and initiatives and the proposed arrangement including the roles and responsibilities of the different institutions.

### 6.1.1 Current Institutional Arrangements and Coordination

Ghana has anchored its institutional architecture for climate action within the entire national development planning system, where the National Development Planning Commission (NDPC) has a legal mandate to coordinate national development policy and planning. Section 2 (2) c of Act 479, National Development Planning Systems 1994 states that "the Commission shall at the request of the President, Parliament or on its own initiative make proposals for the protection of natural and physical environment with a view to ensuring that development strategies and programmes are in conformity with sound environmental principles." As a result, NDPC works with all the MDAs and MMDAs to guarantee that environment and climate change issues are integrated into the entire national development processes integrated in policy formulation, planning, budgeting and implementation and monitoring and evaluation at all levels of governance (national, regional and districts).

The Environmental Protection Act 2025 (Act 1124) mandates the EPA to act as the coordinating body for the country's response to climate change. Section 5 of the Act sets out the provisions on climate change, including the EPA's responsibility for mainstreaming of climate change responses into national, sectoral and district plans, in collaboration with relevant stakeholders. The EPA is also tasked with supporting the development of adaptation plans to enhance community resilience to the impacts of climate change, and to coordinate with various stakeholders (including relevant MDAs, and private and civil sector organisations) to establish and operationalise enhanced data systems for planning and implementing adaptation measures. The EPA must also mainstream climate change disaster risk reduction into strategies and develop measures around the loss and damage resulting from climate change impacts.

The roles and responsibilities of institutions supporting NAP implementation are ) as detailed below.

#### 6.1.1.1 The National Medium Term Development Policy Frameworks

Climate change has been considered cross-cutting given as seen in national medium term development policy frameworks., For instance, a few MDAs such as the Ministry of Gender, Children and Social Protection (MoGCSP) have climate change focal points. The Ministry of Finance (MoF) has set up the Natural Resources and Climate Change Unit under the Economic Strategy and Research Division. The Forestry Commission also has a Climate Change Directorate. All these divisions collaborate with other units, departments and agencies to respond to the mandates of climate change within their jurisdictions.

#### 6.1.1.2 Inter / Intra Institutional Arrangement

The NDCs, the NCCP and the National Climate change committee (NCCF) have built on inter and intra-institutional arrangements for policies and strategies formulation and implementation, programmes and projects, from within the ministries and state agencies, private sector, academia and research institutions, non-state actors, and with external institutions including development partners that GNAP can be anchored. The MEST and the EPA coordinate the implementation of national climate change policies, strategies other related programmes and interventions on climate change, and work in close collaboration with sector ministries and other institutions such as NDPC. Broad consultations involving MDAs, MMDAs, development partners, private sector, academia and civil society organizations were led by the MEST in the process of updating the NDCs (2020-2030) in line with Article 4 of the Paris Agreement and UNFCCC. Similarly, the MoF works externally with MEST, EPA, the MMDAs, and NDPC, the private sector including CSOs in climate finance, monitoring, analysis and reporting. The EPA, acting as the National Focal Point for the UNFCCC, technically coordinates climate action at all levels in Ghana and, within this mandate, facilitates the regular preparation and dissemination of international climate reports, including national communications and Biennial update report (BUR) reports.

**National-Level Institutions**

i. **Ecobank Ghana Limited:** is the green climate fund National Accredited implementing Entity. (NAE). It is currently the only direct access entity (DAE) in Ghana.

ii. **Energy Commission** leads the implementation of Sustainable Energy for All Action Plan, implements energy efficient regulations, promotes renewable energy through technical regulation and conducts capacity building and proficiency training on artisan courses, electrical wiring and solar installation.

iii. **Environmental Protection Authority:** it serves as the focal points for UNFCCC and Global Environment Facility (GEF), leads and coordinates the implementation of adaptation and mitigation assessment and initiatives in the country and manages the technical aspects the preparation and implementation of the NDCs, coordinates the regular preparation of national and international climate reports, evaluates and promote climate smart technologies' and administer environmental impact assessment for projects.

iv. **Forestry Commission:** serves as the National REDD+ Secretariat (NRS) and implements the national REDD+ Strategy, the Forest Plantation Strategy and the Cocoa Landscape REDD+ project.

v. **Ministry of Energy (MoE):** The MoE is responsible for the development and implementation of energy policies and scaling up of the renewable energy investment plan and coordinated the adoption of master plans for the national gas and renewable energy.

vi. **Ministry of Environment, Science and Technology (MEST):** This is the ministry with the mandate to oversee and lead the formulation of climate change and environmental policies and programmes and serves as the focal point for clean development mechanism (CDM); Hosts the National Climate Change Committee to oversee the implementation of the climate change policy and lastly coordinates the regular preparation and implementation of the NDC.

vii. **Ministry of Finance:** This ministry is responsible for domestication of SDGs in the country and prepares SDG compliant budgets including climate change action in SDG13, tracks domestic and international climate flows and serves as the national designated entity for the green climate fund. It ensures funding for climate adaptation programs.

viii. **Ministry of Food and Agriculture** leads in policy formulation and implementation of agriculture and climate smart agriculture policies and promotes sustainable agricultural, including, farming practices.

ix. **National Development Planning Commission (NDPC):** The NPDC advises the President on development planning, policies, and strategies; coordinating and regulating planning system; preparing broad national development plans; and monitoring, evaluating, and coordinating development policies, programmes, and projects. It also facilitates and ensures the integration of climate change issues into national development policy, planning and budgetary processes.

## 6.2 Governance

In Ghana, many of the MDAs have established climate change coordination units to ensure mainstreaming of climate change in the different sectors of the economy. The country has not designed a specific structure for national adaptation planning, though the institutions collaborate technically and actively based on their goodwill to achieve common purpose or required mandate. Each of the institutions has a specific mandate on climate change, which has facilitated intra-institutional coordination. In addition, technical aspects of the preparation and implementation of the Nationally Determined Contribution and NAP, the EPA, works and collaborates with the NDPC, MoF, MEST, MLGRD and all the relevant key sectors to achieve the required mandate. Governance is critical to ensure successful implementation play a significant role in ensuring the recently passed Act 1124, (2025) makes coordination of climate change adaptation much clearer as it mandates the EPA to coordinate climate action (mitigation and adaptation) at national and subnational levels. Governance is critical to ensure successful implementation of the objectives of the National Adaptation Plan.

The existing NDC and NCCC structures will be used as the governance structure for the implementation of GNAP. The design of the NDC and NCCF builds on international best practice and has been tailor-made to meet the unique circumstances and needs of Ghana.

## 6.3 Legislation and GNAP Architecture in Ghana

Ghana has not enacted a standalone legislation on climate adaptation but incorporated in the Environmental Protection Act 2025 (Act 1124) enacted on 6 January 2025 to replace the Environmental Protection Act, 1994 (Act 490). Act 1124 consolidates the various legislations that regulate environmental protection in the country, such as the Hazardous and Electronic Waste Control and Management Act, 2016 (Act 917) and the Pesticides Control and Management Act, 1996 (Act 528). Act 1124 also establishes the Environmental Protection Authority to regulate, protect, co-ordinate, and exercise general oversight over climate change and environmental matters.

In addition, it relies on pockets of sections of laws basically pertaining to institutional mandates such as National Development Planning Systems Act, 1994 Act 480, National Development Planning System Act 1994, Act 479, and Act 936 Local Government Act, 2016 and other legal instruments in the integration of climate change into national development planning.

## 6.4 Implementation Arrangements

### 6.4.1 Institutions Supporting Implementation of National Adaptation Plan in Ghana

The Cross Sectoral Planning Groups (CSPGs) supported by the National Development Planning Commission Act 1994 Act 479, Section 15 (1), to provide a forum for a broad-based in-depth discussion and analysis of development issues in order to co-ordinate the planning and development activities of the various sectors of the Ghanaian economy. The CSPGs consist of representatives of NDPC and relevant sector ministries/departments and agencies, other public–sector institutions academic and research institutions, Private Sector Organisations (PSOs), NGOs and CSOs. Individuals are also selected to serve on the CSPGs because of their knowledge and expertise. The NDPC has made use of the CSPGs in the preparation of the National Development Policy Frameworks and Plans.

### Formation of the Cross-Sectoral Policy Groups (CSPGs)

To avoid duplication of institutional structures for the implementation of the NAP, Ghana adopted the CSPGs concept, as supported by the National Development Planning Commission Act 1994 Act 479, Section 15 (1). CSPGs provide a forum for a broad-based in-depth discussion and analysis of development issues to co-ordinate the planning and development activities of the various sectors of the Ghanaian economy within the context of climate adaptation. The CSPGs serve as the "technical heart" for all technical deliverables of the GNAP including the development of a costed national adaptation plan. They provide the tools and mechanisms needed to replicate the NAP process periodically and to mainstream adaptation priorities into sectoral and district development plans.

This was realized though stakeholder engagement of multiple stakeholder representatives from different sectors to formulate the plan, implement, monitor, evaluate and report on the activities in the plan. Five (5) sectoral policy groups aligned to the priority sectors were formed. CSPGs also support learning, education and awareness creation as cross cutting issues and ensure that gender is integrated in all sector policies. . The MEST, EPA, the NDPC, the MoF, the Ghana Statistical Service (GSS), and the Ministry of Gender, Children, and Social Protection (MoGCSP) serve on all the five CSPGs for effective coordination.

### National Climate Change Committee (NCCC)

The NCCC was established under the MEST and includes representatives from various ministries, departments and agencies, academia, private sector and civil society organizations. The committee is responsible for developing strategies to address climate change challenges and creating a NAP to help Ghana adapt to climate variability. The NCCC has been instrumental in drafting Ghana's NCCP, which outlines key objectives and strategies for sustainable development while tackling climate-related issues. The committee also collaborates with international partners to ensure Ghana's climate policies align with global frameworks.

## 6.4.2 Selected Non-Governmental Institutions Supporting Implementation of Adaptation in Ghana

There are several non-government institutions that are already actively engaged in the NAP process and have gained useful insights. These institutions include:

**Ghana Agriculture Insurance Pool (GAIP):** GAIP provides two main insurance products: index-based and indemnity-based insurance products. Index-based insurance products are for smallholder farmers, and it includes weather (Drought) index and area yield index insurance (AYII). The indemnity-based insurance products are for commercial farmers.

**Strategic Youth Network for Development (SYND):** SYND is a youth-oriented NGO that focuses primarily on promoting youth inclusion in the governance of the Natural Resources and Environmental (NRE) sector. SYND convenes the Youth in Natural Resources and Environmental Governance (Youth-NREG) Platform. SYND works in four thematic areas: climate change, biodiversity, forestry, and renewable energy.

**KASA Initiative Ghana** is a Natural Resource and Environment (NRE) Civil Society Platform that supports advocacy in seven (7) NRE thematic sectors with a Secretariat coordinating the activities. The seven thematic sectors include environment and climate change; fisheries; forestry and wildlife; oil and gas; CSOs coalition on land; CSOs mining working group; and

water and sanitation. KASA Initiative Ghana has a membership of 529 CSOs. The initiative engages in advocacy and policy influencing issues such as gender inclusion, ecosystem services integration in development planning, sustainable natural resource use, and accelerated scale-up renewable energy inclusion in the national energy mix, among others.

**Youth Empowerment for Life (YefL)** is a youth focused development and climate civil society organization based in Tamale, the Northern region of Ghana. YefL has been leading life changing climate adaptation initiatives including vulnerability assessments, youth trainings and awareness raising campaigns. YefL has been very instrumental in the development phase of the GNAP and will be a key collaborator for the implementation, monitoring and evaluation of the NAP especially within the northern landscape of Ghana.

## 6.5 Institutional Arrangements for GNAP

Institutional arrangements are fundamental for the implementation of the national adaptation plan. Ghana has established several institutional arrangements that involve multiple levels of governance and coordination to support climate change adaptation. These frameworks ensure coordinated efforts across different levels of governance. The NCCAS (2015-2025) proposes an institutional arrangement that supports decentralized planning and implementation system where MDAs at the national level are responsible for policy, planning, monitoring and evaluation of development programmes and projects while execution of such programmes and projects are undertaken at the sub national levels through the government agencies and district assemblies. Both governmental and non-governmental agencies, including the private sector and civil society organizations have been identified as implementing bodies at the national, regional, district and community levels. These multilevel of governance and coordination focuses on: Coordination at national level, decentralized implementation at sub-national levels (Municipality, metropolitan and district assemblies), stakeholder participation and engagement, collaboration and partnerships, policy development support and implementation, Sensitization and public education, financing, capacity building, resource allocation and monitoring, evaluation, reporting and learning (MERL).

Thus, institutions essential in the implementation of the Ghana NAP and their roles and responsibilities as stipulated in **Table 45**. The proposed implementation arrangement for GNAP is illustrated in **Figure 29**.

