

Adapting Together, Thriving Tomorrow



Climate Change Adaptation Action Plan for the Agricultural Sector in Ghana

Enhancing Multi-Sector Planning and
Capacity for Effective Adaptation in Ghana



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This symbol in the NAP Logo represents the Agriculture Sector and the Agricultural National Adaptation Plan.



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Abbreviations and Acronyms

ACHPR	African Charter on Human and People's Rights
CGIAR	Consultative Group on International Agricultural Research
CCRA	Climate Change Risk Assessment
CEDAW	Convention on the Elimination of all Forms of Discrimination Against Women
CSIR	Council for Scientific and Industrial Research
EPA	Environmental Protection Agency
FAO	Food and Agriculture Organization
GASIP	Ghana Agricultural Sector Investment Programme
GEF	Global Environmental Facility
ADCOM	Ghana Adaptation Communication
GIPC	Ghana Investment Promotion Center
GSS	Ghana Statistical Service
GIDA	Ghana Irrigation Development Authority
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (German Agency for International Cooperation)
GMet	Ghana Meteorological Agency
GCF	Green Climate Fund
GDP	Gross Domestic Product
IFAD	International Fund for Agricultural Development
ILRI	International Livestock Research Institute
IPCC	Intergovernmental Panel on Climate Change
ICESCR	International Covenant on Economic, Social and Cultural Rights
IUCN	International Union for Conservation of Nature
LC	Lands Commission
MoF	Ministry of Finance

MoFAD	Ministry of Fisheries and Aquaculture Development
MoFA	Ministry of Food and Agriculture
MLNR	Ministry of Lands and Natural Resources
MLGRD	Ministry of Local Government and Rural Development
MoGCSP	Ministry of Gender, Children and Social Protection
MCDM	Multi-Criteria Decision Making
NAES	National Agricultural Extension Services
NAP	National Adaptation Plan
NCCAS	National Climate Change Adaptation Strategy
NCCP	National Climate Change Policy
NDCs	Nationally Determined Contributions
NDPC	National Development Planning Commission
NGOs	Non-Governmental Organizations
PPPs	Public-Private Partnerships
SNV	Netherlands Development Organisation
SDGs	Sustainable Development Goals
ITA	International Trade Administration
UNEF	United Nations Emergency Force
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
WWF	World Wildlife Fund





EXECUTIVE SUMMARY

Background: The adverse impacts of climate change are widespread with the agricultural sector suffering disproportionate effects because of its heavy dependence on rain-fed agrarian systems. Ghana is projected to suffer increasing temperature patterns coupled with erratic rainfall patterns. These will significantly affect the production of crops and livestock, leading to significant food security challenges for the country. This is particularly critical, considering the agricultural sector's contribution to the country's Gross Domestic product and the fact that this sector employs a significant proportion of low-income families. Nonetheless, the impacts of climate change are felt more by females who suffer from socioeconomic inequalities that further disadvantage these socioeconomic groups and deepen their overall vulnerability. Addressing the adverse impacts of climate change should therefore be a gender-responsive approach. Encompassing gender within the agriculture sector can provide pathways to understanding the linkages between social dimensions of climate change vulnerability.

Aim and approach - The plan seeks to reduce the agricultural 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. The methodology adopted a structured participatory approach involving a desk review, information synthesis, stakeholder consultation, and final revision and validation.

Key findings – The action plan reveals that the agricultural sector in Ghana faces significant climate change risks including erratic rainfall patterns, drought, increasing temperature, flood, and heat stress. These risks pose a challenge to agricultural development and compromise the attainment of Sustainable Development Goal Two (food security). The action plan proposes a blend of nature-based, technological, and policy-driven adaptation measures that can reduce the overall climate change vulnerability and risks within the agricultural sector. Detailed actions have been proposed for the crop, livestock, and fisheries sub-sectors. For the crop sub-sector, the key adaptation proposed includes: improving women's access to and availability of land across the country for effective climate change adaptation, improving access to extension services for women in agriculture, increasing women's participation in decision-making and implementation of agricultural programs and projects, and enhancing agricultural sustainability and resilience by promoting Integrated Pest Management (IPM) practices that reduce reliance on chemical pesticides and minimize environmental and health impacts. Others include enabling farmers to reduce their dependence on a single source of income, making them less vulnerable to climate-related shocks such as droughts or floods as well as encouraging the use of crop varieties that are resistant to pests and diseases to increase agricultural resilience.

The key adaptation actions proposed for the livestock sub-sector include designing structures to enhance livestock comfort and productivity, preventing land degradation and improving pasture health, using digital tools to monitor and manage livestock, and creating breathable and functional animal gear for heat stress reduction. Others include building farmer capacity for adaptive livestock management, developing livestock breeds resistant to local diseases, providing timely alerts on climate-related livestock health risks, and providing timely weather forecasts to support decision-making.



For the fisheries sub-sector, the key adaptation actions include developing aquaculture systems with diverse and resilient fish species, breeding fish species adapted to temperature variations, restoring degraded marine ecosystems and improving biodiversity, and protecting vulnerable fish species. Others include predicting and mitigating the impacts of temperature changes on marine ecosystems and building community capacity for sustainable fishing in changing climates. The report also recommends the restoration of marine biodiversity by providing habitats for fish and other marine species, improving ecosystem resilience against climate impacts.

The action plan further highlights the institutional and policy architecture underpinning the implementation of the action plan. The key ministries include the Ministry for Food and Agriculture, Ministry of Finance, Ministry of Land and Natural Resources, Ministry of Fisheries, etc. The report shows that there is a broad legal and policy framework for climate change issues in Ghana. Ghana has taken several steps to address the socio-economic impacts and the development challenges arising from climate change. Key policies identified include the National Climate Change Adaptation Plan, National Food and Agriculture Sector Development Policy Phase II (FASDEP II), National Climate Change Adaptation Strategy, National Adaptation Plan framework, Nationally Determined Contributions, and National Climate Change Master Plan. Others include the Agriculture and Food Security Action Plan, Ghana Agricultural Sector Investment Plan: Investing for Food and Jobs, Ghana Irrigation Policy, and National Tree Policy.

Implementation challenges – The report has highlighted key challenges in the implementation of the agricultural sector adaptation action plan for Ghana. Key among these challenges include financial and logistical support, lack of capacity, and inadequate governmental commitments in addressing climate change threats in Ghana.

Recommendations – The report recommends the need to strengthen institutional frameworks by establishing clear roles and responsibilities for institutions involved in the plan's execution, ensuring effective coordination and accountability. It further suggests the need to enhance financial and logistical support. This is necessary because the implementation of the various adaptation actions proposed in this action plan would require significant investment departments, units, and agencies within the agricultural sector in Ghana. These departments, units, and agencies are encouraged to integrate this action plan into their annual plan of action and budget to facilitate the allocation of Government of Ghana resources for its implementation. Capacity Building through the provision of training and resources to stakeholders, particularly smallholder farmers, to enable them to adopt and sustain climate-resilient practices, will be critical for the success of this action plan. The policy analysis reveals an array of policies for addressing climate change threats in the agricultural sector. This is important as it presents appropriate policy guidelines for climate change threats, yet, there are considerable challenges that require greater integration and alignment to ensure synergy and avoid duplications. Finally, we need to strengthen gender considerations by actively involving women and marginalized groups in decision-making processes and access to resources. There is a need to improve existing national information regarding the role of women in agriculture through the collection of sex-disaggregated data and the generation of gender statistics.





1. CONTEXT AND RATIONALE

1.1. Background

Climate change is a pressing global issue characterized by long-term shifts in temperatures and weather patterns, primarily due to human activities such as burning fossil fuels, deforestation, and industrial processes. The impacts of climate change are widespread, including rising sea levels, more frequent and severe weather events, and disruptions to ecosystems and biodiversity (International Union for Conservation of Nature and Natural Resources [IUNCN], 2024). Sub-Saharan Africa is particularly vulnerable to climate change due to its reliance on rain-fed agriculture, limited adaptive capacity, and high poverty levels. The region experiences increased temperatures, altered precipitation patterns, and more frequent extreme weather events such as droughts and floods. These changes threaten food security, water resources, and livelihoods, exacerbating existing socioeconomic challenges (Connolly-Boutin & Smit, 2016).

Ghana is a country that is highly vulnerable to climate change, as indicated in the country's fourth National Communication to the United Nations Framework Convention on Climate Change (UNFCCC) in 2020, and Ghana's ND-GAIN index of vulnerabilities to climate change and other global challenges. The National Communication specifies agriculture as one of the most exposed sectors to climate change, which also has a low adaptive capacity. Ghana is projected to suffer intense drought and increasing rainfall variability. The mean temperature will increase by 1-3°C by 2060 and between 1.5°C and 5.2°C by the 2090s (Environmental Protection Agency, 2020). Rainfall will continue to be uncertain and difficult to predict. In Ghana, climate change manifests through rising temperatures, erratic rainfall, and increased frequency of extreme weather events (Asante & Amuakwa-Mensah, 2014). These changes significantly impact various socioeconomic sectors, particularly agriculture, a cornerstone of the Ghanaian economy.

Agriculture in Ghana is predominantly rain-fed, making it highly susceptible to climate variability (Antwi-Agyei et al., 2012). The sector faces reduced crop yields, increased pest and disease outbreaks, and soil degradation (Baffour-Ata et al., 2021). For example, farmers in Ghana are experiencing more unpredictable rainfall, which disrupts planting and harvesting schedules. This unpredictability can lead to crop failures and reduced yields (Derbile et al., 2016). Rising temperatures stress crops and livestock, reducing productivity. Heat stress can also increase the prevalence of pests and diseases (Naazie et al., 2024). Changes in weather patterns contribute to soil erosion and loss of fertility, making it harder to grow crops (Sekyi-Annan et al., 2021). Thus, Ghana's agricultural future must adjust to the evolving climate. Climate change adaptation in the agricultural sector is essential to boost food security, enhance livelihoods, and support the growth of other sectors.

A gender-responsive approach is required to address gender differences in the agricultural sector. Applying intersectional approaches (encompassing gender) within the agriculture sector can provide pathways to understand the linkages between social dimensions of identity (encompassing gender) and social institutions (formal and informal), which shape interactions between value chain actors, households, and agro-ecosystems (FAO and UNDP, 2020). This would provide an in-depth understanding of adaptive capacities (Thompson-Hall, Carr, and Pascual, 2016). Therefore, when a gender-responsive approach to the agriculture sector in the context of climate change adaptation is applied during the planning and implementation phase, it would avoid reinforcing existing gender inequalities and lead to the identification of relevant adaptation options (FAO and UNDP, 2018).

This plan outlines a framework for climate change adaptation actions in the agricultural sector. The National Adaptation Plan (NAP) for Agriculture is part of Ghana's broader national adaptation planning process. The NAP process builds on existing adaptation efforts to integrate climate change into national

decision-making and planning. Established in 2010 under the Cancún Adaptation Framework by the United Nations Framework Convention on Climate Change (UNFCCC), the NAP process was adopted by UNFCCC parties in 2011 in Durban, with guidance developed by the UNFCCC Least Developed Countries Expert Group in 2012. NAPs aim to reduce countries' vulnerability to climate change by enhancing adaptive capacity and resilience and integrating adaptation into development planning across all sectors. For Ghana, preparing NAPs complies with UNFCCC requirements, enabling the country to identify and address medium and long-term adaptation needs through strategic planning and implementation. The plan also aims to ensure a stable food supply by promoting climate-resilient agricultural practices. By supporting farmers with adaptation strategies, the plan seeks to improve the livelihoods of those dependent on agriculture. The NAP integrates sustainable practices to protect natural resources and ensure long-term agricultural productivity.

The NAP is coordinated by the Ministry of Environment, Science, Technology, and Innovation (MESTI), in collaboration with the Ministry of Food and Agriculture, the Environmental Protection Agency (EPA), and other stakeholders. This coordinated approach ensures that adaptation efforts are integrated and effective across different levels of governance and sectors. The plan is supported by funding from various sources, including the Green Climate Fund (GCF), to ensure that the necessary resources are available for implementation. By focusing on these strategies, Ghana aims to build a resilient agricultural sector that can withstand the challenges posed by climate change, ensuring food security and sustainable development for the future.

1.2. Aim and Objectives

The NAP for the Agricultural Sector of Ghana aims to address the impacts of climate change on agriculture, which is a critical sector for the country's economy and food security. The plan seeks to reduce the agricultural 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. It also encourages research and innovation to develop new crop varieties, farming techniques, and technologies that are resilient to climate change. The plan aims to mobilize resources from national and international sources to support adaptation initiatives in the agricultural sector. However, the overarching aim of this assignment is to develop a costed sector adaptation plan and to build the capacity of the agricultural sector for the mainstreaming of adaptation considerations in Ghana's agricultural and climate change policies and plans. The assessment is guided by the following specific objectives:

- To conduct rapid climate risk assessments in the agricultural sector.
- To develop a costed adaptation plan for the agricultural sector.

1.3. A Gender-Responsive Action Plan for the Agricultural Sector

Climate change is expected to worsen existing poverty and exacerbate inequalities because of gender differences in sociocultural and economic roles and responsibilities. Significant gender-based differences exist concerning access to and control over resources, work opportunities and wages, time spent in productive and household roles, and leadership and participation in decision-making processes (Least Developed Countries Expert Group, 2015a). A gender-sensitive approach ensures that women's voices are heard and considered in formulating and implementing adaptation strategies, leading to more comprehensive and effective solutions (Adzawla et al., 2019). Additionally, addressing gender-specific



social norms and practices that limit women's participation in agriculture and adaptation efforts is crucial. This includes challenging discriminatory practices and promoting gender equality in all aspects of agricultural development (Lawson et al., 2020). Lastly, integrating gender perspectives provides a more comprehensive understanding of community vulnerabilities and capacities, leading to more effective and sustainable adaptation outcomes (Wrigley-Asante & Dake, 2019). By incorporating these considerations, Ghana can develop a more inclusive and effective adaptation plan that not only addresses the impacts of climate change but also promotes gender equality and empowers women in the agricultural sector.

A gender-responsive approach to climate change would strengthen resilience as it would lead to the inclusion of the different capacities, experiences, expertise, and perspectives possessed by men and women in the adaptation initiatives. A gender-responsive adaptation plan allows stakeholders to recognize gender differences in adaptation needs, opportunities, and capacities, whilst ensuring equitable participation and influence of women and men in the adaptation decision-making process. Such an approach also ensures gender-equitable access to, and control over, financial resources and other benefits resulting from adaptation investment (FAO and UNDP, 2018).

The purpose of the Sectoral Adaptation Plan for Agriculture is to provide a strategic framework that guides Ghana's agricultural sector in adapting to the impacts of climate change. This plan aims to ensure the sustainability and resilience of agricultural practices, thereby securing food security, improving livelihoods, and supporting economic development. The Action Plan seeks to facilitate the integration of gender considerations into policies, programs, and strategies related to agricultural development about climate change. The key objectives include:

- **Enhance Food Security:** By promoting climate-resilient agricultural practices, the plan seeks to ensure a stable and sufficient food supply

for the population. This involves the adoption of drought-resistant crop varieties, improved irrigation techniques, and sustainable farming practices.

- **Improve Livelihoods:** Agriculture is a primary source of income for many Ghanaians. The plan aims to support farmers in adapting to climate change, thereby enhancing their productivity and income levels. This includes providing access to climate information, training, and resources to implement adaptive measures.
- **Support Economic Development:** The agricultural sector is a significant contributor to Ghana's economy. The plan helps stabilize agricultural output by building resilience against climate-related shocks, which in turn supports broader economic growth and development.
- **Promote Sustainable Practices:** The plan encourages the adoption of sustainable agricultural practices that protect natural resources and ensure long-term productivity. This includes soil conservation, agroforestry, and the use of organic fertilizers.

The strategic actions for the adaptation plan also include:

- **Risk Assessment and Management:** Conducting comprehensive assessments of climate risks and vulnerabilities specific to the agricultural sector. This helps in identifying priority areas for intervention and developing targeted adaptation strategies.
- **Capacity Building:** Enhancing the capacity of farmers, extension officers, and other stakeholders through training and education on climate-resilient practices and technologies.
- **Research and Innovation:** Investing in research to develop innovative solutions for climate adaptation in agriculture. This includes



breeding climate-resilient crop varieties and developing efficient water management systems.

- **Policy Integration:** Ensuring that climate adaptation is integrated into national and local agricultural policies and planning processes. This promotes a coordinated and cohesive approach to addressing climate change impacts.
- **Monitoring and Evaluation:** Establishing mechanisms to monitor and evaluate the effectiveness of adaptation actions. This helps in making necessary adjustments and improvements to ensure the plan's success.

The Sectoral Adaptation Plan for Agriculture is a critical component of Ghana's overall strategy to combat climate change. By focusing on enhancing food security, improving livelihoods, supporting economic development, and promoting sustainable practices, the plan aims to build a resilient agricultural sector that can thrive despite the challenges posed by a changing climate. Through coordinated efforts and strategic actions, Ghana can ensure a sustainable and prosperous future for its agricultural sector and its people.

1.4. Definitions

1.4.1. Gender

“Gender refers to the social attributes and opportunities associated with being male and female and the relationships between women and men and girls and boys, as well as the relations between women and men. These attributes, opportunities, and relationships are socially constructed and are learned through socialization processes. They are context / time-specific and changeable and determine what is expected, allowed, and valued in a woman or a man in a given context (UN, 2018). In regards to climate change adaptation, gender refers to: (i) the impact socio-political relations between men and women have on the planning and implementation of

adaptation actions; (ii) access to and control over resources; (iii) differing impact climate change and adaptation measures have on men and women; and (iv) the differing contributions of men and women to adaptation actions (Least Developed Countries Expert Group, 2015a).

1.4.2. Gender Responsiveness

Gender responsiveness contributes to gender equality as it involves identifying, reflecting on, and implementing interventions that are required to address existing gender gaps and overcome historical gender biases in policies and interventions (Least Developed Countries Expert Group, 2015a). Furthermore, gender responsiveness is the process of integrating gender equality into climate change adaptation efforts. It involves recognizing and addressing the different roles, needs, and vulnerabilities of women and men, ensuring that adaptation strategies empower women and promote their participation in decision-making. This approach seeks to reduce gender disparities by enhancing women's access to resources, opportunities, and decision-making power, ultimately making adaptation efforts more effective and promoting broader goals of social justice and equality (CARE International, 2010).

1.4.3. Climate Change

Climate change means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable periods.” (UN, 1992). The IPCC further defines climate change as “a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or variability of its properties, and that persists for an extended period, typically decades or longer” (IPCC, 2007). This definition emphasizes the persistent nature of climate changes and their significance over long-term periods, driven



largely by anthropogenic factors such as emissions of greenhouse gases, land-use changes, and industrial processes that disrupt the natural climate balance.