**Table 45: Implementation of GNAP**

| Level | Actor | Roles and responsibilities |
|---|---|---|
| **National Level Co-ordination** | Environmental Protection Authority (EPA) | • It was established under Articles 86 and 87 of the 1992 Constitution and operates under the National Development Planning Commission Act, 1994 (Act 479) and the National Development Planning (System) Act, 1994 (Act 480) of Ghana. The NDPC is responsible for advising the President on development planning policy and strategy and plays a crucial role in shaping Ghana's long-term development plans, ensuring sustainable economic growth, and coordinating national policies |

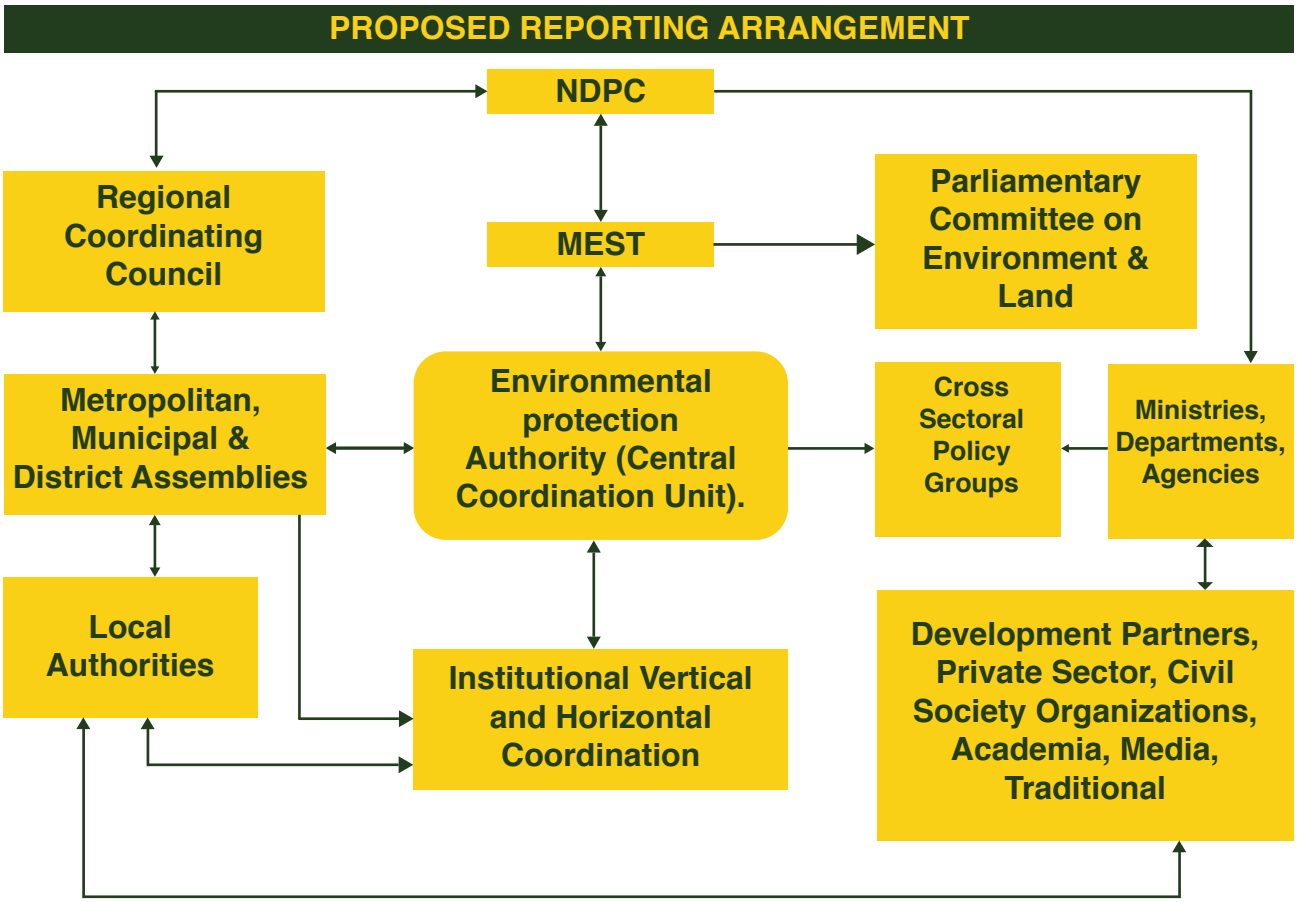
| Level | Actor | Roles and responsibilities |
|---|---|---|
| | Ministry of Environment, Science, Technology and Innovation | • Provides supervisory role by ensuring relevant and appropriate institutional mechanism to implement NAP and mainstreaming of adaptation in national planning and budgeting<br>• Coordinate the efforts of the other Government agencies, the private sector and civil society organizations.<br>• Ensure that the programmes/ projects under the strategy are in line with sectoral government policies and strategies • Provide technical, financial and logistical support for the various actors involved in programme activities, and<br>• Supervise, monitor and evaluate the implementation of NAP |
| | National Climate Change Committee | NCCC was formed in 2012 as the Secretariat at MEST and strategic body to coordinate the planning, implementation and monitoring of climate change policies and programs at the highest level.<br>It plays a crucial role in shaping climate policies and strategies. It provides guidance on climate-related initiatives and ensures coordination among various stakeholders. Examples of roles include:<br>• Advising on and contributing to Ghana's National Climate Change Policy implementation.<br>• Supporting stakeholder coordination by bringing together ministries, agencies, and organizations such as the Environmental Protection Authority (EPA), Ministry of Finance, Ministry of Food and Agriculture, and the National Development Planning Commission.<br>• Ensuring climate adaptation and mitigation strategies are effectively executed by playing an oversight role.<br>• Supporting scientific research and data collection to inform climate action.<br>• International Collaboration: Engaging with global climate initiatives and funding mechanisms like the Green Climate Fund |

| Level | Actor | Roles and responsibilities |
|---|---|---|
| | Ministries, Departments and Agencies (MDAs) | • Support coordination, planning, implementation as well as the monitoring and reporting phases of the NAP process in Ghana. The MDAs include: MEST, Ministry of Food and Agriculture (MoFA), Ministry of Water and Sanitation, Ministry of Lands and Natural Resources, the National Disaster Management Organization (NADMO), Ministry of Finance (MoF), Ministry of Local Government and Rural Development (MLGRD), Forestry Commission (FC), Energy Commission (EC), Water Resource Commission (WRC), Ghana Meteorological Agency (GMet), academic and research institutions. |
| | Technical Working Groups | • Establishment of five technical working groups, or cross-sectoral policy groups (CSPGs) on health, cities and disaster risks, private sector, agriculture and forestry, infrastructure (water, energy and transport) each consisting of a dozen representatives from government and academia—an approach borrowed from national communications to the UNFCCC |
| **Sub-National level** | Metropolitan, Municipal and District Assemblies (MMDAs) | • The local government system already has an existing, well-defined and decentralized structure in place through the district assembly system, which can facilitate the effective and coordinated mainstream at the subnational level.<br>• The District Assemblies will also be assisted by the decentralized departments, NGOs, CBO's, traditional authorities and the private sector in the preparation of detailed action plans and their implementation. For instance, the District Environment Committees can be expanded and resourced to play this role. |
| **Regional Level** | Regional Coordination Council (RCC) | • It is responsible for monitoring and evaluating District Climate Change Adaptation and will liaise with monitoring staff of National Climate Change Committee to remove bottlenecks in the implementation of District adaptation programmes. |
| | Civil Society Organizations | • Mobilize, animate, sensitize, create awareness and educate the people on the National Adaptation Plan.<br>• Liaise with the District Assemblies and the Communities to achieve efficiency and effectiveness in implementation of adaptation<br>• To be a valve for evidenced based research, monitoring, communicating information and capacity building. |

| Level | Actor | Roles and responsibilities |
|---|---|---|
| | Private Sector | • Harnesses the private sector potential for adaptation and climate risks reduction, Ghana's sustainable development agenda and realization of nationally determined contributions (NDCs) to the Paris Agreement. |
| | Media | • Plays critical role in connecting people to Ghana's socio-economic development agenda including environment and climate change. They provides vital information in times of emergency — from warning of imminent floods to explaining how to deal with disease outbreaks. As such it is expected that the media will be involved in the dissemination of the NAP and disseminating its progress against the key indicators. Indeed, strategic actions that improve climate change journalism can themselves be forms of adaptation because accurate, timely and relevant information is a critical component of resilience. |
| | Academic and Research Institutions | • Increased cases of malaria and respiratory diseases have increased, affecting people with chronic illnesses, and children. |

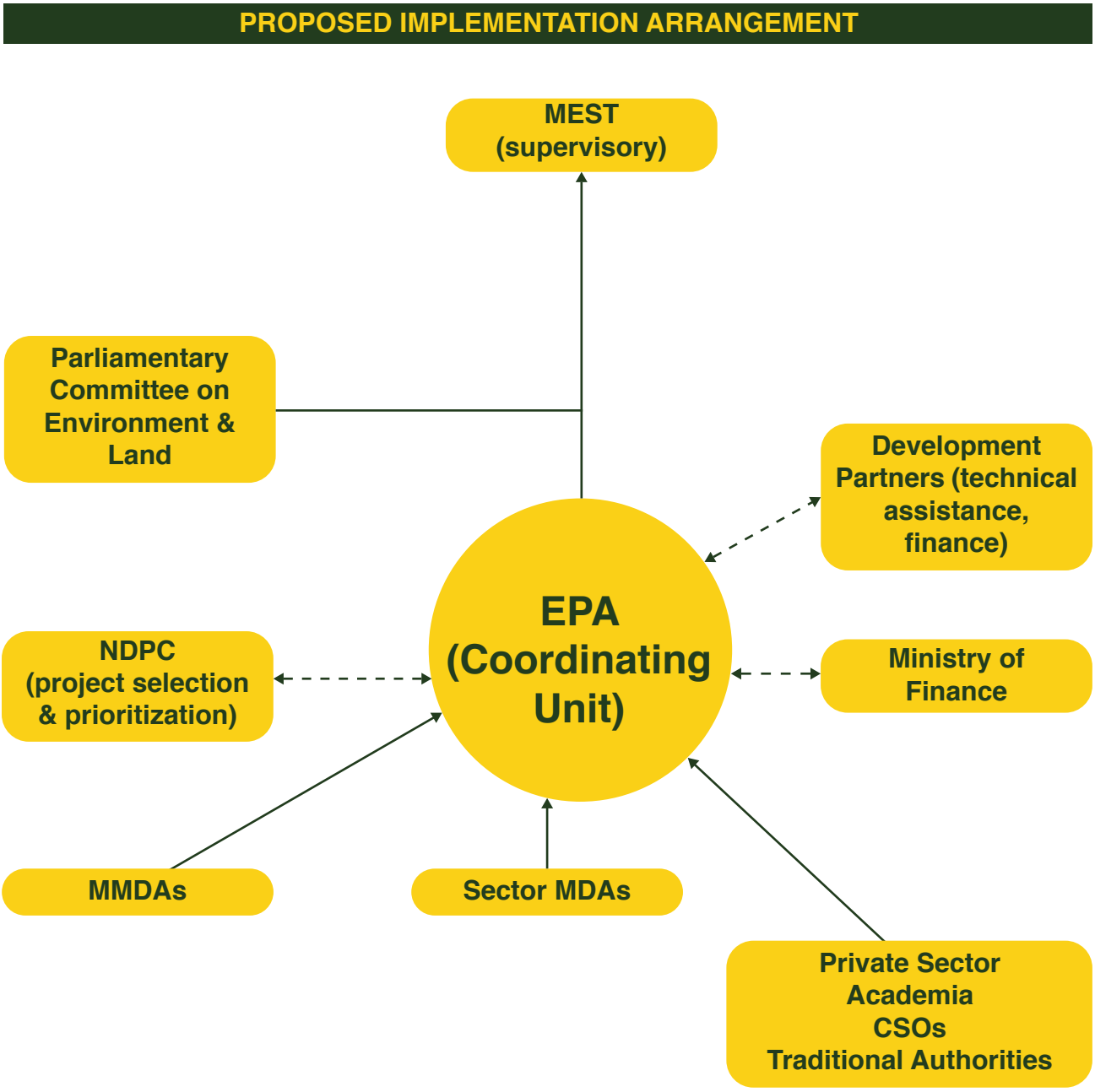
***Source: Adapted from EPA, 2018; EPA Act (2025)***

**Figure 28: Proposed Reporting Arrangement for the GNAP**




***Source: EPA, NAP Validation, 2025.***

**Figure 29: Proposed Implementation Arrangement for the GNAP**




*Source: EPA, NAP Validation, 2025.*

# 7

# Financial Resources and Budgeting

## 7.1 Ghana's Climate Finance Landscape

The world is experiencing an unprecedented climate crisis with the potential to cause severe consequences at both local and global levels. As a result, the resilience of the most vulnerable communities is increasingly compromised, reducing their adaptive capacity amid insufficient mitigation efforts (UNEP 2023). In Ghana, this situation poses threats to critical aspects of human life given its impact on the agricultural, health, water, biodiversity and forestry and infrastructure sectors.

In light of the growing recognition of the magnitude of the threat to society, adaptation has gained increasing prominence as a global challenge with local, subnational, national, regional and global dimensions (article 7.2 of the Paris Agreement). However, budgeting and funding options pose significant challenges for both national and local national governments in Ghana, limiting their ability to achieve climate goals (Adjaison & Antwi-Boasiako, 2024).

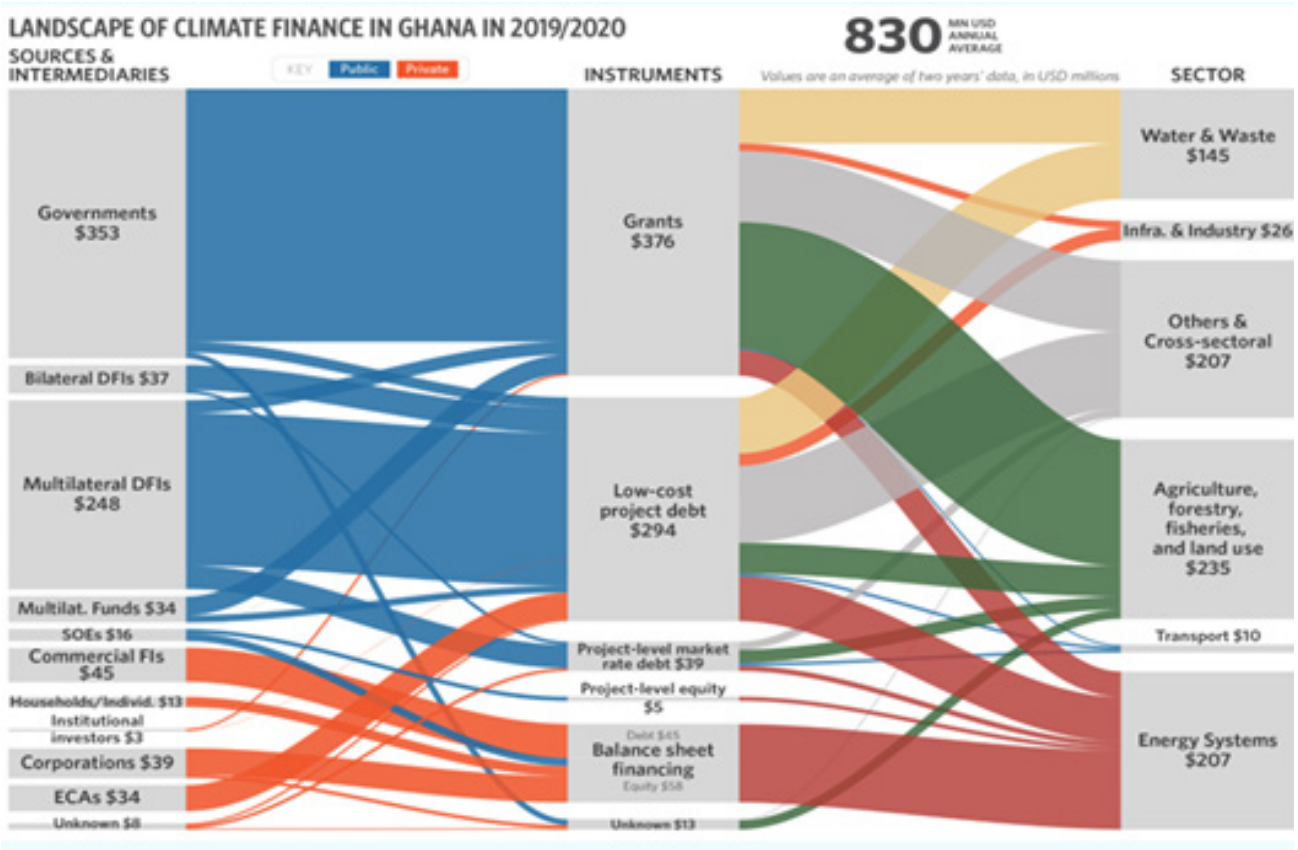
Climate finance plays an important role in the realization of Ghana's commitment to tackling climate change through adaptation and mitigation. Climate finance is generally difficult to track given several organizations in the country receive climate funding from diverse sources that do not always go through a consolidated fund such as the MoF. Much of the funding to civil society organizations is not reported to public agencies. It is also difficult to monitor and

report non-monetary support. However, evidence from public documents on climate finance over the past decade reveal that financing is growing in Ghana, though it remains unequally distributed across different climate change actions (Government of Ghana, 2021; MEST, 2013; 2015).

The 2019 and 2020 analysis of climate finance flows in Ghana was estimated at an annual average of USD830 million **(Figure 30)**, approximately 5-9% of the total required investment of between USD9.3-15.5 billion to achieve Ghana's NDCs (UNFCCC, 2021). Of the total amount, adaptation flows were USD.403 million **(Figure 31)**. This figure is likely higher given that countries often underestimate their financial needs due to limited capacity and guidance to make accurate assessments, especially on adaptation and a lack of data from subnational governments and vulnerable communities (CPI, 2022c).

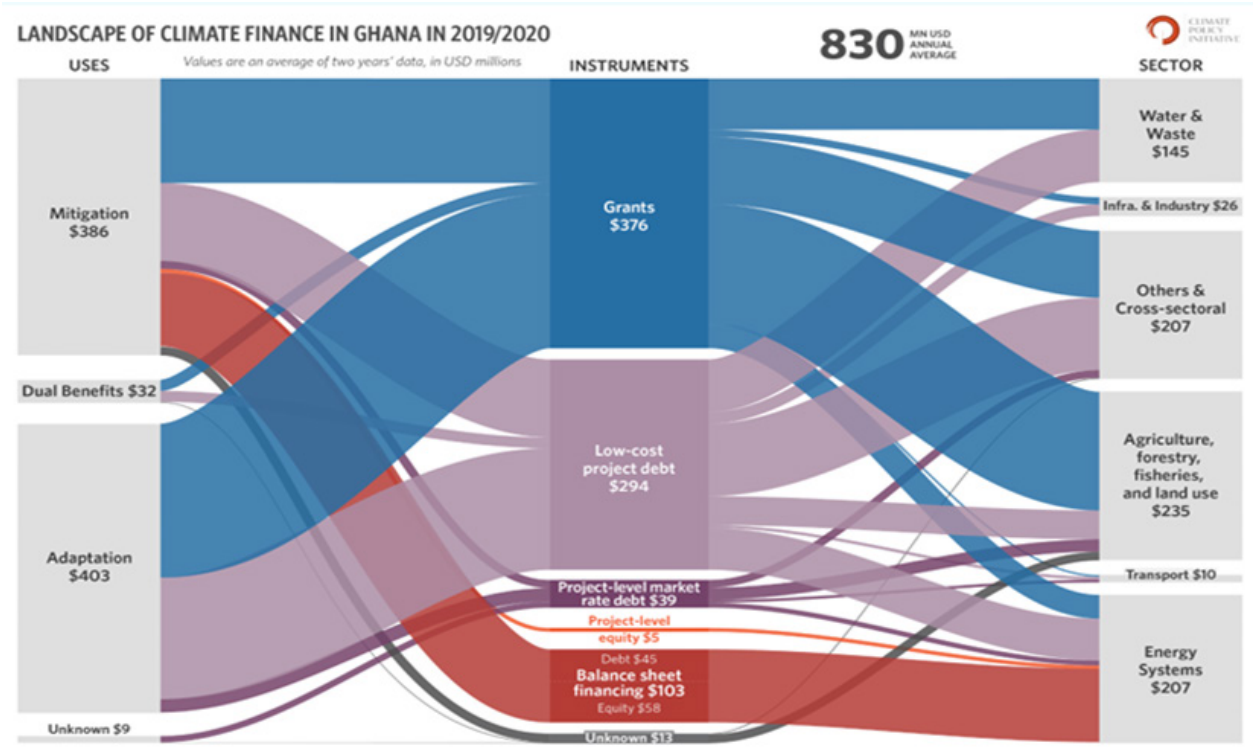
Adaptation Finance accounted for 49% (USD. 403 million, primarily funded by the public sector and actors) and mitigation accounted for 47% (USD386million).

**Figure 30: Climate Finance In Ghana- Sources, Instruments and Sectors (2019/2020. USD Million)**




***Source: CPI, 2022c.***

**Figure 31: Climate Finance Users, Instruments and Sectors (2019/2020 USD Million)**




***Source: Brief 2: Ghana Climate Finance Brief w/ Layout pp2-11/***

**Table 46: Climate Financing for Different Sectors**

| Climate finance | Channeled |
|---|---|
| Adaptation finance | AFOLU (32%), other & cross-sectoral (30%), and water & wastewater r(28%). |
| Mitigation finance | Energy sector, accounting for 51% of total mitigation finance (USD197million), followed by AFOLU (USD86million), and other & cross-sectoral (USD63 million). |

## 7.2 Adaptation Finance Needs

Ghana's adaptation plan identifies key climate risks and priority sectors as follows:

a. Rising temperatures and heat stress predominant in agriculture (crop and livestock), health, infrastructure (roads, bridges) and cities.

b. Erratic rainfall patterns affect rain-fed agriculture, water resources and education sector through school closures.

c. Droughts or prolonged dry spells, whose strongest impacts are in the northern and interior agricultural zones. They affect water, energy (hydropower) and livelihoods.

d. Flooding has high impact in urban centres (Accra, Sekondi-Takoradi), river basins and low-lying communities. It damages infrastructure, schools and health facilities.

e. Sea-level rise and coastal erosion negatively impact coastal settlements, fisheries, ports and tourism.

f. Storms and extreme events affect infrastructure, health and emergency response capacity nationwide.

In view of these sector-hazard links, Ghana has identified adaptation options and prioritized them across five sectors: agriculture, human health, infrastructure (water, transport and energy) biodiversity and ecosystems, and cities and disaster risk reduction. It is these adaptation actions that inform climate finance needs in Ghana. Costs for the adaptation actions were estimated by integrating system dynamics modelling with Cost-Benefit Analysis (CBA). This approach quantifies each cost and benefit, determining a course of action as favourable when benefits surpass expenses.

The cost of adaptation for five sectors; water, health, agriculture, cities and DRR, and biodiversity and ecosystems is estimated at USD 22.6 billion for the period 2025 to 2030, under the business-as-usual scenario. The purpose of this section is to address the climate change adaptation funding gap in Ghana. **Table 47** presents the adaptation actions and their respective implementation costs for the period 2025 to 2030. Separately, the GNAP developed a sustainability strategy to ensure continuity of the NAP. Chapter 6 summarizes the sustainability strategy, as cost estimates for its operationalization are highlighted in **Table 48** below. Sustainability actions are expected to be funded domestically and will need appropriate planning by the Government of Ghana.

**Table 47: Estimated cost of Adaptation Actions per Sector**

| WATER SECTOR | | | |
|---|---|---|---|
| | **Key Adaptation Actions** | **Cost Estimates (Million USD) 2025 - 2030** | |
| | • Restoration and conservation of wetlands and watersheds | Ground Water | Surface Water |
| | • Restoration of buffer zones | | |
| | • Watershed management | | |
| | • Promotion of Indigenous knowledge and practices in water conservation | 271.6 | 787.7 |
| | • Strengthen research on water resource management including groundwater resources | | |
| | • Management plans for River basins | | |
| | • Real-time monitoring and forecasting of the flows | | |
| | • Climate-smart River Management System | | |
| | • Provide climate-resilient infrastructure in critical areas of disaster risk reduction | | |

| | | | |
|---|---|---|---|
| | • Strengthen capacity in designing and developing climate-resilient infrastructure<br>• Monitoring of extreme rainfall events that could cause flood<br>• Comprehensive Disaster Management (DM) Plans<br>• Improved drought and flood forecasting, preparedness and response system<br>• Enhance awareness of communities on water-related hazards<br>• Harvesting rainwater for domestic use<br>• Adoption of Green roofing in cities<br>• Ensuring proper monitoring, planning and supply of drinking water<br>• Strengthen drinking water quality monitoring and surveillance | | |
| | | **Sub-Total** | **1,059.3** |
| **Subsector** | **Key Adaptation Actions** | **Cost Estimates (Million USD) 2025 - 2030** | |
| Health Facilities | • Upgrade health facilities to climate-resilient standards (e.g., flood-proofing, heat-resistant designs)<br>• Integrate climate risk assessments into facility planning and maintenance<br>• Enhance energy reliability through solar-powered systems for critical operations<br>• Retrofit existing facilities to withstand extreme weather events | 993 | |
| Health Workforce | • Conduct gender-sensitive training on climate-health risks (e.g., heat stress, vector-borne diseases)<br>• Build capacity for emergency response to climate-induced health crises<br>• Increase recruitment and deployment of health workers in climate-vulnerable areas<br>• Develop training modules on climate-adaptive healthcare delivery | 320 | |

| | | |
|---|---|---|
| Monitoring and Response Systems | • Develop a comprehensive HNAP M&E framework with climate-health indicators<br>• Mainstream HNAP indicators into DHIMS2 and health M&E systems<br>• Create and maintain an operational climate-health database<br>• Establish reporting structures for sectoral, national, and international levels<br>• Adopt digital tools for real-time monitoring of climate-health risks<br>• Strengthen institutional capacity for M&E through training | 393 |
| Overall | | 1600 |
| | **Sub-Total** | 3,306 |
| **AGRICULTURE SECTOR** | | |
| **Sub-sector** | **Key Adaptation Actions** | |
| Crop | • Climate-Smart Extension Services for Women<br>• Gender Integration in Planning & Budgeting<br>• Employ rainwater harvesting systems for irrigation during dry periods<br>• Adoption of Efficient Irrigation Systems | 2,660 |
| Livestock | • Gender-Sensitive Training & Capacity Building<br>• Rotational Grazing Strategies<br>• Localized Disease-Resistant Breeding Programs<br>• Weather Forecasting & Advisory Access | 1298 |
| Fisheries | • Promote Aquaculture and Diversify Fish Species<br>• Climate-Adaptive Fish Breeding Programs<br>• Marine Ecosystem Restoration<br>• Create Climate-Resilient Aquaculture Technologies | 168 |
| | **Sub-Total** | **4126** |

| BIODIVERSITY & ECOSYSTEMS | | | |
|---|---|---|---|
| | **Key Adaptation Actions** | **Cost Estimates (Million USD) 2025 - 2030** | |
| | | Aquatic | 222 |
| | | Forestry | 832 |
| | | Marine | 950 |
| | | Wetlands | 63 |
| | **Sub-Total** | | 2,067 |
| **CITIES SECTOR** | | | |
| Sub-sector | Adaptation Actions | Cost Estimates (Million USD) 2015 - 2030 | |
| Buildings (Housing & Infrastructure) | • Assess vulnerability of existing housing and infrastructure to climate hazards.<br>• Enforce building codes for climate-resilient construction.<br>• Retrofit critical public buildings (schools, hospitals, administrative offices).<br>• Rebuild disaster-affected housing with resilient designs.<br>• Enforce zoning regulations to prevent construction in waterways and flood-prone zones. | | 4,450. |
| Roads (Transport & Mobility) | • Assess vulnerability of transport networks (roads, bridges, drainage) to climate hazards.<br>• Build elevated roads and bridges in flood-prone areas.<br>• Reconstruct damaged roads with climate-resilient materials.<br>• Expand and enhance public transport systems (buses, trains) for resilience and emission reduction.<br>• Maintain and upgrade roadside drainage to reduce flooding.<br>• Introduce energy-efficient and low-emission transport options (e.g., electric buses, charging infrastructure). | | 7,630. |
| | **Sub-Total** | | **12,080** |