1.5. Structure of the Agricultural Sectoral Plan

Climate change adaptation involves making adjustments to ecological, social, or economic systems in response to actual or anticipated climatic stimuli and their effects. This process includes changes in processes, practices, and structures to moderate potential damages or to benefit from opportunities associated with climate change (UNFCCC, 2021). The IPCC further defines climate change adaptation as “the process of adjustment to actual or expected climate and its effects, to moderate harm or exploit beneficial opportunities” (IPCC, 2021). This emphasizes the need for proactive and context-specific measures that not only address immediate risks but also anticipate future climate impacts, ensuring long-term sustainability and resilience.

The first chapter provides the background of the plan, outlining its aims and objectives. It explains the purpose of the sectoral plan and describes its structure, setting the stage for the detailed discussions in the subsequent chapters. The approach and methodology used in developing the sectoral adaptation plan are presented in chapter two. It includes the processes, tools, and frameworks employed to gather data, engage stakeholders, and formulate the plan. Chapter three provides the situational analyses of the agricultural sector in Ghana focusing on the three key sub-sectors – crop, livestock and fisheries.

Chapter four examines the trends in climate change at the national level. It discusses historical climate data, current trends, and future projections, highlighting the implications for the agricultural sector. Chapter five focuses on the impacts of climate change on the agricultural sector and analyzes the sector’s vulnerabilities. It identifies the key risks and challenges posed by climate change to agriculture in Ghana.

Chapter six outlines the proposed actions to address climate change risks in the agricultural sector in Ghana. These actions are designed to address the vulnerabilities and enhance the resilience of agriculture in Ghana. In chapter seven, the report outlines the proposed adaptation actions to address the identified vulnerabilities and impacts. It includes specific strategies, programs, and projects aimed at enhancing the resilience of the agricultural sector.

Chapter eight presents the policy and institutional framework for the sector plan. The framework for monitoring and evaluation is also explained in chapter eight. The chapter also provides overview of the key implementation challenges and their suggested solutions. The chapter also discusses the key gender considerations for the agricultural sector adaptation plan.

The final chapter provides conclusion and the way forward for the implementation of the agricultural sector action plan. summarizes the key findings and recommendations of the plan.



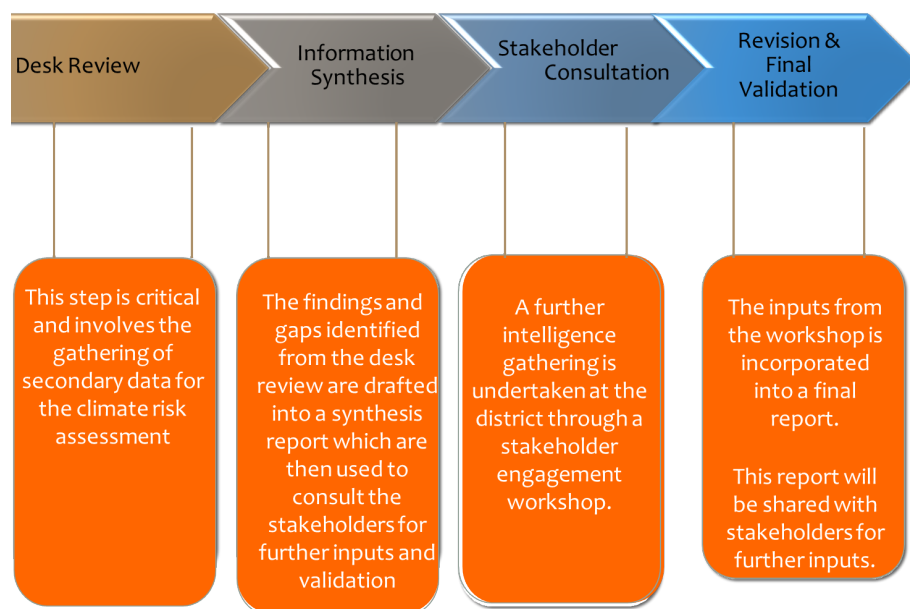


2. METHODOLOGICAL APPROACH FOR THE DEVELOPMENT OF THE SECTOR PLAN

2.1. Approach

The assessment method for this Climate Change Risk Assessment for the Agricultural Sector is a structured, sequential procedure that comprises the following steps (see Figure 1):

Figure 1: Overall work approach for the Climate Change Risk Assessment for the Agricultural Sector



2.1.1. Desk Review

The desk review is the foundational step in the climate risk assessment process. This phase involved the critical task of gathering secondary data, which serves as the bedrock upon which the entire assessment is built. Secondary data refers to information that has already been collected, analyzed, and published by other sources. This could include academic research, government reports, climate models, historical climate data, and case studies from other regions or projects. The primary objective of the desk review was to compile a comprehensive dataset that provided a detailed understanding of the current state of climate risks. This step involved meticulous research and the synthesis of vast amounts of data to ensure a well-rounded perspective. Analysts must evaluate the reliability and relevance of the sources, cross-referencing data to confirm accuracy and identify any discrepancies or gaps in the existing knowledge.

The gathered data provides insights into various climate-related factors such as temperature changes, precipitation patterns, sea level rise, and the frequency of extreme weather events. Understanding these elements is crucial for identifying vulnerabilities and potential impacts on the environment, economy, and communities. This initial phase sets the stage for more targeted and specific investigations in subsequent steps, ensuring that the assessment is grounded in robust and credible information.

2.1.2. Information Synthesis

Following the desk review, the information synthesis step involved distilling the vast amount of collected data into a coherent and comprehensive synthesis report. This phase was crucial as it translated raw data into actionable insights, highlighting key findings, trends, and gaps identified



during the desk review. The synthesis report serves multiple purposes. Firstly, it provides a summarized version of the extensive research conducted in the desk review, making the information more accessible and understandable for stakeholders. This is achieved by organizing the data thematically, identifying patterns, and drawing preliminary conclusions about climate risks.

Secondly, the synthesis report is a tool for engagement and was used to consult with stakeholders, allowing them to provide input and validation. Stakeholders, including local communities, policymakers, scientists, and industry representatives, bring diverse perspectives and expertise, which are invaluable for refining the findings. Their feedback helps to ensure that the assessment is comprehensive and considers all relevant factors.

By identifying gaps in the data, the information synthesis step also sets the agenda for further research and stakeholder consultation. It highlights areas where additional information is needed, guiding subsequent steps in the assessment process. This iterative approach ensures that the climate risk assessment is both thorough and responsive to the needs and concerns of all stakeholders involved.

2.1.3. Stakeholder consultations

The stakeholder consultation step is pivotal in ensuring that the climate risk assessment is inclusive, participatory, and grounded in local realities. This phase involves engaging with a broad range of stakeholders through a district-level engagement workshop, aimed at gathering further intelligence and insights. Stakeholders typically include representatives from local governments, community organizations, businesses, academic institutions, women and youth groups, and other relevant entities. Their involvement is crucial as they possess unique local knowledge, experience, and expertise that can enrich the assessment. Engaging stakeholders in a workshop

setting fosters open dialogue, encouraging the sharing of perspectives and the identification of additional risks and opportunities.

During the consultation, the preliminary findings from the synthesis report are presented, and stakeholders are invited to provide feedback. This collaborative approach ensures that the assessment is not only scientifically sound but also socially and culturally relevant. Stakeholders can highlight local vulnerabilities, suggest mitigation strategies, and identify practical adaptation measures that may not have been apparent through secondary data alone.

Furthermore, the consultation process builds trust and ownership among stakeholders. By actively involving them in the assessment, they are more likely to support and contribute to the implementation of the recommendations. This step highlights the importance of a participatory approach in addressing climate risks, ensuring that the solutions developed are both effective and equitable.

2.1.4. Revision and Final Validation

The final step in the climate risk assessment process was the revision and final validation phase. This refined the assessment based on the inputs gathered during the stakeholder consultation and ensured that the final report was accurate, comprehensive, and actionable. The inputs from the stakeholder workshop were meticulously reviewed and incorporated into the final report. This involved updating data, revising findings, and adding new information or perspectives that were brought to light during the stakeholders' consultations. The goal was to produce a document that accurately reflects the collective knowledge and insights of all participants, providing a robust basis for decision-making.



Once the revisions are made, the final report undergoes a validation process. This involves sharing the revised document with stakeholders for final review and approval. Their validation ensures that the report is not only technically sound but also aligned with the expectations and needs of the stakeholders. This step is crucial for building consensus and ensuring that the recommendations are feasible and supported by all involved.

The final report serves as a strategic tool for policymakers, planners, and other stakeholders, providing a clear roadmap for addressing climate change risks. It includes detailed recommendations for mitigation and adaptation measures, prioritizing actions based on the identified vulnerabilities and risks. By incorporating stakeholder inputs and undergoing rigorous validation, the final report becomes a credible and authoritative guide for climate risk management, setting the stage for effective implementation and long-term resilience building.

2.2. Methodology

2.2.1. Climate Change Risk Assessment

The Climate Change Risk Assessment (CCRA) for the Agricultural Sector adopted a methodology similar to that of Norman et al. (2014). This methodology is a structured approach divided into three primary stages, each with its specific focus and activities (see **Figure 2**). The adapted approach integrates gender dimensions which will help the district reduce its climate change and gender vulnerabilities:

- **Stage 1: Risk Identification**

The first step in risk identification for the agricultural sector was establishing the context. This stage involved defining the parameters that influence the climate risk management process in the agricultural sector. This involved desk reviews to gather relevant information. These reviews

involved examining existing documentation, reports, and data to gain a comprehensive understanding of the sector's unique environmental, socio-cultural, and socio-economic attributes. By analyzing historical data, trends, and previous risk assessments, the team identified patterns and factors that may influence future climatic risks. This step is essential as it lays the foundation for identifying and analyzing climate change-related risks. Once the context was established, the next step was to identify relevant climate change-related risks. This involved recognizing and documenting potential risks that may arise due to climate change and could impact the sector. These risks were varied and may have included physical risks (such as extreme weather events).

- **Stage 2: Risk Assessment**

The second stage in climate change risk management is risk assessment. This stage involved analyzing the identified risks to evaluate their potential impacts and likelihood. This stage was essential for understanding the significance of identified risks and determining appropriate actions to address them. The risk assessment began with the analysis of past, current, and future risks. This involved evaluating how historical events and current trends can influence future risks. By examining past data, the consultants identified patterns and understood how similar risks may have impacted the sector in the past. Desk reviews and stakeholder engagement are key activities in this step. Insights from desk reviews involved analyzing historical data, scientific reports, and case studies to understand the nature and impact of past risks. Stakeholder engagement ensured that the analysis was comprehensive and considered diverse perspectives. The results of the risk evaluation feed into the risk management documentation. This documentation provides a detailed analysis of the potential risks, their impact, and likelihood. It serves as a critical input for decision-making regarding risk acceptance and treatment.



The results of this stage are meticulously documented in Chapter 5 of the assessment, which examined and prioritized hazards based on their potential consequences and probability. Following the entire assessment, a decision point was reached at which risks were either approved for further action or denied based on preset criteria. These factors included the severity of the impact, the effect on vulnerable groups, the financial costs of adaptation, and the sector's ability to effectively manage the risks. This decision-making process was critical in determining the direction and focus of the subsequent Agricultural Adaptation Action Plan.

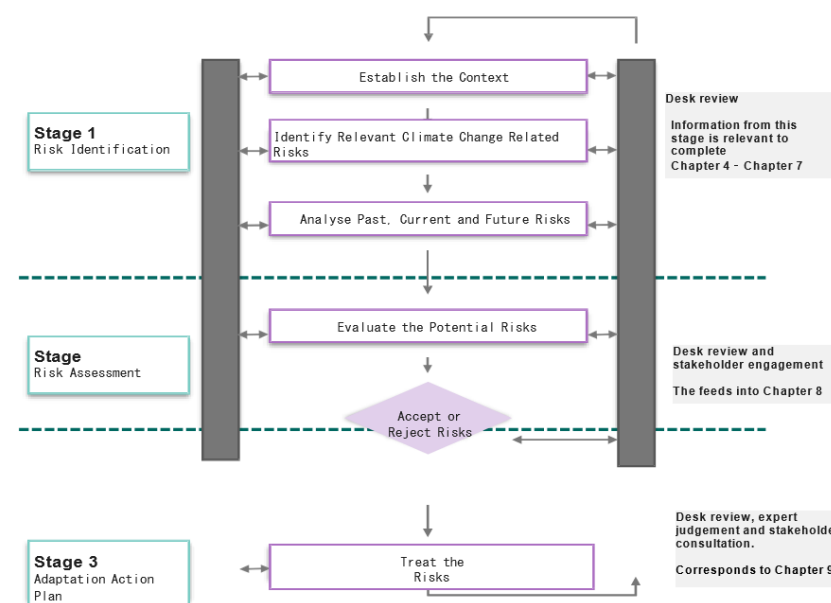
• Stage 3: Adaptation Action Plan

This final stage involved the formulation and implementation of an Adaptation Action Plan to the identified risks. The objective of the adaptation action plan is to ensure that the agricultural sector is resilient to the impacts of climate change and can continue to operate effectively in the face of the identified risks. Treating the risks involves developing and implementing strategies to manage or mitigate the identified risks. The adaptation action plan is the final stage in climate change risk management.

The adaptation action plan is a detailed document that outlines the strategies and actions to be implemented to manage and mitigate identified risks. It includes specific actions, timelines, responsibilities, and resources required for implementation. The plan also includes monitoring and evaluation mechanisms to assess the effectiveness of the implemented strategies and make necessary adjustments.

The methodology emphasizes a collaborative approach, incorporating diverse perspectives and expertise to shape the assessment and subsequent action plan. This process is crucial for creating a strong, contextually tailored strategy for climate change adaptation in the agricultural sector.

Figure 2: Methodology for Climate Change Risk Assessment (CCRA) for the Agricultural Sector



Source: Adapted from (Norman, et al., 2014)

2.2.2. Identification and Compilation of Sector-Specific Adaptation Actions

The comprehensive National Adaptation Action Plan for the Agricultural Sector outlined and gathered specific adaptation strategies tailored to the sector. This process enabled the examination of various potential adaptation strategies and the identification of appropriate actions. The planning team used the techniques described in Table 1 to determine these adaptation options.

Table 1: Methodology to identify adaptation options

Vulnerability assessment report recommendations	The climate change vulnerability assessment for the agricultural sector made recommendations regarding adaptation measures that could be explored to build resilience, increase adaptive capacity, and reduce vulnerability. These recommendations were well considered in the planning process.
Literature review	An extensive review of best solutions and practices was undertaken, using desk review of government documents, scientific publications, grey literature, Metropolitan reports, etc. to identify adaptation actions that ameliorate similar impacts and vulnerabilities.
Stakeholder consultation	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. Agricultural stakeholders were consulted.

Source: Author's construct (2024)

After compiling a list of potential adaptation options, the next step was to evaluate and prioritize them using clear information and criteria. This involved assessing how suitable the options were for the agricultural sector, their ability to enhance resilience and reduce vulnerabilities, and their overall impact on sustainable development. This prioritization process aimed to make informed decisions that lead to effective adaptation and avoid maladaptation. To achieve this, relevant actors and stakeholders were involved in the assessment process to ensure the chosen adaptation options were appropriate and free from potential negative outcomes. The key agricultural stakeholder groups evaluated the proposed adaptation options using a Multicriteria Decision Making (MCDM) Analysis (see Appendix A). This approach was necessary because each adaptation measure might

perform differently across various criteria and could involve trade-offs. Therefore, they needed to be carefully and critically evaluated, and the results of the analysis integrated into decision-making about priority options.

Multicriteria Decision Making (MCDM) Analysis is a systematic approach used to evaluate and prioritize multiple options based on various criteria. It involves identifying relevant criteria, assigning weights to each criterion based on their importance, and then scoring each option against these criteria. This method helps in making informed and balanced decisions, especially when dealing with complex issues involving multiple stakeholders and conflicting objectives (Dixit & McGray, 2013). The criteria for the evaluation of the climate change adaptation strategies are defined in Table 2.

Table 2: Criteria for the assessment of the climate change adaptation options

S/N	Dimension	Indicators	Description
1	Technological	Effectiveness	Effectiveness or importance describes how well 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 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. The extent to which does 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 behavior 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.
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.

Source: Dixit & McGray (2013)

After ranking the different indicators, it was essential to assign appropriate weights to them. An unequal weighting system, reflecting the relative importance of each indicator, was used (Zobeidi et al., 2024; Antwi-Agyei et al., 2013; UNFCCC, 2011). Therefore, a five-point Likert scale (Table 3) was utilized, where climate change experts, as well as agricultural and food experts, ranked the indicators based on their perceived importance, similar to the method used by Antwi-Agyei et al. (2013). The frequency with which each indicator was cited was used to develop the weighting system (Zobeidi et al., 2024; Antwi-Agyei et al., 2013; UNFCCC, 2011).

Table 3: Ranking of adaptation options based

1	Low
2	Neutral
3	Medium
4	High



(....)	Enclose a number in a bracket to show high uncertainty .
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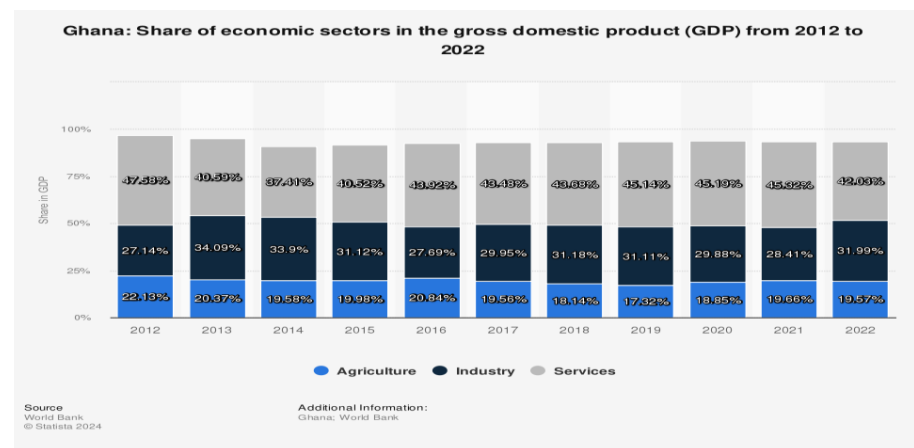
3. SITUATION ANALYSIS OF THE AGRICULTURAL SECTOR

3.1. Background

Ghana has one of the fastest-growing global economies. Agriculture is critical to Ghana's foreign exchange revenues and general economic prosperity. Ghana's agricultural sector is largely subsistence-based, composed of 80% crop production, 10% livestock, poultry, and fishery production, and 10% forestry (The International Trade Administration [ITA], 2019).