***Source: GNAP Economic Appraisal of Adaptation Actions, 2025.***

## Table 48: Cost Estimates for Sustainability Actions

| Category | Activity | Actor | Estimated Cost (USD) | Timeframe | Annual Allocation (USD) |
|---|---|---|---|---|---|
| **Institutional Sustainability** | Operationalize NAP Steering Committee CSPGs<br>• Biennial NAP Steering Committee Meetings<br>• Annual Technical Dialogue & Knowledge Forums<br>• Operational costs (communication, secretarial) | NDPC<br>EPA | 150,000 | Short-term (0-2 years) | 75,000 |
| **Financial Sustainability** | Develop & Operationalize Climate Adaptation Finance Strategy and Project Pipeline | MoF<br>MEST | 100,000 | Short-term (0-2 years) | 50,000 |
| **Financial Sustainability** | Scale training of MMDAs on adaptation planning, finance and MERL | MEST<br>MoF<br>EPA | 200,000 | Short-term (0-2 years) | 100,000 |
| **Capacity Strengthening** | Develop & roll out NAP capacity development<br>• Training of Technocrats on Adaptation project design and proposal writing<br>• Establish adaptation curricula in tertiary institutions | NAP Steering Committee | 400,000 | Medium-term (3-5 years) | 80,000 |
| **Data Knowledge & MERL** | Operationalize MERL framework<br>Conduct annual reviews, learning events and reports | All MDAs | 375,000 | Medium-term (3-5 years) | 75,000 |

| Category | Activity | Actor | Estimated Cost (USD) | Timeframe | Annual Allocation (USD) |
|---|---|---|---|---|---|
| **Stakeholder Engagement** | NAP national communication and climate literacy campaigns | EPA | 150,000 | Medium-term (3-5 years) | 50,000 |
| **Private Sector & Financing** | Host Green Investment forums and PPP dialogues | MoF | 150,000 | Medium-term (3-5 years) | 50,000 |
| **TOTAL** | | | **1,525,000** | | **480,000.** |

## 7.3 Climate Finance Sources, Instruments and Sectors

### 7.3.1 Multilateral Climate Funding Sources

Multilateral climate finance is a key component of the climate funding inflows for Ghana. The multilateral sources comprise of the Climate Investment Funds, Adaptation Fund, the Global Environment Facility, and the Green Climate Fund, among others. The funding from these sources is discussed in the subsequent sub sections.

#### 7.3.1.1 Green Climate Fund

Green Climate Fund is the largest international climate finance fund. It partners with the business world to mobilise institutional investors at scale to fund climate action, and to encourage local private sectors in developing countries to deliver climate solutions. It has supported various development programs, especially in the agriculture sector in Ghana. The GCF grant of USD 50 million for the project entitled "Resilient Landscape for Sustainable Livelihoods" that to be executed by the Ministry of Food and Agriculture with the UN Environment as the accredited entity has gone through evaluation process and is yet to be approved. The project will focus on supporting conservation agriculture techniques; agroforestry; fire management; and riverbank stabilization. Vulnerable communities are trained on post-harvest management approaches (e.g. post-harvest storage, processing and financial management) that optimize the benefits accrued from on-field interventions. The project targets to facilitate a widespread and sustained behavioural transformation in smallholder farming communities.

#### 7.3.1.3 Global Environment Facility

The GEF has continuously provided financial support to the agriculture sector and climate change projects in Ghana. Financial and technical support towards the preparation of Ghana's BUR2 was provided by the GEF via the UN Environment (BUR2, 2020). In 2016, with the World Bank as the as the implementing agencies and the Ministry of Environment, Science and Technology (MEST) as the executing agency. It has extended additional facility to fund a project called the Sustainable Land and Water Management, which aimed at expanding the area under Sustainable Land and Water Management Practices in Selected Watersheds by supporting adoption of adoption of the sustainable land and water management practices for reducing land degradation and enhancing maintenance of biodiversity **(Table 49)**. In this

regard the project focuses on capacity and monitoring for SLWM; implementation of SLWM; national sustainable land management and Payment for Environmental Services monitoring; and management of biodiversity corridors. Additional support was received from the UNDP through the NDC Support Programme.

#### 7.3.1.4 UNCDF LoCAL Mechanism

The UNCDF Local Climate Adaptive Living (LoCAL) Facility mechanism provides Ghana with a practical means to channel climate finance to local governments for locally-led adaptation. LoCAL supports districts to integrate climate change into their development plans and budgets through performance-based climate resilience grants. The facility allocates resources to communities most affected by climate hazards to support local capacity and advance community adaptation priorities. This mechanism is currently implemented in selected districts and functions as an example of decentralized financing for adaptation.

**Table 49: List of Major Projects in Ghana under International and Multilateral Climate Funds (2012-2020)**

| Name of Project | Fund | Amount of Funding Approved (USD millions) | Disbursed (USD millions) | Dates |
|---|---|---|---|---|
| Increased resilience to climate change in Northern Ghana through the management of water resources and diversification of livelihoods | Adaptation Fund (AF) | 8.30 | 5.0 | 2015-2020 |
| Ghana Agricultural Sector Investment | Adaptation for Smallholder Agriculture Programme (ASAP) | 10.00 | 0.4 | 2014 |
| Preparation Grant for Program Planning | Scaling-Up Renewable Energy Program for Low Income Countries (SREP) | 1.51 | | 2015 |
| Enhancing Natural Forest and Agroforest landscapes Project | Forest Investment Program (FIP) | 30.00 | | 2014 |
| Preparation of Ghana's Initial Biennial Update Report to UNFCCC | Global Environment Facility (GEF5) | 0.40 | | 2013 |

| Name of Project | Fund | Amount of Funding Approved (USD millions) | Disbursed (USD millions) | Dates |
|---|---|---|---|---|
| Enabling Preparation of Ghana's Fourth National Communication and Second Biennial Update Report to UNFCCC | Global Environment Facility (GEF6) | 0.85 | | 2016 |
| Ghana Climate Innovation Center | World Bank (contribution by Netherlands and DANIDA) | 17.20 | | 2016 |
| Second additional financing for sustainable land and water management project | World Bank | 12.80 | | 2016 |
| Sustainable rural water and sanitation additional funding | World Bank | 45.70 | | 2017 |
| Sustainable land and water management | World Bank | 8.60 | | 2014 |

#### 7.3.1.5 Adaptation Fund

The Adaptation fund provided a funding of USD 8,293,972 in 2015 for a programme entitled *"Increased Resilience to Climate Change in Northern Ghana through the Management of Water Resources and Diversification of Livelihoods"* for a period of 4 years. The programme aims to enhance the resilience and adaptive capacity of rural livelihoods to climate impacts and risks on water resources in the northern region of Ghana. This is achieved through the improvement of water access and increasing institutional capacity and coordination for integrated water management to support other uses of water resources especially for the diversification of livelihoods by rural communities. The programme focuses on three regions in the northern part of Ghana: the Upper East, Upper West and Northern Regions, based on their higher degree of exposure to climate variability and change characterized by increasing temperatures and decreasing and erratic rainfall.

Ghana is also one of the West African countries that have benefited from the AF funded regional project (USD 14,000,000) called *"Promoting Climate-Smart Agriculture in West Africa"* in 2018 for a period of 3.5 years for the food security sector. The project aim is to reduce the vulnerability of farmers and pastoralists to increase climatic risk, which undermines the level of food security, income generation, and the supporting ecosystem services of poor communities. It has supported strengthening of knowledge and technical capacity through regional and local interactions for the promotion of agriculture practices resilient to the adverse effects of climate change. It has also supported scaling up of best practices related to climate change adaptation in agriculture and pastoralism at local and regional level.

#### 7.3.1.6 Other Global Financing Initiatives

Nordic Development Fund (climate change facility) sponsored several climate change studies that are relevant to achieving the NDC targets. These include the Climate-proofed water conservation strategies in Northern Ghana with the objective to promote transfer of knowledge and skill on the sustainable management of water resources through cost-effective climate-proofed water storage and conservation strategies.

### 7.3.2 Multilateral Development Banks

#### 7.3.2.1 World Bank

The World Bank is usually the conduit through which these funds are channelled. Climate financing from the World Bank cuts across many sectors of the economy. Energy sector, however, dominates the climate financing from the World Bank. Related to agriculture, there is the Sustainable Land and Water Management Project that brought to Ghana a total of US$13.25 million in grant and loans. The Government of Ghana also committed a total of US$4.5 million to the project. For technology transfer, the World Bank is financing the Ghana Climate Innovation Centre with an amount of US$17.5 million. This is meant to target 500 businesses including agro industries in climate innovation. Other World Bank funded climate projects are listed on **Table 49**.

#### 7.3.2.2 African Development Bank

The African Development Bank (AfDB) is an important financier of Ghana's development programmes generally. In the specific area of climate financing, one may cite the US$600 million loan the Bank facilitated for the Ghana Cocoa Board (COCOBOD) which has oversight of the cocoa industry in the country. The loan is meant to finance large scale pollination of cocoa farms, expanded tree pruning, construction of warehouses, rehabilitation of declining plantations and increased local processing.

#### 7.3.2.3 International Fund for Agricultural Development

The International Fund for Agricultural Development (IFAD) Ghana Agricultural Sector Investment Program promotes and mainstreams climate change resilience approaches in Ghana, particularly in the northern regions. It is financed through the Adaptation for Smallholder Agriculture Programme. Food and Agriculture Organisation (FAO) Supports the promotion of conservation agriculture and integrated pest management for sustained soil fertility and productivity.

### 7.3.3 Bilateral Arrangements

The Nationally Determined Contributions Support Program (US$1,695,372; 2017-2020) is sponsored by the UNDP and Government of Germany and supports Ghana in achieving the NDCs via technical and institutional capacity building. The Government of Norway also provided a grant of US$5.2 million to the Government of Ghana for community resilience through early warning systems.

DANIDA through its efforts at building stronger universities in Africa through a North South collaboration has supported the University of Ghana to carry out research on the theme; Adaptation and mitigation of climate change in Ghanaian agriculture. The initiative includes capacity building and networking and support with equipment for research. DANIDA also

supported a project (2016 – 2020) on Climate Smart Cocoa Systems for Ghana, a project with the aim to develop a comprehensive understanding of the impacts of climate change on the socio-biophysical basis of cocoa systems in Ghana and assess the role of agroforestry as a model for climate and carbon smart agriculture. Another funding had been provided to University of Energy and Natural Resources, Ghana for a project titled 'Building Resilience on Lake Bosumtwi to Climate Change' to be executed between 2018 and 2022 to enhance the fishery resources in the lake Bosumtwi watershed. Building climate-resilience into basin water management was also funded by DANIDA from 2019 to 2024 at a total grant of 11,998,167 DKK to a consortium of institutions led by the Water Research Institute.

The USAID also funded, Sustainable Fisheries Management Project, over the period; 2013-2019. From 2012-2017, The German Federal Ministry of Economic Cooperation and Development (BMZ) funded Climate Change Adaptation of Agro ecosystems in Ghana. Another climate change project in Ghana is the Adaptation at Scale in Semi-Arid Regions' (ASSAR), a five-year project (2013-2017) funded by the International Development Research Centre (IDRC) and DFID aimed at improving understanding of climate change in semi-arid areas across Africa and Asia. The West African Science Service Centre on Climate Change and Adapted Land Use' (WASCAL), is also a major climate change project aimed at capacity building in the design of resilient land-use systems.

### 7.3.4 Other Funding Sources

Other funding sources that have provided grants for climate change projects in Ghana include the Rockefeller Foundation provided a grant to support the project entitled 'Design and launch a Climate-smart Agricultural Finance Facility in Ghana'. Bill & Melinda Gate Foundation also provided a grant to the International Institute of Tropical Agriculture to carry out a study "Predict the impacts of Climate change on the cocoa-growing regions in Ghana and Cote D'Ivoire". This project aimed at determining which environmental variables drive the climate suitability of an area to grow cocoa, predict the change in climate for the cocoa-growing areas in Ghana.

Another funding (US$ 214,430.00) was received by the University of Ghana for Regional Integrated Assessment of climate change impact on livelihoods of smallholder farmers in Ghana (Navrongo) over the period 2012-2014 and 2015 – 2017. The funds were granted by United Kingdom UKaid of the Department for International Development (DFID), through the Agricultural Model Inter-comparison and Improvement Project (AgMIP: (www.agmip.org) for work in Sub-Saharan Africa and South Asia to substantially improved assessments of climate impacts on the agricultural sector. The analysis was structured around 4 core questions (Rosenzweig et al. 2016; Freduah et al. 2019; Adam et al. 2020).

The AFOLU and energy sectors are the two largest contributors to GHG emissions in Ghana and accounted for more than 53% of total climate finance that is largely public investment driven. AFOLU sector received 28% (USD. 235million) of total climate finance investment, the highest amount for any sector, over a half of which was dedicated for adaptation, with mitigation receiving only 37% of funds.

Climate change solutions are split across several sectoral categories, especially in the case of adaptation (CPI, 2022). Since the sectors of key economic importance for Ghana are highly vulnerable to climate change, investment in disaster-risk management is necessary

to build resilience against potential shocks. Capacity building has been another key priority of the government, with Ghana's NDC outlining key capacity building needs and financing requirements.

Water and waste received 17% of overall climate finance. Due to the lack of targeted tagging mechanisms within the sector, its detailed assessment could not be conducted. There is a growing need to understand climate finance flows at the sectoral level. However, the absence of a national level taxonomy with specific definitions to understand what activities constitute climate finance severely limits the tagging of investments at the sector and sub-sector level. Moreover, within the private sector, climate investments at the sectoral level lack a standardised reporting methodology coupled with the lack of incentives and resources for tracking financial flows. This problem is inflated, as many private sector investments, especially in adaptation, are often smaller climate constituents of larger investment portfolios, further complicating the tracking process. There is a strong need for the creation of an overarching tracking and reporting framework to support a more detailed assessment of sector level investments (CPI, 2022b).

The Program on Affirmative Finance Action for Women in Africa finances climate resilient agricultural practices which have cross-cutting focus on Ghana's NDC commitments. The program aims to empower vulnerable women groups in this most vulnerable agro-ecological zone through Line of Credit (LoC) and through Technical Assistance (TA) to participate in low-emission climate resilient agricultural (CRA) practices in the country. In 2018, the country together with Uganda and Nigeria benefited from Acumen Resilient Agriculture Fund (ARAF), under the GCF. Acumen aims at supporting pioneering and early-growth stage innovative agribusinesses that enhance the climate resilience of smallholder farmers. This funding focused on adaptation with emphasis on food and water security areas. UNEP also accessed funds in 2019 from GCF to develop a NAP adaptation process that will produce a costed adaptation strategy for the country and provide the tools, mechanisms, systems and information with which to replicate the NAP process at regular intervals and to mainstream the adaptation strategy into sector and District development plans.

### 7.3.5 Flagship Adaptation Programmes and Projects

The Government of Ghana has additionally initiated some key flagship public programmes and actions, at various stages of implementation, to mitigate and support adaptation. They include the following:

- Investing nearly US$ 670 million in seven sea defence projects along Ghana's coastline over the last decade.
- Promulgating the Petroleum Exploration and Development Act, 2016, (Act 919) to restrict the flaring of gas in petroleum exploration and development.
- Committing The Forestry Commission to deliver six million tonnes of greenhouse gas emissions reduction under the Ghana Cocoa Forest REDD+ Programme with the World Bank in 2019
- Leverage Technology and Innovation
    - > Investing in advanced technologies, such as localized weather stations, early warning systems, and digital platforms, for real-time climate risk management.

> Promoting the adoption of climate-smart agricultural technologies, water-saving infrastructure, and renewable energy solutions.

- Investing more than US$ 100 million since 2016 in the northern drylands to build the resilience of smallholder farmers and the fragile ecosystem they depend on for a livelihood
- City-wide resilient infrastructure planning, including an investment of US$ 200 million in the Greater Accra Resilient Integrated Development Project to improve flood risk and solid waste management in the Odaw River, led by the Ministry of Water Resources and Sanitation with funding from the World Bank
- Management of climate-induced and gender-related health.
- Enhancement of climate education and climate services for efficient weather information management
- Early warning and disaster risk management
- Integrated water resources management

## 7.4 Financial Gaps and Strategies for Mobilizing Climate Change Adaptation Resources

Financing climate adaptation in Ghana requires creative approaches that blend public, private, and international funding sources. Insufficient funding is a major barrier to climate projects, especially in low- and middle-income countries. Sustainable financial solutions and collaboration with private business and civil society are vital for effective funding strategies (Adjaison & Antwi-Boasiako, 2024).

**International Climate Funds:** Ghana leverages international climate funds such as the GCF and other blended finance mechanisms to support climate resilience. A systematic review of Ghana's climate finance landscape highlights challenges such as regulatory fragmentation, limited institutional capacity, and procedural inefficiencies. To improve effectiveness, experts recommend institutional reforms, a comprehensive green finance framework, and integration of climate-risk assessments into public financial management system.

**Non-Market Mechanisms:** Non-Market Mechanisms (NMMs) offer Ghana an important complementary path for mobilizing finance outside traditional carbon markets. These mechanisms, recognized under Article 6.8 of the Paris Agreement, can provide additional support through capacity building, technology transfer, and non-traditional financing streams. For Ghana, NMMs could support adaptation by facilitating South-South cooperation.

**Green Bonds:** These are fixed-income instruments designed to fund projects with environmental benefits. In Ghana, they are governed under the Ghana Fixed Income Market (GFIM) Rules 2022, ensuring transparency and credibility in the market. Ghana is making strides in green bond financing to support sustainable development and climate adaptation. For example, Ghana's Securities Exchange Commission (SEC) has issued guidelines in 2024 on the outline for eligibility criteria, reporting requirements, and measures to prevent "greenwashing"—the practice of falsely labelling bonds as environmentally friendly. The green bonds offer potential to attract international investment for climate adaptation projects,

finance large scale environmental climate adaptation projects and boost economic growth. Market Development through the Ghana Fixed Income Market has integrated sustainability bonds into its listing rules, allowing issuers to tap into investor demand for green financing, thus promoting sustainable or green investment.

**Community Public-Private Partnerships (PPPs):** These remain critical in driving climate resilient investments in key economic sectors such as agriculture, infrastructure, energy, and businesses and in green and renewable energy such as solar, wind, geothermal, hydrothermal and biogas reducing reliance on fossil fuels and enhancing resilience and climate adaptation. Ghana's Public Private Partnership (PPP) Act, 2020 (Act 1039) provides a legal framework for private investment in public infrastructure. This allows for financing climate-resilient roads, water systems, and energy projects. Ghana's MoF, UNDP and the German Government launched a PPP initiative on flood insurance for urban areas to enhance financial resilience and provide rapid recovery support for vulnerable communities. Other opportunities for PPP investment are climate smart agriculture in areas of irrigation systems, drought tolerant and resistant crops and breed, feed management. Lastly, the National Insurance Commission (NIC) in Ghana is an enabler for micro insurance that allows low-income farmers to access financing enhancing their financially stability enhancing their resilience to climate shocks. There is need to increase more involvement of the local communities.

**Innovative Tax Incentives:** Government of Ghana has offered innovative tax incentives to international investors to economic growth. Currently Ghana is offering three types of tax incentives for foreign investors, industrialization and corporate tax credit. The foreign investors are receiving tax exemptions and subsidies to encourage investments in manufacturing, technology and agribusiness to stimulate job creation and technology development and transfer. In industrialization, One District One Factory (1D1F) Policy provides tax relief for businesses setting up manufacturing plants across Ghana to accelerate industrial growth and local production. The Corporate tax credits as per the Ghana Investments Promotion Centre Act, 2013 (Act 865), businesses in strategic sectors such as export oriented, machinery and equipment and venture benefit from reduced corporate tax rates.

# 8

# GNAP Sustainability Strategy

## 8.1 Purpose and Rationale for the NAP Sustainability Strategy

Sustainability of the NAP for Ghana is essential, and it ensures that the country plans for climate change adaptation in the short, medium and long term. This is well implemented by the government of Ghana by integrating climate change adaptation in the country's long term development strategies as well as contribute to international commitments that Ghana is a signatory to.

The sustainability strategy for the GNAP aims to ensure the long-term resilience and adaptive capacity of the country in the face of climate change. It is designed to be iterative, allowing for continuous improvement and adaptation based on lessons learned and evolving climate conditions. The strategy is closely linked to the Monitoring and Evaluation (M&E) framework to ensure that progress is tracked, and adjustments are made as necessary.

Ghana's National Adaptation Plan incorporates sustainability by integrating climate change adaptation into long-term development strategies, ensuring that adaptation measures are not only effective but also contribute to sustainable development. Ghana's NAP implementation is designed to utilize the already existing structures such as the medium-term development plans at the sector and district levels coordinated by the National Development Planning

Commission (NDPC). The implementation of the NAPs will NOT run parallel BUT in TANDEM with the existing medium to long term plans at sectoral/national and the MMDAs level.

## 8.2 Guiding Principles

National ownership and leadership: The strategy emphasizes Ghana's sovereign leadership over the adaptation agenda, grounded in the roles of MESTI, EPA, NDPC, and MMDAs. Ownership is expressed through domestic planning instruments, legal frameworks, and government-led coordination structures.

Integration and coherence across sectors: Adaptation is treated as a cross-cutting issue. The strategy ensures that sectoral policies especially in agriculture, water, health, infrastructure, and disaster risk management; incorporate climate risk considerations. Mechanisms such as CSPGs and integration into MTDPs at district level ensure coherence.

Financial viability and resource mobilization: Sustainability depends on predictable and diversified funding. The strategy promotes integration of adaptation into national budgets and leveraging of international finance (GCF, Adaptation Fund) and private sector innovation (green bonds, insurance).

Social inclusion and equity: Vulnerable groups including women, youth, persons with disabilities, and coastal and rural communities are prioritized. The strategy builds on the Gender Strategy developed under the NAP Readiness Project to ensure that adaptation measures are inclusive and equitable.

Learning and adaptive management: The strategy is built to evolve. Through the MEL framework, climate information systems (GMet), and iterative stakeholder engagement, Ghana aims to institutionalize a feedback loop for evidence-based policymaking and continuous improvement.

## 8.3 Strategic Objectives

### a. Ensure long-term integration of adaptation into planning and development processes

This objective aims to embed climate adaptation as a permanent feature of Ghana's development planning and governance systems. It calls for the full integration of adaptation priorities into national development plans, sectoral strategies, district-level Medium-Term Development Plans (MTDPs), and public investment frameworks. By mainstreaming adaptation in these processes, Ghana ensures that climate resilience is no longer addressed in isolated projects but is treated as a national development priority. This also requires alignment between policy and budget cycles, harmonization of sectoral targets with adaptation needs, and consistent use of planning tools that include climate risk screening and resource allocation for resilience-building initiatives.

### b. Build institutional and technical capacity across levels

Effective and sustained adaptation requires institutions that are capable, well-resourced, and coordinated. This objective focuses on enhancing the technical, organizational, and human resource capacities of key national entities such as MESTI, EPA, NDPC, and MoF, as well as regional and district-level government institutions. It recognizes that capacity building must be continuous and embedded in institutional systems; not treated as one-off training

events. This includes supporting MDAs and MMDAs with tools, guidance, and technical assistance to assess climate risks, plan and budget for adaptation, and implement inclusive, gender-responsive interventions. Strengthening coordination mechanisms such as the Cross-Sectoral Planning Groups (CSPGs) will further support the harmonization of efforts across sectors and scales.

**c. Secure diversified and sustainable financing**

Adaptation cannot be sustained without reliable, adequate, and diversified sources of finance. This objective emphasizes the need to shift from donor-dependence toward a more balanced approach that includes domestic public finance, international climate funds, and private sector investment. It includes efforts to integrate adaptation into national and district budgets through budget tagging systems, earmarked allocations, and fiscal incentives for climate-resilient spending. It also prioritizes the development of a national Climate Finance Strategy and a project pipeline to guide engagement with the Green Climate Fund (GCF), Adaptation Fund, and other global climate financing mechanisms. At the same time, it calls for enabling frameworks to mobilize innovative financing instruments such as green bonds, blended finance, and weather-indexed insurance, that can unlock private capital for adaptation and resilience.

**d. Promote evidence-based decision-making and knowledge-sharing**

Sound adaptation decisions must be grounded in robust data, inclusive learning, and timely feedback. This objective focuses on strengthening Ghana's climate information and data systems, improving access to vulnerability and risk assessments, and ensuring that adaptation actions are informed by both scientific research and local realities. It also calls for the operationalization of a Monitoring, Evaluation, and Learning (MEL) framework aligned with national development tracking systems to support accountability, learning, and adaptive management. Knowledge-sharing platforms including digital tools, learning forums, and community-level feedback mechanisms will help foster a culture of continuous improvement and collaboration among practitioners, policymakers, researchers, and communities. By promoting transparency, participation, and the systematic use of evidence, this objective aims to enhance the effectiveness and legitimacy of adaptation actions over time.

## 8.4 Key Pillars and Strategic Actions

| Pillar | Strategic Action |
|---|---|
| Institutional Sustainability | Formalize roles of EPA, MEST, NDPC, and sectoral agencies<br>• NAP process should move beyond project-based arrangements and embed adaptation responsibilities within existing governance structures to ensure long-term sustainability.<br>• EPA mandated as the coordination and technical Secretariat (EPA Act, 1124)<br>• NDPC to embed NAP actions into the national planning cycle and enforce compliance among MDAs. sectoral ministries, such as Health, Agriculture, Roads, and Local Government.<br>• To receive defined mandates with corresponding resource allocations for adaptation delivery. |

| Pillar | Strategic Action |
|---|---|
| | Embed adaptation mandates in MMDAs and sector MDAs<br>• Inclusion of adaptation responsibilities in MMDA job descriptions, budget guidelines, and performance contracts.<br>• District Planning Units to receive capacity-building and resourcing to deliver and report on localized adaptation actions in line with NDPC and EPA frameworks. |
| Financial Sustainability | • Mainstream adaptation in national and district budgets<br>• Develop a climate finance strategy and project pipeline<br>• Strengthen access to international climate funds (e.g., GCF, AF)<br>• Mobilize private sector investment and innovative financing |
| Policy and Regulatory Integration | • Integrate NAP actions into sectoral and local development plans<br>• Review and revise laws, building codes, and EIAs to reflect climate risk<br>• Institutionalize climate adaptation screening in public investment processes |
| Capacity Strengthening | • Provide continuous training and technical support to MDAs and MMDAs<br>• Support development of adaptation curricula in tertiary institutions<br>• Foster partnerships with academia, CSOs, and professional bodies |
| Data, Knowledge, and Monitoring Systems | • Operationalize a NAP Monitoring, Evaluation, and Reporting framework<br>• Strengthen Ghana's climate information systems<br>• Establish an integrated national database for vulnerability, risk, and adaptation actions |
| Stakeholder Engagement and Inclusivity | • Institutionalize stakeholder engagement platforms for youth, women, and civil society<br>• Strengthen community-based adaptation mechanisms<br>• Implement national communication and public awareness strategies |

## 8.5 Implementation and Coordination Framework

The successful implementation of Ghana's NAP Sustainability Strategy hinges on robust institutional arrangements, clearly defined mandates, multi-level coordination, and full alignment with national development planning and budgeting systems. This framework outlines how the strategy will be anchored within Ghana's governance structures and operationalized across sectors and administrative levels.