The sector employs about approximately 45% of the population and contributes approximately 20% of the Gross Domestic Product [GDP] (Figure 1) (Statista, 2024). The sector accounts for over 40% of export earnings, while at the same time providing over 90% of the food needs of the country (Food and Agriculture Organization [FAO], 2024). Ghana's main agricultural products include cocoa, coffee, cotton, cashew, oil palm, rubber, maize, rice, sorghum, millet, cassava, yam, plantain, banana, pineapple, mango, citrus, coconut, cowpea, groundnut, soybean, shea nut, livestock, poultry, and fish (Ministry of Food and Agriculture [MoFA], 2021).

Figure 3: Share of economic sectors in the GDP of Ghana from 2012 to 2022



Agriculture is predominantly practiced on smallholder, family-operated farms using rudimentary technology to produce about 80 percent of Ghana's total agricultural output. It is estimated that about 2.74 million households operate a farm or keep livestock (Ghana Statistical Service [GSS], 2018). The agricultural sector consists of five main subsectors, namely: crops (cereals and starchy crops), livestock (cattle, sheep, goats, pigs, and poultry), fisheries (marine, inland, and aquaculture), forestry, and cocoa. However, the Ghana Cocoa Board under the Ministry of Finance (MoF) is responsible for cocoa affairs in the country, whereas the Ministry of Lands and Natural Resources (MLNR) has responsibility for the Forestry Commission, and the Ministry of Fisheries and Aquaculture Development (MoFAD) is responsible for the fisheries sub-sector.

The agricultural sector of Ghana has grown in the past years but at a slower rate than the other sectors. The reasons for this growth include favorable policies, increased support from international partners, and improved access to inputs and finance (Mordor Intelligence, 2024).



The favorable policies and extended support from the agencies are increasing the development of agriculture. For instance, in 2021, the United States Agency for International Development (USAID) Ghana helped over 63,000 farmers, half of whom are women in northern Ghana, to access agricultural inputs and finance. The same year, it organized 3,000 women to save USD 250,000 through village savings and loan associations. Industrialization and productivity improvement programs are expected to increase the agriculture sector's output, create jobs, and encourage greater participation by the private sector (Mordor Intelligence, 2024). Some of the favorable policies and programs that the country has implemented to boost the agricultural sector over the past years include the Planting for Food and Jobs, the One District One Factory, the One Village One Dam, the Rearing for Food and Jobs, the Ghana Commodity Exchange, and the Ghana Tree Crop Development Authority (MoFA, 2021). However, the reasons for the slow growth include low productivity, high post-harvest losses, inadequate infrastructure, limited access to credit, climate change and variability, pests and diseases, and land tenure issues (MoFA, 2021).

The agricultural sector of Ghana plays a vital role in improving the livelihoods and well-being of vulnerable groups such as rural women, people living with HIV/AIDS, rural populations affected by climate change and disasters, and smallholder farmers. For example, the sector has been providing employment and income opportunities for the poor and marginalized segments of society (FAO, 2020). It has been enhancing food security and nutrition of vulnerable groups by increasing the availability and affordability of diverse and nutritious foods (Ferreira et al. 2022). The sector has also been reducing poverty and inequality among vulnerable groups by stimulating economic growth and improving the distribution of income and wealth (FAO, 2019). The agricultural sector has been empowering women and youth by increasing their access to productive resources, markets, and decision-making processes (Teye, 2019). Furthermore, the sector has been building the resilience and adaptation of vulnerable groups to climate change

and natural hazards by promoting sustainable and climate-smart agricultural practices (FAO, 2024).

Agricultural development is one of the most powerful tools to end extreme poverty, boost shared prosperity, and feed a projected 9.7 billion people by 2050.¹ Growth in the agricultural sector is two to four times more effective in raising incomes among the poorest compared to other sectors. World Bank research in 2016 concluded that 65 percent of poor working adults made a living through agriculture.² However, the impact of climate change on agriculture is projected to result in global GDP losses from 0.6 percent to 4.4 percent in 2060.³

3.2. Overview of the Crop Sub-Sector



¹ World Bank (2020).

² World Bank (2020)

³ FAO. (2018). Climate change and global market integration - Implications for global economic activities, agricultural commodities, and food security.



The crop sub-sector is a vital part of Ghana's agricultural sector, contributing significantly to the country's economy and food security. In 2023, the crop sub-sector contributed approximately 30.4 billion Ghanaian cedis to Ghana's GDP. It constitutes about 77% of the agricultural sector's total GDP, making it the most significant component (Bank of Ghana, 2024). It also provides employment for a large proportion of the rural population, with an estimated 60% of the agricultural workforce engaged in crop farming. Smallholder farmers dominate the sub-sector, cultivating about 80% of the arable land. Additionally, the sub-sector is responsible for about 30-40% of Ghana's total agricultural exports (GSS, 2022; GSS, 2023). The key crops are grouped into staple crops, cash crops, and horticultural crops. Maize, rice, millet, sorghum, and cassava are the primary staple crops. These are essential for food security and are widely cultivated across the country. Cocoa is the most significant cash crop, making Ghana one of the world's largest cocoa producers (Statistics Research, and Information Directorate of Ministry of Food and Agriculture, 2022). Other important cash crops include oil palm, rubber, and cashew nuts. Ghana also produces a variety of fruits and vegetables, such as pineapples, mangoes, tomatoes, and peppers, which are important for both domestic consumption and export (Ghana Investment Promotion Center [GIPC], 2022). In terms of production systems, the majority of crop production is carried out by smallholder farmers who use traditional farming methods. These farmers typically operate on small plots of land and rely on family labor. There is a growing trend towards commercial farming, especially for cash crops like cocoa and oil palm. These farms are larger and often use more advanced agricultural techniques and inputs (GIPC, 2022). Concerning challenges, variability in rainfall patterns and increasing temperatures pose significant risks to crop production (Asare-Nuamah & Botchway, 2019). The crops are frequently affected by pests and diseases, which can reduce yields and quality. Poor infrastructure, including inadequate storage facilities and transportation networks, affects the distribution and marketing of crops (Baffour-Ata et al., 2024). Initiatives undertaken by the

Government to enhance this sub-sector include the Planting for Food and Jobs (PFG) and the Ghana Cocoa Board (COCOBOD).

The flagship program (i.e., PFG) aims to increase food production and create jobs through the provision of improved seeds, fertilizers, and extension services to farmers. COCOBOD supports cocoa farmers through research, extension services, and the provision of inputs. It also regulates the cocoa industry to ensure quality and sustainability. In terms of economic impact, the crop sub-sector employs a large portion of the population, particularly in rural areas. Cocoa and other cash crops are significant export commodities, contributing to foreign exchange earnings and economic growth. Overall, the crop sub-sector is crucial for Ghana's economy, providing food, employment, and export revenues. However, addressing the challenges faced by farmers is essential for sustainable growth and development in this sector.

3.3. Overview of the Livestock Sub-Sector



The livestock sub-sector is a vital part of Ghana's agricultural sector, contributing significantly to the economy and rural livelihoods. The livestock sub-sector's contribution to Ghana's agricultural GDP has experienced a decline over recent years. It decreased from 12.6% in 2014 to 8.31% in 2020 (FAO, 2020). Additionally, it accounts for a relatively smaller proportion of agricultural exports, contributing approximately 2-4% of total agricultural exports. In 2023, approximately 500,000 people were directly or indirectly employed by the livestock sub-sector in Ghana (USDA, 2023; GIPC, 2023). The sub-sector includes a variety of animals including ruminants (e.g., Cattle, sheep, and goats), pigs (Widely reared across the country), poultry (e.g., Chickens, guinea fowl, ducks, turkeys, and ostriches), and non-conventional species (e.g., Grasscutters, snails, guinea pigs, and rabbits). Livestock farming plays a crucial role in providing meat, milk, and eggs. Many rural households rely on livestock for their primary income and create jobs in farming, processing, and marketing (MoFA, 2004).

The sector faces several challenges such as disease control, feed and water, and infrastructure (MoFA, 2004). For example, there have been outbreaks of avian influenza and foot-and-mouth disease. Also, there is an inadequate supply of quality feed and water, especially during dry seasons. Furthermore, there is limited access to veterinary services and markets. The government has implemented various policies and programs to address these challenges, including the National Livestock Development Policy, Veterinary Services, and Support Programs. The National Livestock Development Policy aims to improve productivity and sustainability. The Veterinary Services enhance disease surveillance and control measures. The support programs provide subsidies for feed, vaccines, and other inputs. The livestock sub-sector has significant growth potential, especially with increased investment in modern farming techniques, market access, and research and development. For example, there is an adoption of improved breeding and feeding practices, the development of better infrastructure, market linkages, and innovations in animal health and production.

3.4. Overview of the Fisheries Sub-Sector



The fisheries sub-sector is also a crucial component of Ghana's agricultural sector, contributing significantly to the economy and food security. The fisheries sub-sector contributes about 4.5% to Ghana's national GDP, accounting for approximately 12% of the agricultural GDP (Mapedza et al., 2024). Annual fish production is approximately 450,000 metric tons, with aquaculture contributing over 50,000 metric tons. The fishery industry is one of Ghana's largest agricultural export sectors, with fish exports accounting for about 7-10% of total agricultural exports. In 2020, Ghana's fish exports were valued at approximately USD 40 million (USDA, 2022). In 2022, the fisheries sub-sector directly employed about 10% of the country's population, with an estimated 2 million people engaged in fishing, fish processing, and related activities (GSS, 2022). The types of fisheries in Ghana are marine fisheries, inland fisheries, and aquaculture. Marine fisheries include both artisanal and industrial fishing activities along Ghana's coastline. The artisanal sector is particularly important, employing



a large number of fishers and contributing significantly to local economies. Inland fisheries are based on numerous rivers, lakes, and reservoirs, with Lake Volta being the most prominent. Aquaculture is a growing area, involving the farming of fish in controlled environments such as ponds and cages. The fisheries sector contributes about 4.5% to Ghana's annual GDP (Food and Agriculture Organization [FAO], 2016). It supports approximately 135,000 fishers in the marine sub-sector alone and indirectly supports the livelihoods of around 2.2 million people. The sector generates around USD 1 billion in revenue each year (FAO, 2016). The fisheries sub-sector faces several challenges including overfishing, illegal, unreported, and unregulated (IUU) fishing, climate change, and infrastructure. For instance, excessive fishing pressure has led to declining fish stocks. Also, IUU fishing remains a significant problem, affecting sustainable management efforts. Changes in sea temperatures and weather patterns impact fish habitats and breeding cycles. Concerning infrastructure, there is limited access to modern fishing equipment and facilities. To address these challenges, the government has implemented various policies and programs such as the Fisheries and Aquaculture Sector Development Plan which aims to improve management practices and increase productivity, some regulatory measures, and other support programs.

Regarding regulatory measures, there has been an enforcement of fishing regulations to combat IUU fishing. The support programs provide subsidies and training for fishers to adopt sustainable practices. The fisheries sub-sector has significant potential for growth, especially with increased investment in sustainable practices, aquaculture expansion, and research and development. For example, there has been the adoption of eco-friendly fishing methods and better management of fish stocks. Aquaculture expansion is promoting fish farming to reduce pressure on wild fish populations. Lastly, there have been innovations in fish breeding, disease control, and feed production.

3.5. Gender Issues in the Agricultural Sector of Ghana

Gender is an important issue in the agricultural sector of Ghana because it affects the productivity, income, and well-being of farmers, especially women. Women constitute about 50% of the agricultural labor force in Ghana, but they face many constraints and inequalities in accessing and controlling productive resources (FAO, 2018). Women are mainly involved in subsistence farming, while men dominate commercial farming and cash crop production (Consortium of International Agricultural Research Centers, 2021). Access to land is critical for farming, and control over land is usually synonymous with wealth, status, and power. Lack of access to land for farming activities in northern Ghana has been found to inhibit women's ability to implement certain adaptation practices including planting trees to address the threats posed by climate change.⁴ Women have limited access to land, which is mostly owned and controlled by men (Figure 2). Only 10% of women have land rights, compared to 90% of men (Consortium of International Agricultural Research Centers, 2021). According to the FAO, women across all developing regions are consistently less likely to own or operate land. It is estimated that if women farmers are granted similar access to resources (productive) as their male counterparts, they could increase yields on their farms by 20–30 percent, which could raise total agricultural output in Ghana by 4 percent, leading to a 17 percent reduction in hunger. (SEND Ghana, 2014).

Women also have limited access to credit, extension services, technologies, and innovations, which affect their productivity and income (FAO, 2018). Women are more vulnerable to the adverse impacts of climate change, such as droughts, floods, pests, and diseases, due to their dependence on natural resources and their low adaptive capacity. Women have less participation and representation in decision-making processes and policy formulation in the agricultural sector. These gender gaps hinder the potential of women farmers to contribute to the agricultural sector and the achievement of broader economic and social

4 Antwi-Agyei et al. (2015).



development goals. Therefore, addressing gender issues in the agricultural sector of Ghana is essential for improving food security, poverty reduction, and environmental sustainability.

The key sub-sectors within the agricultural sector of Ghana are crop production, livestock production, and fisheries and aquaculture. For crop production, Ghana produces a variety of crops, such as cocoa, maize, cassava, yam, plantain, rice, sorghum, millet, groundnut, soybean, oil palm, cotton, and horticultural crops. Crop production accounts for about 70% of the agricultural GDP and employs about 90% of the agricultural labor force (MoFA, 2021). Ghana has a livestock population of about 25 million, comprising cattle, sheep, goats, pigs, poultry, and other animals (MoFA, 2021). Livestock production contributes about 14% of the agricultural GDP and provides animal protein, manure, and draught power (MoFA, 2021). Ghana has a rich marine and inland fishery resource, with an estimated potential yield of 1.2 million metric tons per year (MoFA, 2021). Fisheries and aquaculture contribute about 16% of the agricultural GDP and provide food, income, and employment for about 10% of the population (MoFA, 2021; Oxford Business Group, 2024).

The agricultural sector of Ghana is impacted by both climatic and non-climatic factors. The climate change impacts are highlighted in the next section. However, the non-climatic factors that affect the performance of the sector are infrastructure, socioeconomic factors, and policy and institutional factors. For instance, the agricultural sector in Ghana suffers from inadequate infrastructure, especially roads, and irrigation, which limits access to markets, inputs, and water for crops (the World Bank Group, 2017; Badmos et al. 2018). The sector also is influenced by various socioeconomic factors, such as education, skills, access to finance, land tenure, gender, and poverty (Ferreira et al. 2022). These factors affect the productivity, income, and resilience of farmers, especially women and smallholders (Ayumah et al. 2020). Furthermore, the agricultural sector in Ghana is also affected by the policy and institutional environment, such as the level

of public investment, the quality of extension services, the availability of innovations, and the participation of stakeholders (Badmos et al. 2018). These factors affect the competitiveness, diversification, and sustainability of the agricultural sector (The World Bank Group, 2017).

A Report by the UNDP (2022) highlighted the key gender issues in the agricultural sector as follows:

- Women either work on their own as unpaid workers on family lands or as paid or unpaid laborers in some agricultural enterprises. Their contributions are however mediated by multiple forms and expressions of gender inequalities and patriarchal relationships, which limit their access to and control of resources such as land, technology, labor, and capital. Women farmers tend to produce less yields.
- Women do not have satisfactory access to technical knowledge on agriculture due to numerous barriers to accessing information and profiting from extension services and training.
- In certain parts of the country, women's access and control over land is woefully inadequate, and hindered by various customary laws, and this leads to low economic power, poverty, and women's low productivity.
- Women's participation and representation in decision-making spaces in the agriculture sector are woefully inadequate.
- Gender and related issues are often not key in the development of policies but an afterthought. There is often a mere mention of gender but no clearly stated frameworks or strategies for addressing gender and related concerns.
- The Ministry of Fisheries and Aquaculture Development (MoFAD) is a rather new ministry cut out from the Ministry of Food and Agriculture,



which presents an opportunity for gender mainstreaming. Therefore, key stakeholders' capacities on gender—and climate-change-related issues need to be built for effective mainstreaming.





4. NATIONAL CLIMATE CHANGE TRENDS

This section provides an overview of the country and stocktaking of climate change trends to understand the context of climate change and the key vulnerabilities of the agricultural sector.

4.1. Country Overview

This section provides an overview of the country and stocktaking of climate change trends to understand the context of climate change and the key vulnerabilities of the agricultural sector.

4.1.1. Geographic Location

Ghana is located in West Africa along the Gulf of Guinea, bordered by Côte d'Ivoire to the west, Burkina Faso to the north, and Togo to the east. It lies between latitudes 4°44'N and 11°11'N and longitudes 1°11'E and 3°15'W, covering a total land area of approximately 238,533 square kilometers (World Bank, 2024). The country's southern coastline stretches for about 560 kilometers, making it a key maritime nation in the region. Ghana's strategic location places it near the equator, giving it a tropical climate with distinct wet and dry seasons. This geographic positioning not only influences its climate and ecological diversity but also facilitates its role as a gateway to West Africa, connecting the region to global trade and cultural exchanges (World Bank, 2024).

4.1.2. Country Profile

Ghana, with a total land area of 227,540 sq. km,⁵ is situated in West Africa on the Guinea Coast and lies close to the equator on latitude 11.5°N and 4.5°N

5 <https://data.worldbank.org/country/ghana>

and longitude 3.5°W and 1.3°E. The country is comprised of the forest zone (30 percent of southern Ghana) and the savanna zone (70 percent of northern dryland) (MLNR, 2012) and is subdivided into 12 distinct vegetation zones. The total land area consists of 69 percent agriculture and 41 percent of forest areas (FAO, 2020).⁶ Agricultural lands have increased from 55 percent of the total land area in 1990 to 69 percent in 2017 (World Bank, 2020). In the same vein, the share of arable land in the country's land area increased from 12 percent to 21 percent in the same period. Agricultural irrigated land constitutes only 0.2 percent of total agricultural land. Agricultural machinery use is 4.5 tractors per 100 sq. km of arable land.

4.1.3. Demographic Characteristics

Ghana has a diverse and dynamic population, estimated at over 32 million people, with a relatively young age structure, as nearly 57% of the population is under 25 years old (World Bank, 2024). The country is composed of multiple ethnic groups, including the Akan, Mole-Dagbani, Ewe, and Ga-Dangme, among others, each contributing to Ghana's rich cultural heritage (GSS, 2023). Urbanization is on the rise, with over 56% of the population residing in urban areas, particularly in cities like Accra, Kumasi, and Takoradi, while rural areas still play a significant role in agriculture and local trade. Ghana boasts a relatively high literacy rate compared to other countries in the region, and its demographic distribution supports a growing workforce, which is key to its socio-economic development (GSS, 2023).

4.1.4. Key Economic Sectors

Ghana's economy is largely driven by key sectors such as agriculture, industry, and services. Agriculture remains a vital part of the economy, employing about 33% of the labor force and contributing significantly to GDP,

6 <http://www.fao.org/countryprofiles/index/en/?iso3=GHA>



with cocoa, maize, and yam as staple products (GSS, 2024). The industrial sector, particularly mining and energy, plays a crucial role, as Ghana is a leading exporter of gold and oil. The services sector has expanded rapidly, driven by telecommunications, banking, and tourism, making it the largest contributor to the GDP (World Bank, 2024). Additionally, small and medium enterprises (SMEs) dominate the informal economy, providing employment and supporting livelihoods (GSS, 2024). These sectors collectively form the backbone of Ghana's economy, ensuring growth and resilience in the face of global challenges.

4.2. Past Climate Trends

Ghana is located in the tropics and has a mostly hot and humid climate. The climate in Ghana is tropical and influenced by the West African monsoon winds (Government of Ghana, 2015b). Rainfall and temperature have been generally variable in Ghana. Seasonal patterns in Ghana are heavily influenced by the position of the Inter-Tropical Convergence Zone as it oscillates between the south and the north. Seasonal variations in temperature in Ghana are greatest in the north, which is also the hottest part of the country, with temperatures reaching an average of 27°C–30°C during the hot, dry season (April, May, June) (Asante & Amuakwa-Mensah, 2015). The country has two main seasons: the wet season (April to October) and the dry season (November to March). The wet season is influenced by the southwest monsoon, which brings rainfall from the Atlantic Ocean, and the dry season is influenced by the northeast trade winds, which bring dry and dusty air from the Sahara Desert. The average annual temperature in Ghana is about 27°C, with little variation throughout the year (The World Bank Group, 2021a). However, there are some regional differences due to altitude and proximity to the coast. The coastal areas are generally cooler and more humid than the inland areas, and the northern regions are hotter and drier than the southern regions. The average annual rainfall in Ghana ranges from about 800

mm in the north to about 2000 mm in the south, with most of the rain falling during the wet season (The World Bank Group, 2021).

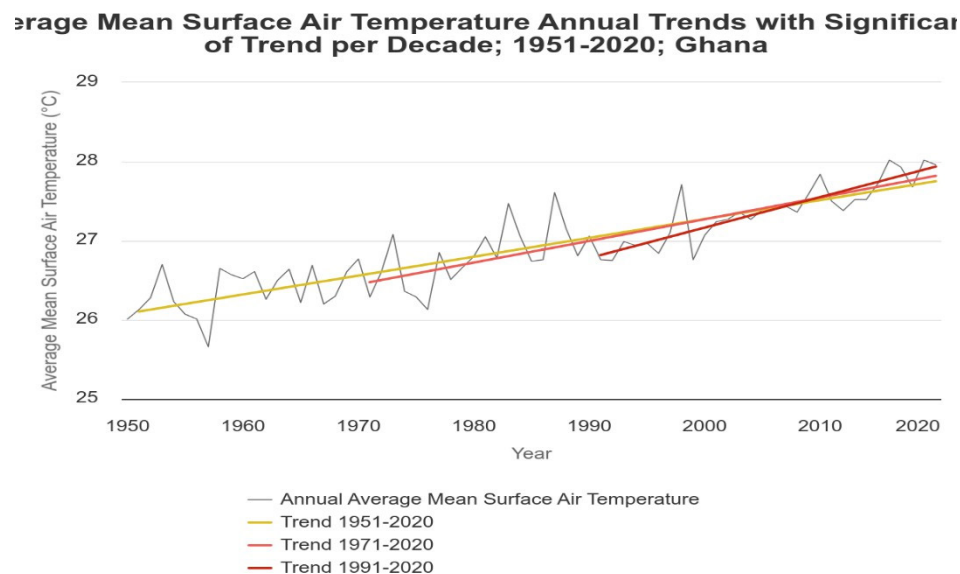
According to historical data and observations, Ghana has experienced some changes in its climate over the past decades. Some of the main trends and variability are:

- An increase in near-surface temperatures of about 0.20-0.25°C per decade during both the wet and dry seasons (Figure 7) (The World Bank Group, 2021b).
- A decrease in annual rainfall of about 2.4% per decade, with more pronounced declines in the northern and coastal regions (Figure 8) (The World Bank Group, 2021b). The rainfall pattern has also become more erratic and unpredictable, with more frequent and intense droughts and floods (Dickinson et al., 2017).
- A decrease in relative humidity of about 0.6% per decade, especially in the dry season (The World Bank Group, 2021b). This is associated with the increase in temperature and the decrease in rainfall, as well as the influence of the dry and dusty Harmattan winds from the Sahara Desert.
- A decrease in sunshine hours of about 0.8% per decade, mainly due to the increase in cloud cover and aerosols (The World Bank Group, 2021b). This has implications for solar radiation and evaporation, which affect the energy and water balance of the country.

These climate trends and variability have significant impacts on various sectors and aspects of Ghana's development, particularly agriculture.

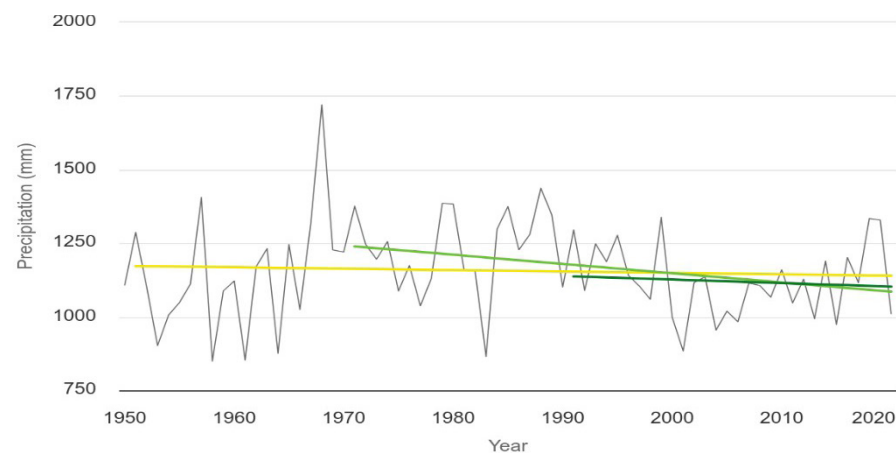


Figure 4: Average mean surface air temperature annual trends with the significance of trend per decade; 1951 – 2020; Ghana



Source: The World Bank Group (2021b)

Figure 5: Precipitation annual trends with the significance of trend per decade; 1951 – 2020; Ghana



Source: The World Bank Group (2021b)

4.3. Projected Climate Trends

Ghana is expected to face significant changes in its climate in the coming decades due to the increase in greenhouse gas emissions and the resulting global warming. Some of the main projections are:

- A rise in near-surface temperatures of about 1.5-3.0°C by 2050 and 2.0-5.0°C by 2080, depending on the emission scenario (Figure 9) (The World Bank Group, 2021c).
- An increase in sea-surface temperatures of about 1.0-2.0°C by 2050 and 1.5-3.0°C by 2080, depending on the emission scenario (The World Bank Group, 2021c).
- A decline in annual rainfall of about 10-20% by 2050 and 15-30% by 2080, with more pronounced reductions in the northern and coastal regions (Figure 10) (The World Bank Group, 2021c).



- A change in the seasonal distribution of rainfall, with a delayed onset, a shorter duration, and an earlier cessation of the wet season.
- An increase in the variability and unpredictability of rainfall, with more frequent and intense extreme events such as heavy downpours and floods.
- A rise in sea level of about 0.2-0.4 m by 2050 and 0.3-0.6 m by 2080, depending on the emission scenario (The World Bank Group, 2021c).

These projected climate trends pose serious challenges and opportunities for Ghana's development, as they affect critical sectors including the agricultural sector and aspects of the economy, society, and environment.

Figure 6: Projected departure from the natural variability of average mean surface air temperature with trends; Ghana

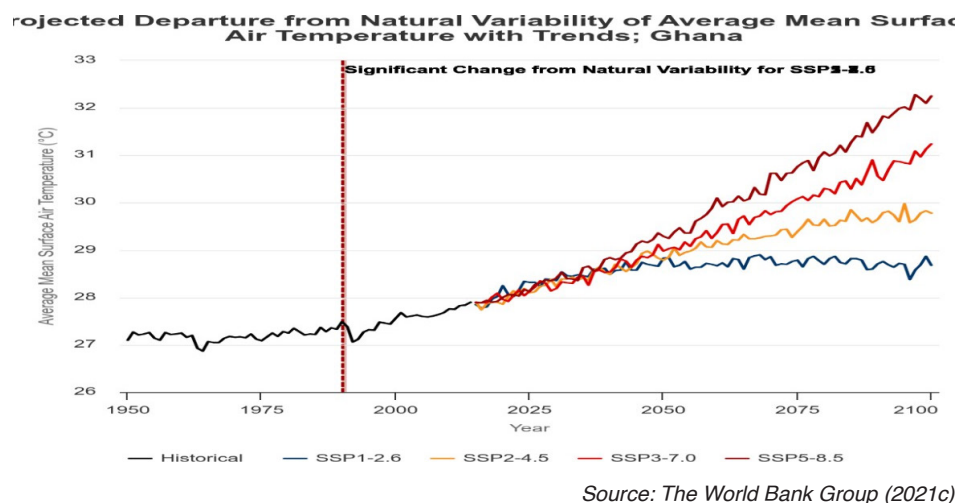
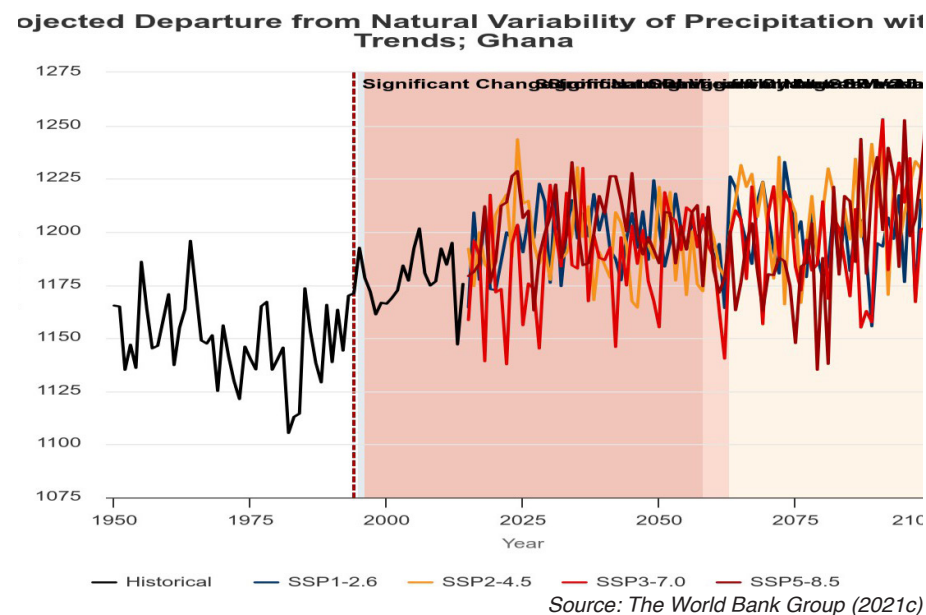


Figure 7: Projected departure from the natural variability of precipitation with trends; Ghana





5. CLIMATE CHANGE IMPACTS AND VULNERABILITY ANALYSIS OF THE AGRICULTURAL SECTOR

5.1. Crops Sub-Sector

The agricultural sector in Ghana is divided into three sub-sectors, namely crops, livestock, and fisheries. The impacts of climate change on these sub-sectors are varied and interconnected. In regards to crops, rising temperatures and changing rainfall patterns are major factors disrupting production. Higher temperatures can lead to heat stress, reducing yields of temperature-sensitive crops like maize, cassava, and cocoa. Unpredictable rainfall, with delayed or erratic onset, hinders proper planting and harvesting times, often resulting in crop failure or lower-quality produce. Additionally, more frequent extreme weather events, such as droughts and floods, further threaten crop productivity. Droughts cause water shortages for irrigation, while excessive rainfall leads to soil erosion, waterlogging, and nutrient depletion. These climate changes affect crops' growth and health and increase the frequency of pest and disease outbreaks, exacerbating the problem (Table 4). In particular, vulnerable smallholder farmers face significant challenges adapting to these climate changes due to limited access to climate information, financial resources, and technology.

Table 4: Risks, vulnerabilities, and impacts of the crop sub-sector

Risks and vulnerabilities	Impacts
Erratic Rainfall Patterns – Unpredictable rains delay planting and reduce yields in staple crops like maize and yam.	Disrupts traditional planting calendars, leading to late planting or staggered planting schedules Inconsistent water supply during critical growth stages such as germination and vegetative growth can stunt plant development.
Flooding – Heavy rains in areas like the Volta and Greater	Floodwaters wash away nutrient-rich topsoil, leading to reduced soil fertility. Prolonged saturation of fields inhibits plant respiration and nutrient uptake, stunting crop growth. Standing water fosters the proliferation of pests like stem borers and diseases such as root rot and fungal infections.
Accra Regions waterlog farms and destroy crops.	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 – Higher temperatures stress crops, reducing yields and crop failures.	Increases evaporation rates and reduces water availability for irrigation. Shifts planting and harvest times. Extreme heat events can lead to crop loss due to wilting and drought. Warmer temperatures foster the growth of pests and pathogens. Higher temperatures can lead to heat stress on crops, reducing their yields. Some crops may no longer be viable in regions that become too hot



Droughts– Prolonged dry periods in the Savannah Region inhibit crop growth.	Reduces the availability of water for irrigation, affecting crop growth. Critical growth stages, such as flowering and fruiting, are disrupted, leading to smaller or fewer yields. Reducing the soil's water retention capacity, making it harder for crops to recover even after rains resume. Causes the buildup of salts in soil, which harms crop growth and soil fertility. Increased frequency and severity of extreme weather events like droughts can damage crops and degrade soil quality, making land less suitable for agriculture.
Heat stress– occurs when temperatures exceed optimal levels, damaging plant tissues and hindering growth.	Heat stress causes cellular breakdown, leading to permanent damage in plant tissues. Crops mature too quickly under heat stress, reducing yield potential. Impairs root development, limiting nutrient and water absorption. Unlike drought, heat stress causes excessive water loss from both soil and plant surfaces.
Pests and Diseases – Fall armyworm infestations and cocoa black pod disease reduce harvests.	lower the productivity of plants by affecting growth and fruiting stages. Increased production costs as Farmers must spend more on pesticides, fungicides, and labor for pest and disease management. Reduced harvests lead to lower sales, affecting household livelihoods, especially for cocoa-dependent farmers. 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 – 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. It also reduces water infiltration and root penetration.

High Input Costs – Rising fertilizers, seeds, and pesticide costs limit smallholder farmers' productivity.	Suboptimal fertilizer application leads to weaker plants being more prone to pest damage and diseases. Many smallholder farmers cannot afford improved or high-yield seed varieties, relying instead on lower-quality traditional seeds. Farmers may forgo pest and disease management, resulting in increased losses from infestations like fall armyworm or fungal diseases.
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. 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. 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. Increased sea levels can lead to more frequent and severe coastal flooding. Floodwaters 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– 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. Unreliable harvests discourage investment in agriculture, particularly among younger farmers. Seasonal unemployment increases as farming activities become less predictable.

Source: Author's construct (2024)



5.2. Livestock Sub-Sector

The livestock sub-sector faces a myriad of impacts due to climate change. The livestock sub-sector faces a myriad of impacts due to climate change. Rising temperatures and changing rainfall patterns affect pasture growth and water availability, leading to a reduction in the quality and quantity of feed for livestock. Heat stress from elevated temperatures can also reduce animal productivity, including lower milk yields, reduced fertility, and increased mortality rates, particularly in cattle, goats, and poultry. Additionally, the increased frequency of droughts exacerbates water shortages, making it harder to meet the water needs of livestock. Furthermore, the changing climate also contributes to the spread of diseases and pests, such as ticks and vector-borne diseases, which affect animal health and productivity. As climate conditions shift, the spread of diseases like Foot-and-Mouth Disease (FMD) and Newcastle disease becomes more unpredictable, placing additional stress on farmers and veterinary systems (Table 5).

Table 5: Risks, vulnerabilities, and impacts of 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. • Affects hormone regulation in livestock, leading to lower conception rates in cattle, sheep, and goats. • 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.

Risks and vulnerabilities	Impacts
• Drought – Limited water and pasture during the dry season affect cattle, sheep, and goats.	• Leads to dehydration, reducing livestock productivity and increasing mortality risks. • Reduces forage availability, leaving cattle, sheep, and goats with inadequate nutrition. • 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. • Weakens immunity, making animals more prone to infections. • Increase water demand, straining available resources. • 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. • Reduces water supply, stressing animals and increasing costs. • 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. • Flooded areas create conditions for waterborne diseases to spread. • Floods can drown livestock or cause injury, leading to higher death rates. • Floodwaters destroy barns and animal enclosures, exposing livestock to harsh conditions.



Risks and vulnerabilities	Impacts
• 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. • Farmers incur higher costs for veterinary services, vaccines, and treatments to manage outbreaks. • Death of breeding stock reduces future herd or flock sizes, affecting long-term productivity.
• 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. • Without veterinary services, farmers cannot obtain essential vaccines, dewormers, or antibiotics. • Farmers lack guidance on early detection of diseases, leading to delayed responses and more severe outbreaks.

Risks and vulnerabilities	Impacts
• 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. • 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. • 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. • 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. • 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. • 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. • 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. • 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. • 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. • 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.
• Conflicts Over Grazing Lands – Clashes between herders and farmers over pasture disrupt livestock production.	• Clashes disrupt livestock farming, causing financial losses from damaged crops and reduced animal production. • Continuous disruptions in grazing areas negatively impact livestock conditions, reducing their market value due to poor health or weight loss. • Cause livestock to be moved frequently, leading to stress and decreased overall health and productivity.

Source: Author's construct (2024)

5.3. Fisheries Sub-Sector

With regards to the fisheries sub-sector, rising sea temperatures, ocean acidification, and altered rainfall patterns are affecting the distribution and abundance of fish species. Warmer waters can lead to the migration of fish to cooler areas, reducing fish stocks in traditional fishing zones and affecting the livelihoods of local fishermen. Changes in rainfall patterns also influence freshwater resources, such as rivers and lakes, where many fish species breed, impacting both inland and coastal fisheries. Additionally, more frequent and intense storms, flooding, and coastal erosion threaten fishing infrastructure, including boats, landing sites, and storage facilities. These extreme weather events can lead to the destruction of fishing equipment, making it harder for fishers to access their catch. The increased runoff from heavy rains also introduces pollutants and sediment into water bodies, negatively affecting water quality and fish habitats. As a result, the fisheries sector faces declining fish stocks, reduced income, and growing food security risks for communities that depend on fishing as a primary source of livelihood (Table 6).