### 8.5.1 Roles and Responsibilities of Core Institutions

A coordinated, whole-of-government approach is required to implement adaptation actions across scales and sectors. The key institutions and their respective roles include:

i. **Ministry of Environment, Science and Technology:** Provides overall policy leadership and oversight of climate adaptation efforts. MEST will chair the NAP Steering Committee and ensure political ownership of the sustainability agenda. It will also liaise with Cabinet and Parliament to ensure that adaptation priorities are embedded in national legislative and executive processes.

ii. **Environmental Protection Agency:** Serves as the technical lead and coordinating entity for the implementation of the NAP Sustainability Strategy. It will provide strategic guidance, develop technical tools, oversee the Monitoring, Evaluation, and Learning system, and support proposal development for climate finance. EPA will also lead the development of knowledge platforms and vulnerability data systems.

iii. **National Development Planning Commission:** Ensures that adaptation is integrated into the national and subnational planning architecture, including Medium-Term Development Plans, Sector Strategic Plans, and Performance Monitoring Frameworks. NDPC will also track implementation through annual performance assessments of MDAs and MMDAs.

iv. **Ministry of Finance:** Plays a critical role in ensuring financial sustainability through budget integration, fiscal policy reforms, climate finance strategy development, and coordination with international development partners. MoF will also lead the operationalization of budget tagging systems and link adaptation investment with Ghana's Public Investment Management framework.

v. **Sector Ministries, Departments, and Agencies:** Responsible for mainstreaming adaptation into sector-specific plans, projects, and programmes. They will implement adaptation actions aligned with sector vulnerabilities and report progress using NDPC's tools and EPA's technical guidelines.

vi. **Metropolitan, Municipal, and District Assemblies:** Serve as the frontlines of adaptation implementation. They will localize NAP priorities through Community Adaptation Action Plans (CAAPs), integrate them into Composite Budgets, and ensure inclusive, participatory planning with local stakeholders. District Planning Units will coordinate data collection, community engagement, and implementation tracking.

## 8.6 Mechanisms for Inter-Institutional Coordination and Reporting

To ensure vertical and horizontal coherence, the following coordination mechanisms will be institutionalized:

i. **NAP Steering Committee:** A high-level, multi-stakeholder body chaired by MEST and co-chaired by MoF. It will include representatives from NDPC, EPA, key sector MDAs, MMDAs, development partners, civil society, academia, and the private sector.

The committee will meet biannually to:

- Review progress and implementation challenges.
- Approve updates to the sustainability strategy and financing plans.
- Align adaptation actions with national priorities and international commitments.

ii. **Cross-Sectoral Planning Groups (CSPGs):** These thematic working groups will bring together technical staff from relevant MDAs, sector experts, and partners to coordinate planning, technical review, and harmonization of adaptation approaches across sectors such as agriculture, water, health, infrastructure, and energy.

CSPGs will support:

- Joint programme design and proposal development.
- Data harmonization and knowledge exchange.
- Peer review of MEL findings and sector adaptation reports.

iii. **Regional and District Climate Committees:** To strengthen subnational coordination, each region and district will establish a multi-agency adaptation coordination unit. These committees will link district planning to national frameworks, support data flow from local to national levels, and ensure community-based priorities inform policy and resource allocation.

iv. **Annual Technical Dialogue and Knowledge Forum:** A national forum, led by EPA and NDPC, will be held to promote peer learning, policy dialogue, and knowledge dissemination. It will also serve as a space to share good practices, research findings, and innovation across government and stakeholder groups.

### 8.6.1 Linkages with Existing Development Coordination Systems

The NAP Sustainability Strategy will be fully embedded in Ghana's existing development architecture to ensure institutional coherence, cost-effectiveness, and strategic alignment. This will include:

i. **Annual Budget Hearings (MoF and NDPC):** Adaptation priorities and funding needs will be reviewed as part of the annual budget process, ensuring that climate-responsive actions are reflected in fiscal allocations and expenditure frameworks.

ii. **Medium-Term Development Planning Guidelines:** NDPC will integrate climate adaptation checklists and tools into the MTDP templates for MDAs and MMDAs, ensuring that planning officers systematically assess and address climate risks and opportunities.

iii. **Performance Monitoring Tools:** NDPC's Performance Contract System and Annual Progress Reporting (APR) formats will include indicators linked to adaptation outcomes. This will facilitate mainstreamed monitoring and reporting across the public sector.

iv. **National Development Results Framework (NDRF):** The NAP's MEL framework will be aligned with the NDRF to avoid duplication, support data integration, and

enable adaptation progress to be tracked as part of broader national development goals.

v. **GIFMIS and Public Investment Management Systems:** Adaptation budget tagging and climate-sensitive project appraisal tools will be embedded into Ghana's PIM process to ensure that all capital investments consider resilience factors.

Through these mechanisms, the implementation of adaptation will be treated not as a standalone exercise, but as an integral part of Ghana's core development agenda, supported by policy coherence, institutional accountability, and multi-stakeholder engagement.

## 8.7 Risk Management and Sustainability Challenges

Implementing and sustaining Ghana's National Adaptation Plan (NAP) entails navigating a complex landscape of risks ranging from institutional fragilities and financing gaps to data limitations and social inequities. These challenges, if not proactively addressed, can undermine the effectiveness, legitimacy, and longevity of adaptation efforts. A robust risk management framework is therefore critical to ensure that the NAP Sustainability Strategy remains adaptive, inclusive, and responsive to changing political, economic, and environmental conditions **(Table 50)**.

## 8.8 Approach and Engagement Strategy with Partners

a). **A sectoral-based approach,** aligning adaptation priorities across key sectors like agriculture, forestry, and infrastructure, while also promoting public-private partnerships, community involvement and gender responsiveness.

b). **Cross sectoral and Sector-Specific Adaptation Planning:** Ghana's NAP framework proposes a sectoral approach, with adaptation priorities identified for key sectors like agriculture, forestry, water, energy, and infrastructure. This approach allows for tailored adaptation measures that address the specific vulnerabilities of each sector while ensuring that they contribute to overall sustainability. For example, in the agriculture sector, adaptation measures might include promoting drought-resistant crops, water-efficient irrigation techniques, and diversifying agricultural livelihoods. In the infrastructure sector, adaptation measures might involve designing infrastructure to be more resilient to extreme weather events, such as floods and droughts. By adopting a holistic and integrated approach, Ghana's NAP seeks to ensure that climate change adaptation is not only a response to immediate threats but also a key driver of long-term sustainable development.

c). **Integrating Climate Change Adaptation into Development Planning and budgeting processes** strengthens the mainstreaming of climate change adaptation into Ghana's national and local development plans, ensuring that adaptation considerations are integrated into policy, legal and decision-making.

d). **Long-Term Vision and Sustainability:** The NAP process considers long-term climate change projections, up to the year 2080, and plans for adaptation accordingly. This long-term perspective ensures that adaptation measures are sustainable and contribute to Ghana's future development. Further the NAP framework also emphasizes the importance of monitoring and evaluation, ensuring that adaptation measures are effective and that progress towards sustainability goals is tracked.

**Table 50: Risks and Risk Mitigation**

| Type of Risk | Key Issues | Risk Mitigation and Contingency Planning |
|---|---|---|
| Institutional Risks | i. Mandate Overlaps and Coordination<br>ii. Staff Turnover and Limited Capacity<br>iii. Dependence on Individuals | **Institutional Capacity Building**<br>i. Roll out structured capacity-building programmes for MDAs and MMDAs, supported by EPA and NDPC, with a focus on climate budgeting, project design, and MEL.<br>ii. Establish institutional memory systems such as knowledge repositories, process manuals, and succession plans to ensure continuity beyond individual staff.<br>iii. Strengthen inter-ministerial agreements and define clear mandates through updated adaptation coordination frameworks and Terms of Reference (ToRs). |
| Financial Risks | i. Donor Dependence and Unpredictability<br>ii. Limited Domestic Budget Allocations<br>iii. Disbursement Delays and Absorptive Constraints | **Diversified Financing Strategy**<br>i. Promote domestic resource mobilization through targeted environmental levies (e.g., carbon levies, plastic taxes), reallocation of fuel subsidies, and climate-responsive taxes.<br>ii. Explore innovative finance mechanisms such as green bonds, climate insurance schemes, and results-based finance to supplement traditional donor funding.<br>iii. Expand access to concessional loans and guarantees for adaptation investments via partnerships with development finance institutions and private sector actors. |
| Operational Risks | i. Data Gaps and Accessibility<br>ii. Infrastructure Deficits<br>iii. Weak Monitoring and Knowledge Management Systems | Adaptive Planning and MEL<br>i. Institutionalize scenario-based planning across sectors to account for uncertainty and enable flexible responses to emerging risks (e.g., El Niño years, sea level rise).<br>ii. Establish contingency financing mechanisms, such as emergency climate resilience reserves or disaster adaptation buffers, at national and local levels.<br>iii. Regularly update vulnerability and risk assessments using real-time data and community feedback to refine adaptation priorities and investment decisions. |

| Type of Risk | Key Issues | Risk Mitigation and Contingency Planning |
|---|---|---|
| Policy and legal Risks | | **Policy Coherence and Legal Mandates**<br>i. Accelerate the review and harmonization of climate-related laws, policies, and strategies to eliminate redundancies and establish a coherent enabling environment.<br>ii. Enforce climate screening in public investment and planning systems via legal mandates embedded in EIA regulations, national planning guidelines, and sector policies.<br>iii. Institutionalize climate adaptation as a standing agenda item in Cabinet, inter-ministerial platforms, and NDPC planning cycles. |
| Social and Political Risks | i. Low Public Awareness on climate change<br>ii. Marginalization of Vulnerable Groups<br>iii. Escalating Climate Disasters | **Social Safeguards and Inclusion Mechanisms**<br>i. Operationalize gender and social inclusion action plans to ensure vulnerable groups are represented in planning, decision-making, and benefit-sharing.<br>ii. Develop stakeholder engagement protocols with clear guidelines on Free, Prior, and Informed Consent (FPIC), especially in Indigenous and marginalized communities.<br>iii. Establish grievance redress mechanisms to address disputes and ensure accountability in the implementation of adaptation projects. |

e). **Donor Engagement:** EPA and MoF will develop a donor coordination framework that includes periodic climate finance roundtables. These will align funding with national priorities, avoid duplication, and support co-financing mechanisms.

f). **Private Sector Engagement:** The NAP recognizes the importance of engaging the private sector in adaptation planning and implementation. Ghana's Private Sector Engagement Strategy for the NAP outlines how to engage private sector stakeholders, promote strategic alliances, and leverage public-private partnerships.

g). **Carbon Markets:** Ghana will operationalize Article 6.2 readiness to attract adaptation-linked results-based finance via bilateral cooperation agreements. Monitoring, reporting, and benefit-sharing mechanisms will be established.

## 8.9 Updating the NAP

To ensure the GNAP is iterative, it is essential to establish a robust monitoring and evaluation framework that allows for continuous assessment and feedback. This framework (see chapter 7) will involve regular data collection, stakeholder consultations, and periodic reviews to identify areas for improvement and adapt strategies accordingly.

It proposes incorporating lessons learned from previous adaptation efforts, and classification of milestones into three timeframes: **short-term (0–2 years)**, **medium-term (3–5 years)**, and **long-term (6–10 years)**. A comprehensive mid-term review and updating of the NAP is projected for the second half of the project **(Year 6)** and is therefore planned within the long-term timeframe.

Incorporating lessons learned from previous adaptation efforts and integrating new scientific knowledge and technological advancements will help refine and enhance the NAP over time. Additionally, fostering strong collaboration among government agencies, local communities, and international partners will ensure that the NAP remains responsive to evolving climate challenges and socio-economic conditions. By maintaining a dynamic and flexible approach, the Ghana NAP can effectively address the country's adaptation needs and contribute to sustainable development.

# 9

# Monitoring, Evaluation and Learning

A robust Monitoring, Evaluation, and Learning (MEL) system is essential for tracking progress, learning from implementation, and making evidence-based decisions that strengthen adaptation over time. MEL plays a critical role in climate adaptation planning by enabling the assessment of impacts and ensuring that resources are used efficiently. At both the sectoral and municipal levels, MEL fosters accountability to stakeholders and supports adaptive management approaches. This allows for real-time adjustments to the implementation of the GNAP, ensuring that actions remain responsive to evolving needs and contextual realities.

By capturing and documenting both achievements and challenges, MEL cultivates a culture of continuous learning, encouraging knowledge exchange and informing future policies, programmes, and projects. Importantly, MEL insights help policymakers at both national and local levels refine adaptation policies and identify best practices for scaling and replication. This ultimately contributes to more effective and sustainable adaptation outcomes across the country.