Table 6: Risks, vulnerabilities, and impacts of the fisheries sub-sector

Risks and vulnerabilities	Impacts
• Sea Level Rise – 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. • Sea level rise threatens coastal ecosystems like mangroves and wetlands, disrupting biodiversity and fishing resources.
• Floods – Occur from heavy rains, often causing widespread waterlogging in fishing areas.	• Pollutants from floodwaters harm fish populations. • Fish are swept away from their habitats during floods. • Floods destroy fishing gear and boats, disrupting operations.



Risks and vulnerabilities	Impacts
• Storms – 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. • Storms prevent access to fishing areas, affecting catch. • Storms damage boats and equipment, halting fishing activities.
• Rising Sea Temperatures – Changes in sea temperature disrupt fish breeding and migration, reducing availability.	• Interfere with the reproductive cycles of fish, reducing population growth. • Force fish to migrate to cooler areas, making them less accessible to local fisheries. • Lead to lower fish catches, affecting food security and income for fishing communities.
• Droughts – Result from prolonged dry spells, reducing water levels in rivers and lakes.	• Low water levels limit fishing areas and habitats. • Leads to higher temperatures and reduced oxygen levels in water. • Fish may move to other areas, reducing local fish populations.
• Heatwaves – Heatwaves in Ghana cause unusually high temperatures, raising water temperatures in aquatic environments.	• Slow down fish growth rates, as higher temperatures affect metabolic functions. • Alter aquatic ecosystems, damaging the delicate balance of habitats for fish. • Elevated water temperatures during heatwaves encourage the growth of harmful algal blooms, which deplete oxygen and poison aquatic life.

Risks and vulnerabilities	Impacts
• Overfishing – 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. • Fishermen face income loss as fish stocks decline, impacting local economies dependent on fishing. • Disturbs the balance of marine ecosystems, affecting biodiversity and the health of coastal environments.
• Coastal Erosion – 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. • Rising sea levels force coastal communities to relocate, disrupting livelihoods and increasing poverty.
• Illegal Fishing Practices – 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. • Undermines sustainable practices, leading to income losses for legitimate fishers and harming the fishing industry.
• Pollution – 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. • Reduces fish catch and damage industries dependent on clean water, leading to financial losses. • Harm breeding grounds for fish, leading to reduced fish populations and lower yields for local fisheries.



Risks and vulnerabilities	Impacts
• Decreased Water Quality due to Higher temperatures and runoff from intense rainfall	• leads to oxygen depletion, harming fish and other aquatic species. • Reduces fish populations, affecting catch rates and the livelihoods of fishermen. • Foster the growth of pathogens, leading to disease outbreaks in fish and other aquatic organisms.
• Shifts in Fish Distribution – As marine ecosystems adapt to climate changes, some fish species may migrate to cooler or deeper waters, making them less accessible to local fishers.	• Forces fishers to travel farther, increasing costs and reducing the efficiency of traditional fishing methods. • As fish become less accessible, fishing communities face income loss and increased financial pressure due to reduced catches. • Affect the availability of popular fish species, disrupting local markets and food supply chains.

Source: Author's construct (2024)





6. PROPOSED ADAPTATION ACTIONS FOR THE AGRICULTURAL SECTOR

This section outlines the proposed adaptation actions to address climate change risks in the agricultural sector. These actions are designed to address the vulnerabilities and enhance the resilience of agriculture in Ghana (Table 7).

6.1. Nature-Based Adaptation Actions

These strategies leverage natural ecosystems and their processes to help mitigate the impacts of climate change while fostering resilience in both human and ecological systems. By working with nature, these solutions provide multiple co-benefits, including improved biodiversity, enhanced ecosystem services, and support for livelihoods, particularly in rural or vulnerable communities. They are cost-effective and sustainable, making them integral to long-term adaptation strategies.

6.2. Technological and Engineering Measures

These measures focus on the development and application of technological innovations and engineered structures to adapt to climate change impacts. Such measures are often grounded in science and engineering principles, ensuring precision and efficiency in their implementation. They can range from large-scale infrastructure projects like flood barriers to small-scale technological innovations that improve resource management or monitoring capacities.

6.3. Policy Measures

These are institutional and governance mechanisms developed to create an enabling environment for climate adaptation. These measures include policies,

laws, strategies, and programs designed to facilitate the implementation of adaptation actions, ensuring they align with national development goals and international climate commitments. They provide the framework for integrating climate adaptation into decision-making processes, allocating resources effectively, and monitoring progress. Policy measures also address barriers to adaptation, such as financial constraints or knowledge gaps, by offering incentives, building capacity, and fostering collaboration among stakeholders at all levels. Table 7 provides a tall List of adaptation actions for the various sub-sectors.



Table 7: Tall list of adaptation actions for the various sub-sectors

Sub-Sectors	Adaption Actions	Assessment of the impact of proposed actions	Supporting Policies/Laws
Crops	Nature-Based Solutions • Develop drought-resistant crop varieties that can withstand prolonged dry periods. • Promote crop diversification to reduce risk and enhance food security. • Integrate agroforestry practices to improve soil fertility and provide additional income streams. • Implement conservation agriculture techniques to improve soil moisture retention. • Encourage intercropping and mixed farming systems to enhance resilience. • Promote soil conservation techniques like terracing and contour farming. • Implement crop rotation practices to maintain soil health and reduce pest vulnerabilities. • Develop green manure and cover crop techniques to enhance soil organic matter and improve moisture retention capabilities. • Establish strategic crop buffer zones to protect agricultural lands from environmental degradation and enhance ecosystem resilience. • Promotion of farming practices to restore degraded ecosystems • Creation of green space • Planting of drought-resistant varieties of crops • Mulching • Agroforestry • Use of climate-smart agricultural practices	Agroforestry contributes to enhanced biodiversity, soil fertility, and ecosystem resilience. The integration of trees into croplands helps sequester carbon, mitigating climate change while reducing wind and water erosion. It also provides farmers with diversified income sources through timber, fruits, and fodder. In Ghana, agroforestry has significant potential to combat land degradation in dryland areas while improving livelihoods. Efficient irrigation systems, such as micro-irrigation and water harvesting, address water scarcity by optimizing water use for agricultural production. These systems enhance crop productivity and allow farming during dry seasons, boosting food security. In Ghana, irrigation technologies are crucial for transforming agriculture into a more climate-resilient sector, especially in areas experiencing prolonged droughts. Crop insurance protects farmers against losses due to climate-related events such as droughts, floods, or pests. This policy measure provides financial security and encourages investment in sustainable farming practices. In Ghana, where many farmers face extreme climate risks, crop insurance can reduce vulnerabilities, promote resilience, and ensure the sustainability of agricultural livelihoods.	



Sub-Sectors	Adaption Actions	Assessment of the impact of proposed actions	Supporting Policies/Laws
	Technological/Engineering Measures • Develop efficient irrigation systems using water harvesting and micro-irrigation technologies. • Create seed banks with climate-resilient crop varieties native to different Ghanaian regions. • Develop localized climate forecasting systems to help farmers make informed planting decisions. • Establish community-based seed multiplication centers for resilient crop varieties. • Develop precision agriculture techniques using digital technologies and satellite imaging. • Implement watershed management strategies to improve water availability and reduce soil erosion in agricultural landscapes. • Promote the availability of machinery • Provision of technical services to farmers • Establishment of agricultural mechanization service provision • Adoption of drip irrigation • Rainwater harvesting		



Sub-Sectors	Adaption Actions	Assessment of the impact of proposed actions	Supporting Policies/Laws
	Policy/Institutional/Social Solutions - Establish climate-smart agricultural training programs for farmers. - Implement crop insurance schemes to protect farmers against climate-related losses. - Develop mobile technology platforms for real-time agricultural advisory services. - Create agricultural extension services focused on climate change adaptation strategies. - Establish farmer field schools to demonstrate and teach climate adaptation techniques. - Create agricultural investment funds specifically targeting climate-resilient agricultural innovations. - Create village-level climate adaptation resource centers providing localized agricultural technology and knowledge transfer. - Provision of knowledge and skills to farmers - Use of improved seeds		
Livestock	Nature-based Solutions - Develop heat-tolerant livestock breeds that can withstand increasing temperatures in tropical regions. - Create drought-resistant pasture and fodder crop varieties to ensure consistent animal feed. - Introduce silvopastoral systems integrating trees and livestock for enhanced environmental resilience. - Implement rotational grazing strategies to prevent land degradation and maintain pasture health.	Silvopastoral systems integrate trees and shrubs into livestock farming, creating a more sustainable and resilient environment. This method enhances soil fertility, reduces erosion, and provides shade, reducing heat stress on animals. Additionally, trees can act as a secondary income source through timber or fruit. In Ghana's tropical regions, where climate extremes are becoming more frequent, silvopastoral systems ensure both environmental sustainability and economic benefits for farmers. Ventilated and insulated animal housing reduces the effects of heat stress on livestock. With better cooling systems, livestock health improves, leading to higher productivity in terms of milk and meat production. In Ghana, implementing such housing designs can significantly reduce mortality rates during extreme heat periods, ensuring steady incomes for farmers and a more resilient livestock industry.	- Ghana Climate Change Policy (2013) - Livestock Development Policy and Strategy (2016-2025) - National Irrigation Policy - National Biodiversity Strategy and Action Plan (2016-2020) - Animal Health and Production Policy (2016) - Ghana Shared Growth and Development Agenda (GSGDA) - National Adaptation Plan Framework (2018) - Forestry Development Master Plan (2016-2036) - Planting for Livestock and Jobs Program



Sub-Sectors	Adaption Actions	Assessment of the impact of proposed actions	Supporting Policies/Laws
	Technological/Engineering Measures - Implement improved animal housing designs with better ventilation and cooling systems. - Develop portable shade structures for livestock during extreme heat conditions. - Develop precision livestock farming technologies using digital monitoring systems. - Implement water harvesting and efficient water management techniques for livestock farming. - Develop lightweight, breathable animal gear for temperature management.	Insurance schemes for livestock protect farmers from financial losses due to climate-related disasters, such as droughts or disease outbreaks. This ensures that farmers can recover quickly and continue operations without significant setbacks. For Ghana's farmers, many of whom depend on livestock as a primary income source, such schemes provide economic security, reduce poverty risks, and encourage investment in adaptive measures.	Sustainable Land and Water Management Project (SLWMP)
Fisheries	Nature-based Solutions - Implement marine protected areas to preserve critical fish breeding and nursery habitats. - Promote aquaculture and diversify fish species for climate resilience. - Develop climate-adaptive fish breeding programs focusing on temperature-resistant species. - Establish regional fish gene banks to preserve genetic diversity. - Create comprehensive marine ecosystem restoration strategies targeting critical coastal zones. - Develop marine biodiversity conservation strategies targeting vulnerable fish species. - Establish community-based fish breeding and restocking programs. - Enhancement of Biodiversity	Marine Protected Areas (MPAs) safeguard breeding and nursery habitats crucial for maintaining fish populations. By restricting destructive activities such as overfishing, MPAs enhance biodiversity and ensure the long-term sustainability of fish stocks. In Ghana, establishing MPAs can restore degraded ecosystems, increase fish yields, and support livelihoods in fishing-dependent communities, ultimately fostering resilience to climate variability. By focusing on breeding fish species that can tolerate temperature changes, these programs reduce vulnerability to climate impacts. For Ghana, where rising ocean temperatures threaten traditional fisheries, climate-adaptive breeding ensures the continuity of fish supplies and enhances food security. These programs also create opportunities for research collaborations and technological advancements in aquaculture. Marine monitoring systems use technology to track fish population changes and oceanographic data, allowing scientists and policymakers to make informed decisions. In Ghana, deploying these systems enables real-time data collection, ensuring proactive responses to climate-induced changes in marine ecosystems. This contributes to better fisheries management and conservation efforts. Overfishing depletes fish stocks and disrupts ecosystems. Enforcing stricter regulations ensures sustainable fishing practices, preserving biodiversity and protecting livelihoods. In Ghana, strengthened laws can mitigate illegal fishing, fostering healthier marine ecosystems and promoting long-term resilience in the fisheries sector. Community-based fisheries management empowers local communities to regulate and monitor their fishing resources. In Ghana, such programs enhance adaptive capacity, promote sustainable fishing practices, and strengthen	- Ghana National Fisheries and Aquaculture Policy (2008) - Fisheries Act, 2002 (Act 625) - National Climate Change Policy (2013) - Ghana Marine Pollution Act (2016) - Coastal Development Strategy (2013) - Ghana Biodiversity Strategy and Action Plan (2016-2020) - Fisheries Management Plan of Ghana (2015-2019) - Environmental Protection Agency Act (1994) - Ghana Aquaculture Development Plan (2012-2017) - Ghana's National Adaptation Plan Framework (2018)



Sub-Sectors	Adaption Actions	Assessment of the impact of proposed actions	Supporting Policies/Laws
	Technological/Engineering Solutions • Develop advanced marine monitoring systems to track fish population changes due to climate shifts. • Create climate-resilient aquaculture technologies for sustainable fish production. • Implement precision aquaculture technologies using satellite and drone monitoring. • Introduce advanced fish tracking and migration pattern technologies. • Develop early warning systems for marine ecosystem temperature changes. • Implement advanced coastal zone management techniques to protect marine habitats. • Develop innovative fish processing technologies that reduce post-harvest losses. • Implement sustainable fishing gear technologies that minimize environmental impact.		
	Policy/Institutional/Social Solutions • Educate communities on climate-smart fishing practices. • Strengthen regulations against overfishing and illegal fishing practices. • Establish community-based fisheries management programs to enhance local adaptive capacity. • Develop alternative livelihood training programs for fishing communities facing resource challenges. • Create digital platforms for real-time fisheries market information and climate alerts. • Create climate change adaptation training programs for fishing communities. • Create insurance schemes for fishers against climate-related economic losses. • Develop integrated coastal zone management plans addressing climate adaptation.		





7. ACTION PLAN FOR THE AGRICULTURAL SECTOR

7.1. Adaptation Actions for the Crop Sub-sector

The crop sub-sector in Ghana is a critical part of the economy, providing food, employment, and income, with staples like maize, rice, cassava, and yams, and cash crops such as cocoa and cashew being key products. However, it faces significant challenges from climate change, such as irregular rainfall, drought, and increased temperatures. Key adaptation actions include employing rainwater harvesting systems for irrigation during dry periods, encouraging the use of climate-resilient crop varieties, promoting integrated crop pest management practices, and adopting efficient irrigation systems, etc, which are highlighted in Table 8. For example, in areas like the Ashanti region, stakeholders prioritize rainwater harvesting and efficient irrigation systems to mitigate water shortages and ensure crop productivity during the dry season, while promoting pest management techniques to safeguard yields against changing climate patterns. Additionally, in Ghana, efforts are made to integrate climate-smart agriculture practices, such as agroforestry and crop diversification, to enhance resilience and reduce risks associated with climate variability



Table 8: Adaptation Actions for the Crop Sub-sector

Adaptation Actions	Objectives	Action steps	Indicators of Success	Time frame	Resources	Lead	Implementing partners	Estimated cost
Ensure women's legal rights to land ownership for climate-resilient farming.	Improve women's access to and availability of land across the country for effective climate change adaptation	Mobilize the local community to develop and incorporate gender in their traditional/customary guidelines to enable women and vulnerable groups to use and own land and invest in its development.	Gender issues incorporated into customary guidelines on land tenure	Medium-term	Human Finance	MoFA	MoGCSP LC EPA FAO NDPC NGOs	
		Encourage women to exercise their rights to access and control land they are entitled to	Number of rural women having access to and owning productive land					
		Encourage women to participate in decision-making on land issues in communities	Number of women participating in decision-making on land issues at the local community					
Train female extension officers to provide climate-smart farming advice.	Improve access to extension services for women in agriculture	Develop infrastructure that supports ICT extension services.	Number of women farmers trained in the use of ICT.	Medium-term	Human, Technology Finance	MoFA	MoGCSP NAES EPA MESTI FAO USAID NGOs	
		Increase farmers' access to ICT extension services.	Number of women having access to ICT extension services (radio, TV, mobile phones, Internet applications).					
		Recruit more women extension officers.	Number of women extension officers recruited and maintained.					
		Provide adequate funding for extension services to target women in the delivery of information, training and input allocations.	Percentage of funds allocated to extension services at the operational levels.					



Adaptation Actions	Objectives	Action steps	Indicators of Success	Time frame	Resources	Lead	Implementing partners	Estimated cost
		Provide community climate information centers to disseminate climate information to both male and female rural farmers.	Number of community climate information centers disseminating climate information					
		Strengthen FBO coordination to provide market linkage for its members, especially vulnerable male and female farmers.	Improved market linkages provided by FBOs to male and female farmers					
Promote women's leadership roles in agricultural decision-making bodies.	Increase women's participation in decision-making and implementation of agricultural programs and projects	Raise awareness on sustainable conservation and management of natural resources to influence decision-making at all levels.	Increase in the adoption of sustainable practices by communities, organizations, or businesses.	Medium-term	Human Technology Finance	MoFA	MoGCSP NDPC MoFA MESTI NGOs Private sector	
		Build women's capacities in communication, leadership, and entrepreneurship skills.	Increase in the number of women participating in leadership roles, starting businesses, or leading community initiatives.					
		Advocate for support to increase women's participation (40%) in decision-making positions at local levels.	Increase in the percentage of women holding decision-making positions at local levels, reaching 40%.					
		Raise awareness on sustainable conservation and management of natural resources to influence decision-making at all levels.	Increase in the number of policies or practices adopted that promote sustainable conservation and natural resource management.					