Ghana has established a robust legal and institutional framework to support M&E efforts across development initiatives. The NDPC, mandated by key legislative instruments such as Articles 86 and 87 of the 1992 Constitution, the National Development Planning System Act (Act 480, 1994), and the National Development Planning (System) Regulations (LI 2232,

2016), is responsible for establishing a results-based M&E system. This system analyses the linkages between inputs, activities, outputs, outcomes, and impacts in the delivery of public services.

To enhance M&E for adaptation, the NAP Monitoring and Reporting Framework developed by the NAP includes the following:

a. Establishes Key Performance Indicators (KPIs) to track the progress of adaptation financing and interventions.

b. Develops feedback loops that incorporate lessons learned and insights from implementing agencies to improve and adapt the NAP over time.

An example of this approach is the integration of climate change considerations into the MTDP of the WMMA, which demonstrates the importance of tracking specific adaptation indicators and targets. However, a gap remains: the NDPC's M&E framework currently lacks a strong emphasis on the "learning" aspect of MEL. Globally, the "learning" component is increasingly recognized as essential for continuous improvement and should be intentionally strengthened within the climate adaptation context in Ghana.

The GNAP's sustainability strategy is linked to the M&E framework, to ensure it is an iterative process that continuously evolves and improves. This approach ensures that adaptation measures remain relevant, effective, and sustainable in the face of changing climate conditions. Through institutional strengthening, financial sustainability, stakeholder engagement, integration with development planning, and robust M&E, Ghana can build a climate-resilient future for its people and ecosystems.

**a. Indicators and Tools to Track Sustainability Outcomes**

Ghana's MEL framework includes a suite of core indicators that span inputs, outputs, outcomes, and impact levels, reflecting both quantitative and qualitative dimensions of adaptation performance.

These indicators will measure, for instance, the sustainability actions set out in each priority sector, the number of beneficiaries reached through adaptation interventions, the proportion of national and district actions tagged as climate-relevant and shifts in key vulnerability indices over time.

To complement traditional data sources, geospatial tools such as vulnerability mapping, alongside participatory mechanisms like scorecards and citizen report cards, will be used to capture community-level feedback, identify implementation bottlenecks, and provide localized evidence for decision-making.

**b. Integration with National Development Monitoring Systems**

The MEL framework will be fully aligned with Ghana's national development monitoring systems to ensure coherence, efficiency, and strategic relevance. In particular, it will be embedded within the Ghana Results Framework (GRF) and linked to NDPC's monitoring and reporting protocols, including the Annual Progress Reports (APRs) submitted by MDAs and MMDAs. Adaptation-specific sections will be included in these reports, allowing EPA, NDPC, and the Ministry of Finance to jointly assess progress and recommend adjustments. Additionally, Ghana's climate Monitoring, Reporting, and Verification (MRV) system, including

the Climate Vulnerability Portal (CVP), will be expanded to accommodate adaptation data. This will support tracking of resources, activities, and outcomes, while ensuring Ghana's compliance with international reporting obligations under the UNFCCC.

**c. Review and Update Mechanisms**

To ensure that adaptation actions remain responsive to emerging challenges and learning, the MEL system will incorporate structured review and feedback mechanisms. Bi-annual learning reviews will be convened, bringing together stakeholders from MDAs, MMDAs, civil society organizations, academia, and the private sector to reflect on progress, identify lessons, and update priorities. The outcomes of these reviews will feed into revisions of the NAP Sustainability Strategy, inform annual and medium-term budget programming, and support knowledge-sharing across sectors and regions. Feedback loops will also be institutionalized through the use of digital platforms, mobile surveys, community radio engagement, and participatory planning sessions, ensuring that insights from local contexts are captured and used to shape national adaptation responses.

## 9.1 Timeline and Roadmap

A phased roadmap is essential to guide the implementation of the NAP Sustainability Strategy in a coherent and measurable manner. This section outlines short-, medium-, and long-term milestones aligned with Ghana's development planning cycles.

The classification of milestones into short-term (0–2 years), medium-term (3–5 years), and long-term (6–10 years) is based on criteria such as institutional readiness, complexity, scale of investment, urgency, and alignment with national planning cycles.

| Phase | Timeframe | Key Milestones |
|---|---|---|
| Short-Term | 0–2 years | • Formalize mandates for MEST, EPA, NDPC, MDAs, and MMDAs through policy directives or legal frameworks<br>• Operationalize the NAP Steering Committee and CSPGs<br>• Finalize and adopt the Climate Finance Strategy and Project Pipeline<br>• Initiate nationwide training on adaptation planning, finance, and MEL<br>• Mainstream adaptation into the next MTNDPF and sectoral plans<br>• Develop the adaptation budget tagging system in collaboration with MoF<br>• Begin piloting MEL tools and vulnerability database in priority districts |

| Phase | Timeframe | Key Milestones |
|---|---|---|
| Medium-Term | 3–5 years | • Full roll-out of NAP MEL framework and integration with NDPC reporting<br>• Implement adaptation priorities in at least 70% of MMDAs<br>• Operationalize Article 6.2 pilot projects and scale blended finance mechanisms<br>• Review and update EIA and planning codes for climate screening<br>• Establish adaptation curricula in at least 5 tertiary institutions<br>• Launch national communication campaign and public climate literacy programme<br>• Secure multi-year financing agreements with donors and private sector partners |
| Long-Term | 6–10 years | • Institutionalize the NAP as a recurring feature of national planning and budgeting cycles<br>• Conduct a full mid-term review of the NAP strategy and revise based on MEL findings<br>• Strengthen inter-generational equity through youth and school engagement programmes<br>• Achieve self-financing capability of at least 40% of adaptation interventions via domestic sources<br>• Fully digitalized, publicly accessible national database for adaptation progress, risks, and knowledge products |

## 9.2 Annual Review Calendar

The roadmap will be supported by an annual cycle of planning, reporting, and review to

| Period | Activity |
|---|---|
| Jan–Mar | Sector planning and budget preparation aligned with adaptation priorities |
| Apr–Jun | Stakeholder review forums and data submission to EPA/NDPC |
| Jul–Aug | National-level consolidation and report drafting |
| Sep–Oct | Joint review and budget alignment sessions with MoF |
| Nov–Dec | Finalization of implementation plans for the following year |

# Conclusion

There are enormous opportunities presented by existing platforms and frameworks to support the implementation of National Adaptation Plan in Ghana. Across horizontal and vertical levels, the existence of policies, legislation, strategies', creation of institutions, institutional arrangements, governance structures are low hanging fruits that provided an excellent anchor to the NAP Ghana. The policies at global, regional, national and metropolitan level already implementing interventions that will support adaptation priorities in Ghana and its priority economic sectors.

The Ghana NAP provides a comprehensive roadmap to safeguard the country's development trajectory in the face of climate change. It highlights that adaptation is not only an environmental aspiration, but also a foundation for resilient economic growth and sustainable livelihoods. For the GNAP to achieve its objectives, strong implementation arrangements, sustained financing, robust monitoring and inclusive governance will be essential.

# Recommendations

To effectively plan and effectively implement adaptation in key sectors of economic development in Ghana, the following are fundamental.

A. Clearly defining roles, responsibilities and coordination mechanisms will support strong accountability in the implementation of the NAP. Empowering government agencies and local institutions through enhanced capacity will enable them to manage and implement adaptation measures effectively.

B. Actively involving local communities through sensitisation and engagement will increase ownership and participation. Embedding gender-responsive approaches in all adaptation actions will ensure the unique vulnerabilities of women, climate-induced migrants and marginalised groups are addressed.

C. Ensuring that gender considerations, already present in policy documents are fully integrated into implementation will empower women, people with disabilities, migrants, and vulnerable groups to participate actively in climate adaptation decision-making, programme implementation and leadership

D. Mobilising substantial investment for adaptation measures will strengthen sector ministries and agencies, reduce reliance on donor funding and improve the availability of infrastructure and equipment for monitoring and enforcement.

E. Application of the monitoring, evaluation, reporting and learning framework developed by the GNAP to track progress, assess impacts will be critical to inform adaptive management strategies. Regular reporting and stakeholder feedback will enhance transparency and accountability, confidence among funders and other partners.

F. Strengthening communication channels and defining mandates among government agencies, as well as promoting vertical and horizontal coordination across ministries, agencies, the private sector, NGOs, and local communities, will foster greater synergy and efficiency in achieving shared adaptation objectives.

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| International Frameworks | |
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| **Name** | **Features / Purpose** |
| United Nations Framework Convention on Climate Change | • Ghana became a member of the UNFCCC after ratification in September 1995.<br>• Parties to ensure that climate change issues are taken into consideration in national development planning.<br>• The Global Goal on Adaptation is established to guide country-driven development and implementation of NAPs, submitting adaptation communication detailing priority needs and reporting on adaptation actions. |
| The Kyoto Protocol | • Ratified on May 30, 2003.<br>• Adopted in 1997, it is a landmark international treaty aimed at reducing greenhouse gas emissions globally.<br>• By ratifying, Ghana committed to implementing climate-friendly policies and participating in global efforts to combat climate change. The country, as a Non-Annex I Party, was not required to meet binding emission reduction targets like developed nations but instead focused on adaptation strategies and sustainable development.<br>• Ghana has since worked on integrating climate action into its national policies, aligning with subsequent agreements like the Paris Agreement, which it ratified in 2016. |
| Paris Agreement | • Ratified in September 2016.<br>• Aims to limit temperature rise to well below 2°C, with efforts to keep it at 1.5°C above pre-industrial levels. Since ratifying the agreement, Ghana has worked to implement its NDCs, outlining climate mitigation and adaptation strategies. Implementing its conditional and unconditional mitigation actions was expected to reduce GHG emissions by 45 percent below business-as-usual (BAU) by 2030. According to the government of Ghana, investments in NDC helps decouple economic growth from the increase in GHG emissions and steer the country toward a climate-resilient low carbon future. |

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| Sustainable Development Goals (2030) | • Were adopted by all United Nations Member States in 2015 as a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity by 2030.<br>• Replaced the Millennium Development Goals (MDGs).<br>• The 17 global goals are a blueprint to achieve a better and more sustainable future for all. All these goals are so closely interconnected that success in one affects success of others.<br>• Adoption of the SDGs coincided with two other historic agreements, the Paris Agreement on Climate Change and the Sendai Framework for DRR |
| Sendai Framework on Disaster Risk Reduction 2015-2030 | • Adopted in 2015, it outlines seven clear targets and four priorities for action to prevent new and reduce existing disaster risks: (i) understanding disaster risk; (ii) strengthening disaster risk governance to manage disaster risk; (iii) investing in disaster reduction for resilience and (iv) enhancing disaster preparedness for effective response, and to "Build Back Better" in recovery, rehabilitation and reconstruction.<br>• The Framework aims to achieve the substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries for the period up to 2030 that are relevant to adaptation (UNDRR, 2015). |
| Hyogo Framework for Action 2005-2015 | • Is a comprehensive and action-oriented response to international concern about the growing impact of disaster on individuals, communities and national development.<br>• Aims to substantially reduce loss of life as well as the social, economic and environmental losses caused to communities. |
| The United Nations Convention on Biological Diversity | • Promotes the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits from the use of genetic resources.<br>• Ghana's biodiversity plays a critical role in climate adaptation through sustainable production of food and other agricultural products; traditional medicine, source of timber and firewood. |

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| African Union's Agenda 2063 | • Is a strategic framework for socio-economic transformation of the continent by 2063.<br>• Builds on and seeks to accelerate the implementation of past and existing continental initiatives for growth and sustainable development.<br>• Identifies agriculture as one of the sectors of the economy to be transformed to achieve the needed sustainable development across the continent (AU, 2017). |
| **National Policies and Frameworks Relevant to Ghana's NAP** | |
| National Disaster Management Organization (NADMO | • Coordinates disaster management among governmental and non-governmental actors and builds the capacity of communities to respond effectively to disasters.<br>• Ghana Plan of Action for DRR set up (Dazé and Echeverría, 2016; UNDP, 2017).<br>• Disaster Risk Management (DRM) Country Plan established with support from WB to support strengthening of flood forecasting as well as advocacy and capacity building on DRR. |
| Constitution of Ghana, 1992 | • Though several rights have been expressly laid out in the 1992 Constitution, the right to a healthy environment has not been specifically provided for. Rather, under Article 41 (k), the Constitution imposes "an obligation on the state and on every citizen to protect and safeguard the environment. Further, it sets out the overarching basis for the implementation of the Government's commitments under the NDC. |

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| The Ghana Shared Growth and Development Agenda (GSGDA) II | • Vision is to increase incomes, especially for those in poor households, improve service delivery in water, sanitation, education health and housing across the country, a rise agricultural in productivity to ensure both food and nutrition security, an aggressive revival of manufacturing as part of a broad strategy of production and export diversification, the creation of decent work, particularly for youth and the development of modern infrastructure systems.<br>• Prioritizes the following thematic areas: (i) ensuring and sustaining macroeconomic stability, (ii) enhancing competitiveness of Ghana's private sector, (iii) accelerated agriculture modernization and sustainable natural resource management, (iv) oil and gas development, (v) infrastructure and human settlements development, (vi) human development, productivity decent work, (vii) transparent, responsive and accountable governance. |
| The Medium-Term National Development Policy Framework (MTNDPF) 2018–2021, "Agenda for Jobs: Creating Prosperity and Equal Opportunity for All | • Lays the foundation for actions to support the Government's flagship projects and programmes. Within this framework, the policy on Investing for Food and Jobs was formulated in line with both Comprehensive Africa Agriculture Development Programme (CAADP) and SDGs 1 and 2. This has supported agriculture sector programs mainly: Planting for Food and Jobs; Aquaculture for Food and Jobs; One-Dam Project; the One-District-One-Warehouse Project; Planting for Export and Rural Development; and Rearing for Food and Jobs. |
| Ghana's 2020 Budget Statement and Economic Policy the government | • Presented on the theme "Consolidating the gains for growth, jobs and prosperity for all" (GoG, 2020).<br>• Major highlight is the government's agriculture modernization programme aimed at improving production efficiency, achieving food security, and profitability for farmers, and significantly increasing agricultural productivity as the basis for industrialization, job creation and export.<br>• The modernization agenda was being executed through the key flagship project of Planting for Food and Jobs (PFJ) under the following modules; Food Crop Production; Planting for Export and Rural Development (PERD); Rearing for Food and Jobs (RFJ); Greenhouse Technology Development as well as Mechanization for Food and Jobs. The necessary budgetary resources were earmarked accordingly. |