Adaptation Actions	Objectives	Action steps	Indicators of Success	Time frame	Resources	Lead	Implementing partners	Estimated cost
Integrate gender considerations into the planning and budgeting processes of government and NGO projects.	Ensure that gender-equality-related issues are factored into programmes, projects, plans and budgets of governmental agencies and NGOs	Assess policies, programmes and projects on climate change from a gender perspective.	Availability of revised policies, programmes and projects on climate change from a gendered perspective.	Medium-term	Technology, Finance, Human	FAO	MoGCSP	
		Develop a training protocol on gender issues regarding climate change for the agricultural sector.	Training protocol on climate change and gender issues available for use.				MoF EPA NDPC UN women MoFA NGOs	
		Conduct research and training on gender, agriculture, and climate change.	Number of studies and training conducted on gender, agriculture and climate change					
Employ rainwater harvesting systems for irrigation during dry periods.	Enhance water availability for irrigation during dry periods, ensuring sustainable agricultural production amidst climate change impacts	Install rainwater harvesting systems to capture water during rainy seasons for use during dry spells.	Increase in water availability during dry spells, compared to previous years without rainwater harvesting	Medium-term	Technology, Finance, Human	MoFA	CSIR GASIP FAO GIDA NDPC	
		Use stored rainwater efficiently to maintain soil moisture and support crop growth during dry periods.	Improved soil moisture content, as the stored water is being used effectively to maintain suitable moisture for crops					
		Implement irrigation systems and drought-resistant crops to maintain crop yields during dry spells.	Level of crop yield during drought or dry spells					



Adaptation Actions	Objectives	Action steps	Indicators of Success	Time frame	Resources	Lead	Implementing partners	Estimated cost
Promote the adoption of drought- and pest-resistant crop varieties	Encourage the use of crop varieties that are resistant to pests and diseases to increase agricultural resilience, thereby enhancing food security and reducing reliance on chemical inputs.	Introduce training programs on pest management and distribute resistant crop varieties to minimize crop damage and losses.	Decrease of crop damage or losses caused by pests and diseases after adopting resistant varieties	Short-term	Finance, Human, Technology	MoFA	EPA CSIR MESTI GASIP FAO	
		Conduct field demonstrations and trials with farmers to showcase the improved yields of resistant varieties compared to traditional ones under pest and disease pressure.	Stable crop yields with resistant varieties compared to traditional varieties, indicating resilience to pest and disease pressures					
		Distribute pest-resistant seed varieties to farmers through government programs or local cooperatives, accompanied by hands-on training on their use and benefits in reducing pesticide reliance.	Lower pesticide application rates due to natural resistance,					



Adaptation Actions	Objectives	Action steps	Indicators of Success	Time frame	Resources	Lead	Implementing partners	Estimated cost
Promoting integrated crop pest management practices	Enhance agricultural sustainability and resilience by promoting Integrated Pest Management (IPM) practices that reduce reliance on chemical pesticides and minimize environmental and health impacts.	Monitor pest populations regularly through field surveys and implement biological control methods to manage pest levels.	Levels of pest population	Medium-term	Finance, Human, Technology	FAO	GASIP NADMO NDPC MoFA MESTI CSIR	
		Organize workshops and distribute resources on the benefits and application of natural pest predators and biocontrol agents like neem oil to farmers.	Increase in the use of natural pest predators (e.g., beneficial insects, birds) or biocontrol agents (e.g., neem oil, microbial pesticides) by farmers					
		Organize and promote IPM training programs and workshops through local agricultural extension services to increase farmer participation.	Number of farmers attending IPM training programs or workshops					
		Provide farmers with access to quality seeds, proper farming techniques, and regular training to improve crop quality and yield.	Increase in the quality and yield of crops					



Adaptation Actions	Objectives	Action steps	Indicators of Success	Time frame	Resources	Lead	Implementing partners	Estimated cost
Livelihood diversification	Enhance the resilience of farming communities by encouraging the diversification of income sources, reducing vulnerability to climate-related shocks, and ensuring economic stability	Provide timely and accessible weather forecasts and climate data to farmers through mobile platforms, workshops, and extension services.	The number of farmers who report using weather forecasts and climate data to make critical decisions regarding crop management.	Short-term	Finance, Human, Technology	MoFA	GMet	
		Support farmers with access to high-quality seeds, fertilizers, and modern farming techniques to boost crop yields	Percentage of crop yields and overall productivity				MESTI GASIP NADMO NDPC ACMAD NGOs FAO	
		Conduct community-based training sessions and distribute educational materials to improve farmers' understanding of weather and climate patterns.	Number of farmers understanding and aware of weather and climate patterns					



Adaptation Actions	Objectives	Action steps	Indicators of Success	Time frame	Resources	Lead	Implementing partners	Estimated cost
Planting of drought-resistant varieties of crops	Enhance agricultural resilience and ensure food security.	Introduce drought-tolerant crop varieties and train farmers on water management techniques to maintain consistent crop yields.	Consistent or increased crop yields despite varying rainfall patterns and drought conditions.	Medium-term	Technology, Human, Finance	MoFA	EPA FAO UNDP Research Institutions (e.g., KNUST) Private Sector	
		Provide subsidies and demonstration farms to encourage the adoption of drought-resistant crop varieties among local farmers.	High rates of adoption of drought-resistant crop varieties among local farmers.					
		Facilitate access to drought-resistant seeds and irrigation technologies to ensure reliable crop yields and stabilize farmers' incomes	More stable and potentially increased incomes for farmers due to reliable crop yields.					
		Promote the use of affordable, water-efficient irrigation systems like drip irrigation and provide training on cost-effective water management practices.	Reduced costs associated with irrigation and other water management practices.					
		Establish farmer cooperatives to negotiate better market access and create dedicated supply chains for drought-resistant crops to connect farmers directly with buyers.	Improved access to markets for drought-resistant crops, potentially leading to better prices and higher income for farmers.					



Adaptation Actions	Objectives	Action steps	Indicators of Success	Time frame	Resources	Lead	Implementing partners	Estimated cost
Adjustment of farming schedules to align with changing climate patterns	Ensures that crops are planted and harvested at the most optimal times, maximizing yields and reducing the risk of crop failure	Provide training and access to accurate climate forecasts, enabling farmers to adjust their planting and harvesting schedules for optimal crop growth.	The percentage of farmers adjusting their planting and harvesting schedules in response to climate forecasts, ensuring optimal crop growth periods	Long-term	Finance, Technology, Human	MoFA	MoFA GMet NGOs Research Institutions Farmer Associations Development Partners	
		Implement training on climate-smart farming techniques to help farmers align planting schedules with favorable climate conditions for improved crop yields.	Improvements in crop yields as a result of better alignment with favorable climate conditions					
Promotion of vertical gardening techniques	By utilizing vertical spaces, urban farmers can grow more crops in smaller areas, which is crucial in densely populated regions.	Set up monitoring systems to track harvest quantities per square meter and provide guidance on optimizing vertical gardening techniques	Measuring the amount of produce harvested per square meter to ensure that vertical gardening is enhancing productivity.	Medium-term	Finance, Technology, Human	MoFA	Local Government Agencies NGOs Educational Institutions Private Sector Community Groups	
		Conduct assessments and pilot projects in urban areas to demonstrate and optimize the use of available spaces for agriculture, such as rooftops and vacant lots.	Assessing the effective use of urban spaces for agriculture, particularly in areas where traditional farming is not feasible.					



Adaptation Actions	Objectives	Action steps	Indicators of Success	Time frame	Resources	Lead	Implementing partners	Estimated cost
Encourage the use of crop varieties	Encourage the use of crop varieties that are resistant to pests and diseases to increase agricultural resilience, thereby enhancing food security and reducing reliance on chemical inputs.	Organize training sessions and distribute mulching materials to encourage farmers to consistently apply mulching techniques	Percentage of farmers who consistently apply mulching techniques on their farms	Short-term	Finance, Technology, Human	MoFA	EPA	
		Conduct field trials and provide guidance on mulching techniques to farmers, monitoring soil moisture levels in mulched areas during dry spells	Measurable increase in soil moisture levels in mulched areas, particularly during dry spell				CSIR	
		Promote mulching practices through workshops and provide farmers with materials, while monitoring soil erosion rates on farms using mulching techniques.	Decrease in soil erosion rates on farms using mulching				MESTI	
							FAO	
							NGOs	



Adaptation Actions	Objectives	Action steps	Indicators of Success	Time frame	Resources	Lead	Implementing partners	Estimated cost
Crop diversification	Enhance the resilience of agricultural systems to climate change and other environmental stresses.	Offer training and financial support to smallholder farmers to encourage the adoption of diversified cropping systems, and track adoption rates compared to previous practices.	Percentage of smallholder farmers adopting diversified cropping systems compared to previous farming practices.	Short-term	Finance, Technology, Human	MoFA	CSIR FAO NDPC MESTI NGOs	
		Implement regular monitoring and data collection on crop yields and income levels from diversified crops to assess the effectiveness of the cropping systems.	Measurement of crop yields and income levels from diversified crops					
		Provide farmers with drought-resistant varieties, flood management techniques, and pest control training	Decrease in crop losses due to droughts, floods, or pests, demonstrating improved resilience					



Adaptation Actions	Objectives	Action steps	Indicators of Success	Time frame	Resources	Lead	Implementing partners	Estimated cost
Use of improved seeds	Enhance agricultural productivity and resilience to climate change by promoting the use of improved seeds among smallholder farmers, thereby improving crop yields.	Distribute high-quality seed varieties through government or NGO programs and provide training on their benefits to increase adoption among farmers.	Percentage of farmers in adopting improved seed varieties	Short-term	Finance, Technology, Human	MoFA	NGOs MESTI NASTAG GADB FAO GIDA	
		Conduct field demonstrations and offer technical support to farmers using improved seed varieties,	Measurable increase in crop yields for farmers using improved seeds					
		Provide farmers with access to advanced farming techniques, quality inputs, and market linkages	Increase in farm productivity and income					
		Offer ongoing support and training to farmers using improved seeds, including pest management and climate-adaptive practices,	Reduction in crop losses for farmers using improved seeds					
		Facilitate access to affordable improved seeds through subsidies or credit schemes and promote their benefits through farmer outreach programs.	Number of farmers investing in improved seeds					



Adaptation Actions	Objectives	Action steps	Indicators of Success	Time frame	Resources	Lead	Implementing partners	Estimated cost
Use of climate-smart agricultural practices	Enhance the resilience of smallholder farmers to climate change. This involves several key goals including sustainably increasing agricultural productivity and incomes, building resilience to climate change, and reducing greenhouse gas emissions.	Provide training and incentives to encourage farmers to adopt climate-smart agricultural practices, and track adoption rates through extension services.	Percentage of farmers adopting at least one climate-smart agricultural practice	Medium-term	Finance, Technology, Human	MoFA	NGOs MESTI MLGDRD FAO EPA GIDA	
		Conduct demonstration projects showcasing climate-smart practices, providing farmers with data on crop yield improvements and productivity gains.	Measurable increase in crop yields and productivity for farmers using climate-smart practices					
		Promote the use of organic fertilizers, crop rotation, and cover crops through training program	Improvement in soil fertility					
Promotion of farming practices to restore degraded ecosystems	Restore degraded ecosystems including enhancing agricultural productivity, increasing resilience, restoring ecosystems, and mitigating climate change.	Implement conservation agriculture practices, such as mulching and cover cropping, and provide training to farmers on improving soil organic matter and reducing erosion	Increased soil organic matter, reduced soil erosion, and improved soil fertility.	Medium-term	Finance, Technology, Human	MoFA	International Organizations (e.g., FAO, UNDP, etc.) NGOs Research Institutions Private Sector	



Adaptation Actions	Objectives	Action steps	Indicators of Success	Time frame	Resources	Lead	Implementing partners	Estimated cost
		Offer incentives and conduct training to encourage farmers to adopt sustainable agricultural practices, tracking adoption rates through local agricultural extension services.	The percentage of farmers adopting sustainable practices.					
		Provide farmers with access to consistent training on sustainable farming techniques and high-quality inputs	More stable and potentially increased crop yields over time.					
		Organize community workshops and provide resources for local participation in ecosystem restoration projects	Increased participation of local communities in ecosystem restoration projects.					
Provision of technical services to farmers	Empower farmers with the knowledge, skills, and resources needed to adapt to climate change	Implement training on climate-resilient farming techniques and provide access to drought-tolerant and pest-resistant crop varieties	Increased productivity and resilience of crops to climate variability.	Long-term	Human Technology Finance	MoFA	FAO UNDP Research Institutions (e.g., KNUST) Private Sector	
		Provide training on soil conservation techniques, such as reduced tillage, cover cropping, and organic amendments	Adoption of practices that reduce soil degradation and enhance soil fertility.					
		Organize hands-on workshops and provide educational materials to increase farmers' knowledge and application of sustainable farming practices.	Enhanced understanding and application of sustainable farming practices among farmers.					



Adaptation Actions	Objectives	Action steps	Indicators of Success	Time frame	Resources	Lead	Implementing partners	Estimated cost
		Strengthen community-based agricultural extension services by offering local training sessions and encouraging community leaders to actively participate in outreach programs	Increased involvement of local communities in agricultural extension programs.					
Implement conservation agriculture techniques	Enhance soil fertility, improve water retention, and increase crop resilience to climate change by promoting sustainable agricultural practices.	Train farmers on no-till farming, mulching, and crop rotation to improve soil organic matter and reduce erosion.	Improvement in soil organic matter and reduced soil erosion through no-till farming, mulching, and crop rotation.	Medium-term	Human Technology Finance	MoFA	FAO GASIP IFAD ADB NGOs	
		Train farmers on soil management practices like mulching and organic fertilization	Increased crop productivity and stability, particularly during dry periods, as a result of better soil management practices.					
		Promote conservation agriculture practices through demonstrations and training to encourage adoption among farmers in targeted regions.	A significant percentage of farmers adopting conservation agriculture practices in targeted regions.					



Adaptation Actions	Objectives	Action steps	Indicators of Success	Time frame	Resources	Lead	Implementing partners	Estimated cost
Implement crop insurance schemes	Provide farmers with financial protection against climate-related risks, such as droughts, floods, and pests, by offering insurance coverage that helps them recover from crop losses.	Raise awareness and provide subsidies for crop insurance to encourage farmers, especially in high-risk areas, to participate in insurance schemes.	A growing number of farmers participating in crop insurance schemes, particularly those in high-risk areas.	Long-term	Human Technology Finance	FAO	MoFA GAIP World bank ARC Insurance companies(eg., GLICO) NGOs	
		Expand access to crop insurance and educate farmers on its benefits to reduce crop loss incidences and provide financial recovery mechanisms.	Lower incidences of farmers facing total crop loss without recovery mechanisms, as insurance payouts mitigate the financial burden.					
		Offer climate adaptation training and resources, along with access to recovery funds, to help farmers bounce back quickly	Increased capacity for farmers to recover from climate-induced losses, as evidenced by faster recovery times and sustained productivity.					



7.2. Adaptation Actions for the Livestock Sub-sector

The livestock sub-sector in Ghana plays a crucial role in supporting livelihoods, providing meat, milk, and other products, as well as contributing to the national economy. However, the sector faces significant challenges from climate change, including heat stress, reduced pasture availability, and water scarcity. Adaptation actions to address these challenges include developing heat-tolerant livestock breeds to withstand increasing temperatures, creating drought-resistant pasture and fodder crop varieties to ensure a stable supply of animal feed, and introducing silvopastoral systems that integrate trees and livestock to enhance environmental resilience, etc, which are highlighted in Table 9. For instance, in the Savannah region, stakeholders prioritize drought-resistant pasture varieties to address feed shortages, while in the forest zones, stakeholders emphasize improving water management systems to ensure consistent access to drinking water for livestock during dry periods.



Table 9: Adaptation Actions for the Livestock Sub-sector

Adaptation Actions	Objectives	Action steps	Indicator for success	Time Frame	Resources	Lead	Implementing partners	Estimated cost
Training and capacity building	Provide gender-sensitive training programs that equip both men and women with skills to adapt to climate change. This includes training on sustainable livestock management practices, disease control, and efficient water use	Conduct a thorough assessment to understand the specific training needs of men and women in the livestock sub-sector. This includes identifying gaps in knowledge, skills, and resources	The number of men and women attending the training sessions. A balanced participation rate indicates that the training is accessible and appealing to both genders.	Medium-term	Technology Human Finance	MoFA	Centre for Women and Food Security-Ghana (CeWaFS-Ghana) International Livestock Research Institute (ILRI) Ghana National Learning Alliance (NLA) Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)	
		Develop a training curriculum that addresses the identified needs and incorporates gender-sensitive approaches. Ensure the content is relevant to both men and women and includes topics such as sustainable livestock practices, disease management, and efficient water use.	The extent to which participants implement the learned practices on their farms. This can be tracked through follow-up surveys or field visits.					
		Organize training sessions that are accessible to both men and women. Consider factors such as timing, location, and childcare support to ensure that women can participate fully	Pre- and post-training assessments to measure the increase in knowledge and skills related to sustainable livestock management practices among participants.					
		Train facilitators and extension officers on gender-sensitive approaches. This ensures that they can effectively deliver the training and address gender-specific challenges in livestock management.						



Adaptation Actions	Objectives	Action steps	Indicator for success	Time Frame	Resources	Lead	Implementing partners	Estimated cost
Develop heat-tolerant livestock breeds that can withstand increasing temperatures in tropical regions.	Breed livestock that can thrive in rising tropical temperatures.	Select heat-tolerant breeds, crossbreed for resilience, and ensure shaded housing with proper ventilation and hydration.	The number of heat-tolerant breeds developed	Long-term	Technology Human Finance	CSIR-Animal Research Institute	FAO, World Bank, ILRI, USAID, CGIAR.	
		Improve hydration, provide shaded shelter, select heat-tolerant breeds, and manage feeding during cooler times.	Survival rates of livestock in high temperatures.					
		Optimize nutrition, ensure proper hydration, provide stress-free environments, and manage breeding for optimal performance.	Increased productivity of heat-tolerant breeds.					
		Provide training, offer incentives, ensure access to affordable breeds, and demonstrate success through pilot programs.	Farmer adoption rates of new breeds.					



Adaptation Actions	Objectives	Action steps	Indicator for success	Time Frame	Resources	Lead	Implementing partners	Estimated cost
Create drought-resistant pasture and fodder crop varieties to ensure consistent animal feed.	Ensure consistent animal feed during drought periods	Invest in research, collaborate with agricultural institutions, prioritize local needs, and fast-track breeding programs.	The number of drought-resistant varieties developed.	Medium-term.	Finance Human Technology	CSIR-Crops Research Institute.	IFAD, FAO, World Bank, UNEP, SNV	
		Offer training, provide incentives, demonstrate success through pilot programs, and ensure access to affordable seeds.	Adoption rates among farmers.					
		Use drought-resistant varieties, optimize irrigation, improve soil management, and provide timely access to inputs.	Yield performance in dry seasons.					
		Diversify feed sources, improve forage management, store feed for dry seasons, and promote drought-tolerant crops.	Reduction in livestock feed shortages.					



Adaptation Actions	Objectives	Action steps	Indicator for success	Time Frame	Resources	Lead	Implementing partners	Estimated cost
Introduce silvopastoral systems integrating trees and livestock for enhanced environmental resilience.	Integrate trees and livestock for environmental resilience	Promote awareness, provide technical support, offer incentives, and demonstrate benefits through pilot projects.	Number of silvopastoral systems established.	Medium-term.	Human Finance Technology	MoFA	UNEP, FAO, ICRAF, GEF, SNV.	
		Implement agroforestry, use cover crops, apply organic compost, and practice contour farming	Increased soil fertility and reduced erosion.					
		Provide hands-on training, demonstrate success through local trials, offer financial incentives, and ensure access to resources and support.	Farmer adoption rates of systems.					
		Improve genetics through selective breeding, optimize nutrition, provide better healthcare, and implement stress-reducing management practices.	Enhanced livestock productivity.					
Implement rotational grazing strategies to prevent land degradation and maintain pasture health.	Prevent land degradation and improve pasture health.	Provide targeted training and resources to farmers in Bibiani on the long-term benefits of rotational grazing, highlighting its positive impact on soil fertility and livestock health to encourage adoption.	Increased in number of farmers practicing rotational grazing.	Short-term	Human Finance Technology	MoFA.	USAID, FAO, ILRI, SNV, World Bank.	



Adaptation Actions	Objectives	Action steps	Indicator for success	Time Frame	Resources	Lead	Implementing partners	Estimated cost
		Implement a soil health monitoring program in grazing areas, offering farmers regular feedback and practical guidance on organic matter management and erosion control techniques.	Improved soil quality in grazing areas.					
		Introduce a livestock management training program focusing on nutrition, breeding, and disease control, to optimize herd health and productivity.	Increased livestock productivity.					
		Establish and enforce rotational grazing schedules in partnership with local agricultural authorities, ensuring proper monitoring to prevent overgrazing in sensitive areas.	Reduction in overgrazing incidences.					
Implement improved animal housing designs with better ventilation and cooling systems.	Design structures to enhance livestock comfort and productivity.	Provide subsidies and technical support for farmers to upgrade to more sustainable and climate-resilient housing systems, such as improved animal shelters with better ventilation and waste management.	Number of housing systems upgraded.	Short-term.	Technology Human Finance	Veterinary Services Directorate.	GIZ, USAID, SNV, FAO, World Bank.	
		Install shade structures and water cooling systems in livestock areas, particularly during hot months, and train farmers on heat stress management techniques	Reduced livestock stress from heat.					



Adaptation Actions	Objectives	Action steps	Indicator for success	Time Frame	Resources	Lead	Implementing partners	Estimated cost
		Offer financial incentives and technical support for farmers to adopt upgraded systems, focusing on efficient water use, improved feeding practices, and better waste management	Increased productivity in upgraded systems.					
		Conduct surveys to gather farmer feedback on housing solutions and address concerns to improve satisfaction and effectiveness.	Farmer satisfaction with housing solutions.					



Adaptation Actions	Objectives	Action steps	Indicator for success	Time Frame	Resources	Lead	Implementing partners	Estimated cost
Develop portable shade structures for livestock during extreme heat conditions.	Provide shade solutions for extreme heat conditions	Distribute portable shade structures to farmers prioritizing high-risk areas for heat stress on livestock.	Number of portable shade structures distributed.	Short-term.	Finance Human Technology	MoFA.	UNEP, World Bank, SNV, FAO, USAID.	
		Install portable shade structures and provide cooling methods to minimize heat stress in livestock during hot periods.	Reduced heat stress among livestock.					
		Collect farmer feedback on the shade structures and make adjustments based on their experiences to enhance satisfaction.	Farmer satisfaction with structures.					
		Provide farmers with heat management training and equip them with cooling systems to improve livestock survival rates during heat waves.	Enhanced livestock survival rates during heat waves					



Adaptation Actions	Objectives	Action steps	Indicator for success	Time Frame	Resources	Lead	Implementing partners	Estimated cost
Develop precision livestock farming technologies using digital monitoring systems.	Use digital tools to monitor and manage livestock.	Conducting targeted training and awareness programs to educate farmers about the benefits and practical use of precision agriculture technologies,	Increased number of farmers adopting precision systems.	Medium-term	Technology Human Finance	CSIR-Science and Technology Policy Research Institute.	UNEP, FAO, World Bank, ILRI, SNV	
		Offer training and incentives to farmers in Bibiani to adopt <i>precision farming systems</i>	Reduction in livestock health issues.					
		Introduce targeted feeding programs and health management practices.	Increased livestock productivity.					
		Provide farmers with tools and training on resource-efficient farming techniques, such as water conservation and precision fertilization	Improved resource efficiency in farming					



Adaptation Actions	Objectives	Action steps	Indicator for success	Time Frame	Resources	Lead	Implementing partners	Estimated cost
Implement water harvesting and efficient water management techniques for livestock farming	Provide reliable water sources for livestock	Offer subsidies and technical support to farmers for installing water harvesting structures, focusing on regions with water scarcity issues.	Increased number of water harvesting structures installed.	Medium-term	Finance Human Technology	MoFA	UNEP, USAID, World Bank, FAO, SNV	
		Install additional water troughs and storage tanks in grazing areas to ensure consistent water supply for livestock,	Increased water availability for livestock.					
		Enhance water storage infrastructure and implement efficient distribution systems to minimize livestock water shortages during dry spells.	Reduction in livestock water shortages.					
		Gather farmer feedback on water solutions and make improvements based on their experiences	Farmer satisfaction with water solutions					
Develop lightweight, breathable animal gear for temperature management.	Create breathable and functional animal gear for heat stress reduction	Distribute animal gear units to farmers, ensuring timely delivery and providing training on their proper use to maximize effectiveness	Increased number of animal gear units distributed.	Short-term.	Technology Human Finance	CSIR-Animal Research Institute	FAO, GIZ, USAID, ILRI, SNV.	
		Provide farmers with upgraded shelters, proper bedding, and climate control tools	Farmer feedback on gear effectiveness.					



Adaptation Actions	Objectives	Action steps	Indicator for success	Time Frame	Resources	Lead	Implementing partners	Estimated cost
		Conduct regular surveys and interviews with farmers to assess the effectiveness of animal gear and make improvements based on their feedback.	Farmer feedback on gear effectiveness.					
		Track and promote success stories of farmers who have adopted new practices or technologies to encourage higher adoption rates.	Adoption rates among farmers.					
Establish community-based livestock insurance schemes to protect farmers against climate-related losses.	Protect farmers from climate-related losses	Provide information sessions and incentives to encourage farmers to enroll in insurance schemes, focusing on risk management and financial security.	The number of farmers enrolled in insurance schemes.	Medium-term	Finance Human Technology	National Insurance Commission	UNEP, World Bank, USAID, FAO, SNV.	
		Streamline the claims process for insurance payouts and ensure timely disbursements to farmers affected by climate-related events.	Payouts made during climate-related events.					
		Survey farmers regularly to assess their satisfaction with the insurance scheme and make adjustments based on their feedback.	Farmer satisfaction with the scheme.					
		Implement breeding programs and disease prevention strategies to enhance the resilience of livestock populations against environmental and health challenges.	Increased livestock population resilience.					



Adaptation Actions	Objectives	Action steps	Indicator for success	Time Frame	Resources	Lead	Implementing partners	Estimated cost
Train farmers in climate-adaptive livestock management techniques and best practices.	Build farmer capacity for adaptive livestock management	Organize regular training sessions for farmers, focusing on key areas like climate-smart agriculture and livestock management, to increase participation and knowledge.	Increased number of farmers trained.	Short-term	Human Finance Technology	MoFA.	FAO, USAID, SNV, ILRI, GIZ.	
		Provide hands-on demonstrations and incentives to encourage farmers to adopt climate-smart practices for better sustainability and productivity.	Adoption rates of climate-smart practices					
		Offer targeted nutrition and health programs to farmers to improve livestock management and boost productivity.	Improved livestock productivity.					
		Implement early warning systems and climate adaptation strategies to help farmers reduce losses from climate-related events.	Reduction in climate-related losses					



Adaptation Actions	Objectives	Action steps	Indicator for success	Time Frame	Resources	Lead	Implementing partners	Estimated cost
Develop mobile veterinary services with real-time disease monitoring and early warning systems.	Deliver real-time veterinary care to remote areas	Deploy additional mobile units equipped with essential resources and services to reach more farmers in remote areas.	Increased number of mobile units deployed.	Short-term	Finance Human Technology	Veterinary Services Directorate	FAO, ILRI, USAID, SNV, World Bank	
		Enhance disease surveillance and provide farmers with training on prevention and early detection to reduce livestock disease outbreaks.	Reduction in disease outbreaks.					
		Collect regular feedback from farmers and make necessary improvements to services based on their satisfaction levels and concerns.	Farmer satisfaction with services.					
		Improve veterinary care and provide better nutrition to enhance livestock health and increase survival rates.	Increased livestock survival rates					
Establish regional fodder banks to ensure consistent feed during prolonged dry seasons.	Ensure consistent livestock feed during prolonged dry seasons	Establish and promote regional fodder banks, ensuring easy access for farmers to store and distribute feed during scarcity periods.	Increased number of regional fodder banks established.	Medium-term	Human Finance Technology	MoFA.	FAO, IFAD, World Bank, USAID, SNV.	
		Monitor and track the quantity of fodder stored in regional banks annually to ensure adequate supply during peak demand seasons.	Quantity of fodder stored annually.					
		Increase access to supplemental feed and water resources during the dry season to reduce livestock mortality rates.	Reduction in livestock mortality during dry seasons.					



Adaptation Actions	Objectives	Action steps	Indicator for success	Time Frame	Resources	Lead	Implementing partners	Estimated cost
		Offer incentives and organize awareness campaigns to encourage more farmers to participate in fodder bank programs.	Increased farmer participation in fodder bank programs					
Create localized livestock disease resistance breeding programs.	Develop livestock breeds resistant to local diseases	Invest in research and breeding programs to develop and distribute more disease-resistant livestock breeds to farmers.	Increased number of disease-resistant breeds developed.	Long-term.	Human Finance Technology	CSIR-Animal Research Institute.	ILRI, FAO, USAID, World Bank, CGIAR.	
		Enhance vaccination programs and disease monitoring to reduce livestock mortality from preventable diseases.	Reduced livestock mortality from diseases.					
		Provide incentives, education, and demonstration programs to encourage farmers to adopt disease-resistant breeds for improved livestock health.	Increased farmer adoption rates of disease-resistant breeds.					
		Implement improved breeding, feeding, and health management practices to optimize livestock productivity.	Increased livestock productivity					
Develop early warning systems for climate-related livestock health risks.	Provide timely alerts on climate-related livestock health risks	Upgrade and expand early warning systems, ensuring they are fully operational and accessible to farmers for timely climate and disease alerts.	Number of operational early warning systems improved.	Medium-term	Human Finance Technology	Meteorological Agency of Ghana	UNEP, FAO, USAID, SNV, World Bank.	



Adaptation Actions	Objectives	Action steps	Indicator for success	Time Frame	Resources	Lead	Implementing partners	Estimated cost
		Promote the benefits of the alert system through awareness campaigns and offer incentives to encourage more farmers to subscribe.	Farmer subscription rates to the alert system.					
		Implement climate-resilient practices, such as improved shelter and water access, to minimize livestock losses during extreme weather events.	Reduction in climate-related livestock losses.					
		Enhance data collection methods and collaborate with experts to improve the accuracy of health risk forecasts for livestock.	Accuracy of health risk forecasts					
Establish community-based animal health worker training programs.	Train local personnel to provide animal healthcare	Provide specialized training programs and resources to increase the number of community health workers, ensuring better healthcare delivery in rural areas.	Increased number of trained community health workers.	Short-term	Human Finance Technology	Veterinary Services Directorate.	FAO, USAID, ILRI, SNV, GIZ	
		Implement mobile health units and improve communication channels to reduce response times to livestock health issues.	Reduced response times to livestock health issues.					
		Provide timely veterinary care and nutritional support to boost livestock survival rates	Increased livestock survival rates.					



Adaptation Actions	Objectives	Action steps	Indicator for success	Time Frame	Resources	Lead	Implementing partners	Estimated cost
		Gather regular farmer feedback on healthcare services and use it to make improvements, ensuring higher satisfaction.	Farmer satisfaction with local healthcare services					
Create market linkages that incentivize climate-resilient livestock production.	Connect farmers to markets that reward sustainable practices.	Promote climate-resilient livestock products through marketing campaigns and support for farmers to expand their reach.	Number of climate-resilient livestock products sold.	Medium-term	Human Finance Technology	Ghana Export Promotion Authority (GEPA).	World Bank, FAO, UNEP, SNV, USAID	
		Provide training and access to resources that enhance sustainable practices, increasing farmer incomes.	Increase in farmer incomes from sustainable practices.					
		Facilitate access to new markets by connecting farmers with buyers and improving supply chain infrastructure.	Number of farmers accessing new markets.					
		Engage the private sector by creating partnerships that enhance investment in livestock value chains.	Engagement of private sector in value chains					
Access to weather forecasts and early warnings	Provide timely weather forecasts to support decision-making	Promote the benefits of weather services through awareness campaigns and provide subsidies or incentives to encourage subscriptions.	Increased number of farmers subscribing to weather services.	Short-term	Human Finance Technology	Meteorological Agency of Ghana	UNEP, USAID, FAO, World Bank, GIZ.	



Adaptation Actions	Objectives	Action steps	Indicator for success	Time Frame	Resources	Lead	Implementing partners	Estimated cost
		Improve forecast accuracy by investing in advanced technologies and collaborating with meteorological organizations.	Accuracy of weather forecasts.					
		Regularly gather feedback from farmers to refine the quality and relevance of weather information, ensuring higher satisfaction.	Farmer satisfaction with weather information.					
		Provide climate adaptation strategies and timely alerts to reduce climate-related losses in livestock farming.	Reduced climate-related losses in livestock farming					



7.3. Adaptation Actions for the Fisheries Sub-sector

The fisheries sub-sector in Ghana is a vital source of nutrition, income, and employment, particularly in coastal and inland communities. However, it is highly vulnerable to climate change impacts such as rising sea temperatures, habitat degradation, and declining fish stocks. Key adaptation actions include implementing marine protected areas to safeguard critical breeding and nursery habitats, promoting aquaculture and diversifying fish species for enhanced climate resilience, and developing climate-adaptive fish breeding programs focusing on temperature-resistant species as highlighted in Table 10. For instance, in coastal areas, stakeholders prioritize marine protected areas to support sustainable fish populations, while in inland regions like the Ashanti region, stakeholders focus on enhancing fish storage and preservation techniques, such as improved cold storage facilities, to reduce post-harvest losses and ensure a steady supply of fish for the urban population.



Table 10: Summary of the Adaptation Actions for the Fisheries sub-Sector

Adaptation Actions	Objectives	Action steps	Indicator for success	Resources	Time Frame	Lead	Implementing partners	Estimated cost
Capacity building and training	Providing gender-sensitive training programs that equip both men and women with skills in sustainable fishing practices, fish processing, and business management. This helps ensure that both genders can effectively adapt to changing environmental conditions.	Identify the specific training needs of men and women in the fisheries sector. This involves understanding their roles, challenges, and knowledge gaps	The number of men and women attending the training sessions. A balanced participation rate indicates that the training is accessible and appealing to both genders.	Human Finance Technology	Medium-term	Ministry of Fisheries and Aquaculture Development (MoFAD)	USAID/Ghana Sustainable Fisheries Management Project (SFMP) Coastal Resources Center (CRC) at the University of Rhode Island. Hen Mpoano SNV Netherlands Development Organisation. Central and Western Fishmongers Improvement Association (CEWEFIA)	
		Create a training curriculum that addresses the identified needs and incorporates gender-sensitive approaches. Ensure the content is relevant to both men and women and covers sustainable fishing practices, fish processing, and business management	The extent to which participants implement the learned practices in their fishing activities. This can be tracked through follow-up surveys or field visits.					
		Equip trainers and extension officers with the skills to deliver gender-sensitive training. This includes understanding gender dynamics and addressing specific challenges faced by women in the fisheries sector.	Increased access to resources such as fishing gear, credit, and markets for both men and women. This can be measured through surveys and interviews.					
Implement marine protected areas to preserve critical fish breeding and nursery habitats.	Protect critical fish habitats and enhance marine biodiversity	Advocate for the establishment of more marine protected areas through policy initiatives and community engagement.	Number of marine protected areas established.	Finance Technology Human	Medium-term	MoFAD	FAO, UNEP, World Bank, GIZ, USAID.	



Adaptation Actions	Objectives	Action steps	Indicator for success	Resources	Time Frame	Lead	Implementing partners	Estimated cost
		Implement sustainable fishing practices and monitoring programs to support the growth of fish populations in protected areas.	Increased fish population in protected areas.					
		Strengthen enforcement and awareness campaigns to reduce illegal fishing activities within these protected zones.	Reduction in illegal fishing activities within protected zones					
Promote aquaculture and diversify fish species for climate resilience.	Develop aquaculture systems with diverse and resilient fish species	Provide training and financial support for aquaculture farms to diversify fish species, improving sustainability.	Increase in aquaculture farms with diverse fish species.	Finance Technology Human	Medium-term.	MoFAD	World Bank, IFAD, FAO, SNV, GIZ.	
		Promote the benefits of aquaculture and encourage its adoption to reduce pressure on wild fish stocks.	Reduced dependence on wild fish stocks.					
		Implement climate-resilient farming techniques, such as temperature-controlled environments, to enhance fish production under variable climate conditions.	Enhanced fish production under variable climate conditions					



Adaptation Actions	Objectives	Action steps	Indicator for success	Resources	Time Frame	Lead	Implementing partners	Estimated cost
Develop climate-adaptive fish breeding programs focusing on temperature-resistant species.	Breed fish species adapted to temperature variations	Invest in research and breeding programs to develop temperature-resistant fish species that can thrive in varying climate conditions.	The number of temperature-resistant fish species developed.	Finance Technology Human	Long-term.	CSIR-Water Research Institute	CGIAR, FAO, ILRI, USAID, UNEP	
		Promote the benefits of climate-adaptive fish breeds through demonstration programs and farmer incentives to increase adoption rates	Increase in adoption rates of climate-adaptive breeds.					
		Implement temperature-controlled aquaculture systems and provide training on managing extreme temperature fluctuations to enhance fish survival rates.	Enhanced fish survival rates during extreme temperatures					
Establish regional fish gene banks to preserve genetic diversity.	Preserve genetic diversity of fish species for future resilience	Establish and support the creation of fish gene banks to conserve valuable genetic resources for future breeding programs.	The number of fish gene banks established.	Human Finance Technology	Long-term	CSIR.	UNEP, FAO, CGIAR, World Bank, SNV.	



Adaptation Actions	Objectives	Action steps	Indicator for success	Resources	Time Frame	Lead	Implementing partners	Estimated cost
		Monitor and increase the quantity of genetic material stored by investing in storage facilities and preservation methods.	Quantity of genetic material stored.					
		Facilitate access to genetic resources by researchers through collaboration with scientific institutions and providing necessary infrastructure.	Increased access to genetic resources by researchers					
		Implement restoration projects focused on rehabilitating marine ecosystems, targeting key areas for ecosystem recovery.	Number of hectares of marine ecosystems restored.	Human Finance Technology	Long-term	Environmental Protection Agency (EPA).	UNEP, FAO, World Bank, GIZ, USAID	
		Monitor and track species richness in restored areas, ensuring biodiversity is restored through active management.	Increase in species richness in restored areas.					