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| National Climate Change Adaptation Strategy (2010) | • Provides the guidance and platform to integrate responsible environmental management with climate change adaptation strategies, in line with the country's social and economic development targets.<br>• Strategies focus on the preparation and strengthening of institutional frameworks for improved management of climate change effects and to make available the necessary resources to support strategic adaptation activities and to advance low emission and climate resilient development (The World Bank Group, 2021). |
| Climate Change Adaptation Strategy (2010-2020) | • NCCAS was published in 2012 and covered the period 2010-2020.<br>• Aimed to enhance Ghana's resilience to climate change by integrating adaptation measures into national development plans.<br>• Focused on key sectors such as agriculture, forestry, water resources, and health, ensuring that climate risks were addressed systematically.<br>• Outlined priority programs to strengthen Ghana's adaptive capacity, including decentralized implementation strategies and institutional arrangements.<br>• Approach emphasized community-level engagement and securing international funding to support adaptation efforts. |

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| Nationally Determined Contributions (NDC) (2020-2030) | • Updated in 2021 as part of Ghana's commitment to the Paris Agreement.<br>• Revised NDCs cover the period 2020-2030 and outline 31 mitigation and adaptation actions across seven economic sectors. Through the priority actions, the country aims to unconditionally reduce its GHG emissions by 15% relative to a business-as-usual scenario emission of 73.95 Mt CO2-eq by 2030 and additional 30% conditional emission reduction alongside an adaptation goal of increasing climate resilience and decreasing vulnerability for enhanced sustainable development.<br>• Focus is on: climate mitigation measures with focus on renewable energy, energy efficiency, and sustainable land use; adaptation strategies – strengthening resilience in agriculture, water management, and coastal protection; sectoral Integration – Climate action embedded in transport, industry, forestry, and waste management; international collaboration – partnerships with global organizations to secure funding and technical support; and just energy transition – plans for a net-zero economy by 2070, ensuring a fair transition for industries. |
| Nationally Determined Contributions (NDC) (2016) | • Ghana's first NDC (2016) was submitted as an intended nationally determined contribution (INDC) in 2015, later becoming its NDC in 2016 when it joined the Paris Agreement (Article 22 of Decision 1/CP.21).<br>• This NDC prioritized a total of 31 actions, 20 in mitigation and 11 in adaptation, for implementation across seven priority economic sectors over 2020–2030.<br>• Ghana committed implementation of two mitigation actions with its own resources and mobilize 34% of the costs of the adaptation actions at the national level with the remaining actions being implemented with international support. |

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| National Climate Change Policy (2015-2020) | • Launched in 2014 and implemented through 2020. It provides the strategic framework for building resilience to climate change across key sectors and guides the development of the NAP.<br>• Aims to achieve a climate-resilient and low-carbon economy, policy prioritized adaptation actions intended to reduce vulnerability and enhance the resilience of communities, ecosystems, and critical sectors.<br>• Promotes inclusive planning, encourages the participation of women, youth, and vulnerable groups, while calling for the integration of climate adaptation into development planning at national and sub-national levels. Its implementation was led by the MEST in coordination with sector ministries and local governments. |
| Low Carbon Development Strategy (2016) | • Ghana has actively pursued low-carbon development strategies (LCDS) to integrate sustainability into its national policies and balancing economic growth.<br>• Is a program of action (PoA) that was developed to support the implementation of the NCCP. Its overarching objective is for the country's long-term economic transformation to be achieved along a low carbon pathway in the most economically efficient and cost-effective way.<br>• A key effort was the Energy and Low Carbon Development Strategy, which focused on mainstreaming low-carbon pathways into Ghana's economic activities and national development plans. The strategy emphasized: a) institutional Arrangements<br>• Strengthening governance structures for climate action; b) renewable Energy Initiatives – Expanding solar, wind, and hydro projects; c) carbon Reduction Measures – Encouraging energy efficiency and sustainable land use and international collaboration<br>• Partnering with global organizations for funding and technical support. |

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| National Action Programme to Combat Drought and Desertification | • Is a sectoral national programme of the Republic of Ghana (2002-2027 and aims at sustaining high agricultural production and ensure food security and enhanced livelihoods whilst combating desertification to maintain the integrity of the ecosystem and to properly manage and conserve natural resources.<br>• Contributes to adaptation through: strengthening research institutions in the development of drought tolerant crop varieties; promoting the dissemination of drought-tolerant crops; strengthening the extension services to effectively promote drought tolerant crop varieties; supporting programmes for training and application of integrated dryland farming systems; and promoting research into dry-land farming systems. |
| National Climate-Smart Agriculture and Food Security Action Plan (2016-2020) | • Provides the implementation framework for an effective development of climate-smart agriculture.<br>• The Plan formulates specific strategies that will contribute developing climate-resilient agriculture and food systems for all agro-ecological zones, as well as the human resource capacity required for a climate-resilient agriculture promotion in Ghana. |
| Nationally Appropriate Mitigation Actions | • As a non-Annex I country, Ghana's first efforts at drawing up mitigation activities that it would formally put forward for international consideration took the form of nationally appropriate mitigation actions (NAMAs) under the Bali Action Plan (2007). Ghana officially submitted them in 2010 after associating with the 2009 Copenhagen Accord. The submission contained the 55 mitigation activities it planned to implement, some with its own resources and the rest in the context of international support. Quite a number of the proposed NAMAs—including the implementation of REDD+112 and the sustainable management of forest, support for the growth of renewable energy, the promotion of energy efficiency in industry, liquefied petroleum gas (LPG) as an alternative to wood fuel use, and the development of hydro dams—continue to form part of Ghana's contributions to the goals of the Paris Agreement. |

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| Fourth National Communication for the UNFCCC (2020): | • Ghana's Fourth National Communication (NC4) to the UNFCCC was published in August 2020. This report provides an overview of Ghana's climate policies, mitigation efforts, and adaptation strategies.<br>• Areas of focus include adaptation strategies which detail Ghana's approach to climate resilience, including policies for water management, disaster preparedness, and coastal protection.<br>• Also includes national & international collaboration which emphasize partnerships with global organizations to secure funding and technical support for climate initiatives. |
| National Climate Change Master Plan (2015–2020) | • The NCCMP translates the NCCP into implementable actions and programs that can be undertaken in the different sectors of the economy.<br>• Provides specific information on the actions and associated costs for each of the 10 policy areas of the NCC and the adaptation strategies and options of each of the economic sectors in the medium term (less than 5 years). |
| National Medium-Term Development and Policy Framework (2018–2021) & the Agenda for Jobs II (2022-2025) current NMTDPF | • Creating Prosperity and Equal Opportunity for All (2022 2025) is the policy framework guiding the implementation of the government's vision, medium-term goals and targets for national development, and the strategies and specific initiatives to achieve them as set out in the CPESDP 2017–2024.<br>• The NMTDPF essentially takes the Government's vision or policy agenda as set out in the CPESDP and converts it into broad national policy objectives and strategies with clearly identified implementation responsibilities for MDAs and MMDAs. |
| Agenda For Jobs: Creating Prosperity and Equal Opportunity For All (2018) | • Is Ghana's Medium-Term National Development Policy Framework, crafted by the National Development Planning Commission (NDPC).<br>• It lays out a strategic roadmap for inclusive economic growth and job creation across the country.<br>• Supports GNAP by creating opportunities for all Ghanaians, safeguarding the natural environment and ensure a resilient built environment, maintains a stable, united, safe, prosperous and society. |

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| Ghana's National Adaptation Plan Framework (2018) | • Provides an overall framework to guide the country in developing, coordinating, and implementing its NAP process led by the EPA in partnership with the NDPC and the MoF.<br>• Framework provides a structured process for addressing medium- and long-term climate adaptation needs.<br>• Key objectives of the NAP Framework include: Clarifying Ghana's adaptation approach – establishing a vision for climate resilience; aligning with existing policies – integrating adaptation strategies into national development plans; stakeholder engagement including women and women and monitoring and evaluation |
| National Climate Smart Agriculture and Food Security Action Plan (2016 2020): | • Specifically aims to: i) develop climate-resilient agriculture and food systems for all agro-ecological zones; ii) develop human resource capacity for climate-resilient agriculture; iii) elaborate on the implementation framework and specific climate-smart agriculture activities to be carried out at the respective levels of governance.<br>• Specific actions include: i) development and promotion of climate-resilient cropping systems; ii) Risk transfer and alternative livelihood systems; and iii) Improved marketing systems (National Drought Plan, 2020). |
| National Integrated Water Resources Plan (2012) | • The Plan recognizes that Ghana's water resources are at risk of depletion and degradation due to uncontrolled catchment degradation, pressure due to climate change and climate variability.<br>• The action programme has six overarching policy objectives, including: strengthen the regulating and institutional framework for managing and protecting water resources for water security and enhancing resilience to climate change; enhance public awareness and education on water resources management issues and ensure gender equity in water resources management and planning (National Drought Plan, 2020). |

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| National Climate Change and Green Economy Learning Strategy (2016) | • It is Ghana's blueprint for building capacity and public awareness to tackle climate change and transition toward a green economy.<br>• Developed by MESTI with support from UNDP and UNITAR, it's part of the One UN Climate Change Learning Partnership (UN CC:Learn) initiative.<br>• Supports GNAP through the creation of a sustainable pool of human resources with the technical expertise and public awareness needed to achieve climate-resilient adaptation and low-carbon economic growth in Ghana. |
| Ghana Plan of Action for Disaster Risk Reduction and Climate Change Adaptation (2011-2015) | • A strategic framework designed to strengthen national resilience against disasters and climate-related risks. It aligned with the Hyogo Framework for Action (HFA) and emphasized a multi-sectoral, decentralized approach to managing risk and promoting sustainable development |
| National Gender Policy (2015) | • Aims to: mainstream gender equality and women's empowerment into Ghana's development efforts through integration of gender equality into national planning and budgeting, women's rights, leadership, and access to justice; enhance economic opportunities and livelihoods; address gender roles and relations to reduce systemic inequalities and strengthen institutional frameworks for gender-responsive governance. |
| National Energy Policy (2010) | • Focuses on promoting renewable energy, enhancing energy efficiency, and managing waste-to-energy systems.<br>• Emphasizes the need for improved support policies and private sector involvement to foster sustainable energy generation. The Ministry of Energy is responsible for formulating and implementing these policies, aiming to ensure energy security and economic resilience.<br>• The Strategic National Energy Plan (SNEP) and the National Energy Policy (NEP) are key frameworks guiding the energy sector. However, challenges such as financial constraints and limited investor confidence hinder progress in the renewable energy transition. |

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| National Transport Policy (2008) | • Describes the crucial role of transportation in national development, economic growth, and poverty reduction.<br>• Emphasizes the need for a well-coordinated transport system to adapt to changing global trade dynamics and supports various strategic initiatives such as the development of non-motorized transport infrastructure, integrated land use planning, and enhancing consultation mechanisms among transport sector agencies that ensures sustainable development, improved accessibility, and maximized public and private sector investment in the transport infrastructure. |

| S/N | Dimension | Indicators | Description |
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| 1 | Technological | Effectiveness | Effectiveness or importance describes how effective an adaptation option can mitigate climate damage. In essence, an effective option yields considerable benefits in terms of avoided consequences, albeit potentially at a high cost. |
| 2 | Economic | Affordability (cost efficiency) | This refers to the cost of implementing the adaptation option |
| 3 | Institutional | Institutional feasibility<br><br>Alignment with district and/or national priorities | Institutional feasibility refers to institutional and legal capacity. The preferred adaptation option aligns with laws, regulations, and institutional structures.<br>The extent to which this measure supports other development priorities of the district or the country. |
| 4 | Technological | Technical feasibility | Technical feasibility focuses on evaluating the technological expertise and the availability of necessary human, financial, and administrative resources for a specific option. |
| 5 | Social | Traditional acceptance of adaptation | Traditional acceptance refers to the degree of acceptability of an adaptation strategy aligning with the context of traditional values. |
| 6 | Social | Social co-benefits | This entails evaluating whether the proposed adaptation aligns with existing social practices and customs and whether it is likely to be embraced by the affected community or population. |
| 7 | Environmental | Flexibility | Flexibility refers to the ability to change behaviour in response to changing conditions. |
| 8 | Environmental | Environmental considerations | This evaluates the potential of the intervention to improve GHG emissions, biodiversity, human health, soil quality, water quality, air quality, climate, and landscape. |
| 9 | Social | Gender responsiveness | This evaluates the extent to which the adaptation options address gender-related issues. |
| 10 | Social | Equity | The extent to which the adaptation option will benefit vulnerable groups and communities. |
| 11 | Technological | Replicability or scalability | This defines the ability or possibility of the intervention to be replicated elsewhere in the country or scaled up |

| S/N | Dimension | Indicators | Description |
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| 12 | Technological/ Economic/ Institutional /Environmental or social | Barriers to implementation | This identifies potential institutional, economic, technological, and social barriers to the implementation of the adaptation option. |