Adaptation Actions	Objectives	Action steps	Indicator for success	Resources	Time Frame	Lead	Implementing partners	Estimated cost
		Support fish breeding programs in restored ecosystems, providing optimal conditions to enhance breeding success rates.	Enhanced fish breeding success rates.					
Develop marine biodiversity conservation strategies targeting vulnerable fish species.	Protect and conserve vulnerable fish species	Designate protected areas and enforce regulations to safeguard vulnerable fish species from overfishing and habitat destruction.	The number of vulnerable fish species protected.					
		Implement conservation strategies and monitoring programs to decrease the extinction risk of targeted species.	Decrease in extinction risk for targeted species.					
		Engage local communities through education, awareness campaigns, and participatory conservation programs to increase involvement in protecting fish species.	Increased community involvement in conservation efforts					



Adaptation Actions	Objectives	Action steps	Indicator for success	Resources	Time Frame	Lead	Implementing partners	Estimated cost
Establish community-based fish breeding and restocking programs.	Enhance local fish stocks through breeding and restocking	Establish community-based breeding programs by providing training and resources to local groups to manage sustainable fish populations.	The number of community-based breeding programs implemented.					
		Monitor and track fish population growth in restocked areas to assess the success of breeding and restocking efforts.	Increase in fish population in restocked areas.					
		Encourage community participation in fish management activities through workshops, cooperative initiatives, and shared decision-making in conservation efforts.	Community participation in fish management activities					
Enhancement of Biodiversity	Promote biodiversity in aquatic and marine ecosystems	Implement habitat restoration and conservation strategies to increase species diversity indices and promote ecosystem balance.	Increase in species diversity indices.	Human Finance Technology	Long-term	EPA.	UNEP, World Bank, FAO, WWF, GIZ.	



Adaptation Actions	Objectives	Action steps	Indicator for success	Resources	Time Frame	Lead	Implementing partners	Estimated cost
		Monitor and address key drivers of habitat degradation, such as pollution and overfishing, to protect marine ecosystems.	Reduced habitat degradation in project areas.					
		Promote sustainable practices and enforce regulations to improve the overall ecological health of marine ecosystems.	Enhanced ecological health of marine ecosystems					
Develop advanced marine monitoring systems to track fish population changes due to climate shifts.	Monitor fish populations and ecosystem changes under climate impacts.	Install and maintain operational marine monitoring systems to track environmental changes and fish populations effectively.	The number of operational marine monitoring systems.	Human Finance Technology	Medium-term	MoFAD	UNEP, FAO, SNV, World Bank, GIZ	
		Enhance data collection techniques and technology to improve the accuracy of fish population assessments.	Improved accuracy of fish population data.					
		Produce and distribute regular reports on ecosystem health trends to inform decision-making and management actions.	Regular reports on ecosystem health trends					



Adaptation Actions	Objectives	Action steps	Indicator for success	Resources	Time Frame	Lead	Implementing partners	Estimated cost
Create climate-resilient aquaculture technologies for sustainable fish production.	Promote aquaculture technologies adaptable to climate change	Promote climate-resilient technologies through training programs, incentives, and demonstrations to increase adoption rates.	Increased number of climate-resilient technologies adopted.	Human Finance Technology	Medium-term	CSIR	FAO, World Bank, USAID, IFAD, CGIAR	
		Monitor and track fish yields in climate-resilient systems, showcasing the benefits of these technologies to encourage wider use.	Increase in fish yields under climate-resilient systems.					
		Collect feedback from farmers on their experiences with new technologies and make improvements to enhance satisfaction and effectiveness.	Farmer satisfaction with new technologies					
Implement precision aquaculture technologies using satellite and drone monitoring.	Enhance aquaculture productivity and resource management through precision technologies	Encourage the adoption of satellite and drone technologies in aquaculture through training and financial support to increase usage among farms.	Number of aquaculture farms using satellite and drone technologies.	Human Finance Technology	Medium-term	MoFAD	FAO, World Bank, GIZ, SNV, UNEP	



Adaptation Actions	Objectives	Action steps	Indicator for success	Resources	Time Frame	Lead	Implementing partners	Estimated cost
		Use satellite and drone data to enhance real-time monitoring of water quality and fish health, improving management practices.	Improved monitoring of water quality and fish health.					
		Promote best practices and optimize resource use through technology, leading to increased productivity and overall resource efficiency in aquaculture.	Increased productivity and resource efficiency					
Introduce advanced fish tracking and migration pattern technologies.	Monitor and understand fish migration patterns to protect stocks	Increase the deployment of tracking devices on key species to gather data on their migration patterns and behaviors.	Number of tracking devices deployed.	Human Finance Technology	Medium-term	CSIR-Water Research Institute.	UNEP, WWF, FAO, USAID, World Bank	
		Analyze and share detailed migration reports to inform conservation efforts and improve species management.	Detailed migration reports for key species.					



Adaptation Actions	Objectives	Action steps	Indicator for success	Resources	Time Frame	Lead	Implementing partners	Estimated cost
		Use tracking data to enforce regulations and reduce overfishing of migratory species, ensuring sustainable populations	Reduction in overfishing of migratory species					
Develop early warning systems for marine ecosystem temperature changes.	Predict and mitigate the impacts of temperature changes on marine ecosystems	Upgrade early warning systems with advanced technology to improve the detection and forecasting of temperature spikes in marine environments.	Improved operational early warning systems in place.	Human Finance Technology	Short-term	Ghana Meteorological Agency (GMet)	UNEP, FAO, World Bank, GIZ, USAID	
		Ensure timely dissemination of temperature alerts to stakeholders, including fishermen and conservationists, to prepare for extreme temperature events.	Timely dissemination of temperature alerts to stakeholders.					
		Implement targeted mitigation strategies based on alerts, such as temporary protected areas, to reduce mortality rates of marine species during temperature spikes	Reduced mortality rates of marine species during temperature spikes.					



Adaptation Actions	Objectives	Action steps	Indicator for success	Resources	Time Frame	Lead	Implementing partners	Estimated cost
Implement advanced coastal zone management techniques to protect marine habitats.	Protect and restore coastal zones to enhance marine biodiversity	Implement and enforce coastal protection measures to reduce habitat degradation from pollution, overfishing, and coastal development.	Reduction in habitat degradation.	Human Finance Technology	Long-term	EPA.	UNEP, FAO, World Bank, WWF, GIZ	
		Launch coastal management initiatives focused on sustainable resource use, habitat restoration, and community involvement.	The number of coastal management initiatives implemented.					
		Monitor and promote conservation efforts to increase species diversity in coastal areas, ensuring healthier ecosystems.	Increase in species diversity in coastal areas					
Develop innovative fish processing technologies that reduce post-harvest losses.	Minimize post-harvest fish losses through modern processing techniques.	Introduce and promote efficient storage and preservation methods to reduce post-harvest losses among fish processors.	Reduction in post-harvest losses among fish processors.	Human Finance Technology	Medium-term	MoFAD	World Bank, SNV, FAO, USAID, GIZ	
		Provide training and financial support to fishers and processors to increase their income through improved processing techniques and access to better markets.	Increased income for fishers and processors.					



Adaptation Actions	Objectives	Action steps	Indicator for success	Resources	Time Frame	Lead	Implementing partners	Estimated cost
		Facilitate the adoption of innovative processing technologies by offering incentives and demonstrating the benefits of increased efficiency and product quality.	Adoption rates of innovative processing technologies.					
Implement sustainable fishing gear technologies that minimize environmental impact.	Reduce environmental harm through sustainable fishing gear.	Distribute sustainable fishing gears to fishers and provide training on their proper use to ensure widespread adoption.	The number of sustainable gears distributed to fishers.	Human Finance Technology	Medium-term	Fisheries Commission.	FAO, WWF, UNEP, USAID, SNV.	
		Monitor and report on the decline in bycatch and ecosystem damage as a result of using sustainable gear.	Decline in bycatch and ecosystem damage.					
		Promote community engagement and awareness programs to encourage adherence to sustainable fishing practices and gear usage.	Community adherence to using sustainable gear					



Adaptation Actions	Objectives	Action steps	Indicator for success	Resources	Time Frame	Lead	Implementing partners	Estimated cost
Educate communities on climate-smart fishing practices.	Build community capacity for sustainable fishing in changing climates.	Provide comprehensive training programs to fishers on climate-smart fishing practices, focusing on sustainability and adaptation strategies.	The number of fishers trained in climate-smart practices.	Human Finance Technology			GIZ, SNV, USAID, FAO, World Bank	
		Encourage the adoption of sustainable fishing methods through incentives and community-based programs to increase participation.	Increase in sustainable fishing activities.		Short-term.	MoFAD.		
		Monitor and evaluate the reduction in environmental impact by assessing water quality, fish stocks, and ecosystem health after implementing sustainable practices.						
Strengthen regulations against overfishing and illegal fishing practices.	Enhance enforcement of sustainable fishing laws.	Strengthen enforcement mechanisms and increase the prosecution of illegal fishing activities to deter unlawful practices.	The number of illegal fishing activities prosecuted.	Finance Human Technology	Short-term	Fisheries Commission.	UNEP, FAO, WWF, USAID, SNV	
		Implement effective monitoring and reporting systems to track overfishing incidents and reduce their occurrence.	Decline in overfishing incidents.					



Adaptation Actions	Objectives	Action steps	Indicator for success	Resources	Time Frame	Lead	Implementing partners	Estimated cost
		Educate fishers on regulations and provide incentives for compliance to improve overall adherence to sustainable fishing practices.	Improved compliance with regulations among fishers.					
Monitor water quality and implement pollution control measures.	Ensure safe drinking water and recreational water quality by monitoring and mitigating pollutants that pose health risks.	Conduct engaging and accessible training sessions, ensuring over 80% participation by addressing local fishers' needs and schedules.	High participation (over 80%) in training sessions on climate-smart fishing.	Finance Human Technology	Medium-term	EPA/Ministry of Fisheries and Aquaculture Development (MoFAD)	Ghana Standards Authority, Local Governments, UNEP, World Bank, FAO, USAID	
		Promote resilient fishing techniques through hands-on demonstrations and follow-up support to ensure adoption	Resilient fishing techniques among local fishers.					
		Enforce strict penalties and raise awareness to eliminate unsustainable practices like dynamite fishing, focusing on long-term ecosystem health.	Reduction in unsustainable fishing practices like dynamite fishing.					



Adaptation Actions	Objectives	Action steps	Indicator for success	Resources	Time Frame	Lead	Implementing partners	Estimated cost
Develop artificial reefs and habitat structures	Restore and enhance marine biodiversity by providing habitats for fish and other marine species, improving ecosystem resilience against climate impacts.	Install artificial reefs strategically to support marine life and increase fish populations and species diversity.	Increased fish populations and species diversity around artificial reefs.	Finance Human Technology	Long-term	MoFAD	Coastal Development Authority, Local NGOs, Fisherfolk Associations, Traditional Authorities, UNEP, FAO, WWF, Global Coral Reef Alliance	
		Strengthen initiatives to protect and restore surrounding marine habitats, ensuring long-term ecological balance.	Enhanced protection and restoration of marine habitats.					
		Engage with local fishing communities to gather positive feedback on improved fish catches and adapt strategies based on their experiences.	Positive feedback from local fishing communities on improved fish catches.					





8. POLICY AND INSTITUTIONAL FRAMEWORK FOR THE AGRICULTURAL SECTOR

8.1. Policy Framework for the Agricultural Sector

There is a broad legal and policy framework for climate change issues in Ghana. As a signatory to the UNFCCC, Ghana has taken several steps in addressing the socio-economic impacts and the development challenges arising from climate change. The development of the action plan for the agricultural sector is premised on existing national policies relating to climate change and agricultural development in Ghana. These policies include the National Climate Change Policy (NCCP) (MESTI, 2013), the National Climate Change Adaptation Strategy (NCCAS) (2012), Ghana's Revised Nationally Determined Contributions (NDCs) (2021), National Adaptation Plan (NAP) Framework (2018), Climate Change Master Plan (2015), National Climate Change and Green Economy Learning Strategy (2016). We also reviewed non-governmental organizations with an interest in agricultural development issues in the country.

Ghana's National Climate Change Policy (NCCP) provides an integrated response to the challenges of climate change. The NCCP seeks "to ensure a climate resilient and climate compatible economy while achieving sustainable development through equitable low carbon economic growth for Ghana". The NCCP (2013) seeks to mainstream climate change into policies and sectoral activities for sustainable growth. Additionally, the Nationally Determined Contributions (NDCs) provide further policy framework for the climate change issues in Ghana. The country has also developed a Climate Change Adaptation Strategy (2012) and has instituted several programs and actions to achieve the Sustainable Development Goals and the Sendai Framework (on disaster risk

reduction). There are several legal and policy frameworks in place to support the successful implementation of Ghana's agricultural sector adaptation plan or action. Some of the key ones are shown in Table 11.



Table 11: Policy Framework for the Agricultural Sector in Ghana

Year	Policy	Aim of the Policy	Reference to Climate Change	Reference to Adaptation	Reference to Agriculture	Reference to Gender
2013	Ghana National Climate Change Policy (NCCP)	Provides strategic direction and coordinates climate change issues in Ghana, including adaptation, mitigation, and social development.	The policy acknowledges the broad impact of climate change on various sectors, including agriculture, water resources, health, and coastal zones, and calls for mitigation and adaptation measures to address these challenges	The policy recognizes that agriculture is highly vulnerable to climate change due to its dependence on weather patterns and emphasizes the need for climate-resilient agricultural practices.	The policy stresses the importance of enhancing resilience to climate change by developing adaptive strategies in vulnerable sectors like agriculture, water, and health.	It calls for the inclusion of gender-sensitive approaches in climate change adaptation strategies, ensuring that both men and women benefit equally from climate action.
2015	Ghana Nationally Determined Contributions (NDCs)	Outline Ghana's commitments and priorities for reducing greenhouse gas emissions and enhancing resilience to climate change impacts.	The NDCs outline Ghana's commitment to reducing greenhouse gas emissions and enhancing climate resilience through both mitigation and adaptation strategies.	The NDCs emphasize the importance of adaptation, particularly in vulnerable sectors such as agriculture, water resources, and coastal zones.	Agriculture is a key sector in Ghana's NDCs, with measures to promote climate-smart agriculture and improve food security.	The NDCs recognize the need to incorporate gender-sensitive approaches in climate action, acknowledging that women are disproportionately affected by climate change, particularly in agriculture and rural areas.
2021	Ghana Adaptation Communication (ADCOM)	Communicates Ghana's adaptation actions, needs, plans, and support to the United Nations Framework Convention on Climate Change (UNFCCC).	It outlines Ghana's efforts to address climate change impacts through adaptation strategies to enhance resilience across sectors.	It details Ghana's adaptation priorities, focusing on enhancing resilience in key sectors such as agriculture, water, and health.	The ADCOM highlights the vulnerability of agriculture to climate change and emphasizes the need for climate-resilient agricultural practices.	The ADCOM acknowledges the gender dimensions of climate change, calling for gender-responsive adaptation measures.



1994	National Development Planning Commission Act, 1994 (Act 479)	Establishes the National Development and Planning Commission (NDPC) as the central agency for planning and coordinating Ghana's development agenda, including climate change adaptation	The Act does not directly address climate change but emphasizes sustainable development, which includes managing environmental impacts.	While not specifically focused on adaptation, the Act supports long-term planning for resilience in vulnerable sectors like agriculture and water resources.	The Act highlights agriculture as a key sector in national development, promoting strategies for growth and sustainability.	The Act does not explicitly mention gender, but it supports inclusive development, which can incorporate gender considerations in planning
1994	Environmental Protection Agency Act, 1994 (Act 490)	Establishes the Environmental Protection Agency (EPA) as the environmental management and protection regulatory body, including climate change adaptation.	The Act emphasizes environmental protection and sustainable development, indirectly supporting climate change mitigation and adaptation efforts.	The Act provides a framework for addressing environmental issues, which includes promoting adaptation to environmental changes, such as those caused by climate change.	It addresses agriculture in the context of managing environmental impacts, ensuring that agricultural practices align with sustainable environmental standards.	The Act does not explicitly mention gender but supports policies that can incorporate gender-sensitive approaches to environmental management and protection.
2015	National Climate Change Master Plan	Provides a comprehensive and strategic approach to address the challenges and opportunities of climate change in Ghana, including adaptation, mitigation, and social development.	The Master Plan outlines comprehensive strategies for both mitigation and adaptation to address climate change impacts across sectors.	The plan prioritizes adaptation strategies, focusing on building resilience in key sectors such as agriculture, water, and health.	It identifies agriculture as a vulnerable sector and promotes climate-smart agriculture practices to enhance resilience and food security.	It acknowledges the importance of gender-sensitive approaches in climate change adaptation, ensuring that women's needs and roles are considered in climate action.



2012	National Climate Change Adaptation Strategy	Provides a comprehensive and strategic approach to reduce the vulnerability of key sectors, regions, and districts to climate change, and to enhance the adaptive capacity and resilience of the society and ecosystems.	The strategy focuses on addressing the impacts of climate change and enhancing national resilience through adaptation measures	The strategy outlines specific adaptation measures to reduce vulnerabilities and enhance resilience in vulnerable sectors like agriculture, water, and health.	It highlights agriculture as a priority sector for adaptation, promoting climate-resilient agricultural practices.	It emphasizes the need for gender-responsive adaptation actions, recognizing that climate change affects men and women differently, particularly in rural areas.
2016	National Climate Change and Green Economy Learning Strategy	Seeks to promote awareness creation and help build national capacity to implement Ghana's Intended Nationally Determined Contribution (INDC) under the Paris Agreement.	The strategy focuses on building capacity to address climate change through education, awareness, and training on climate action.	The strategy promotes learning and capacity-building in adaptation to climate change, targeting vulnerable sectors like agriculture and water.	It emphasizes the importance of integrating climate change considerations into agricultural practices for sustainable development.	It calls for the inclusion of gender perspectives in climate change education and green economy initiatives to ensure equal opportunities for both men and women.
2015	National Gender Policy	Aims to mainstream gender concerns in the national development process, including the agriculture sector.	The policy emphasizes the need for gender-responsive approaches to climate change, recognizing its disproportionate impact on women.	The policy supports integrating gender considerations into adaptation strategies to ensure that both women and men benefit equally from climate change actions.	It highlights the role of women in agriculture and promotes gender equality in agricultural development and decision-making.	The primary focus of the policy is to promote gender equality across all sectors, addressing issues like access to resources, decision-making, and opportunities for women.



2007	National Food and Agriculture Sector Development Policy (FASDEP II) (2007)	Promotes sustainable agricultural growth for food security and poverty reduction	The policy recognizes the impact of climate change on agriculture and emphasizes the need for climate-resilient agricultural practices	FASDEP II promotes adaptation strategies for agriculture, particularly to address climate change challenges and ensure long-term sustainability.	It focuses on enhancing agricultural productivity, food security, and sustainable agricultural development in Ghana.	The policy acknowledges the important role of women in agriculture and aims to enhance gender equality in agricultural development and access to resources.
2012	National Forest Policy	Promotes the sustainable management and utilization of forest and wildlife resources for socio-economic development.	The policy highlights the role of forests in mitigating climate change and promoting resilience through carbon sequestration and ecosystem services.	The policy promotes the conservation and sustainable management of forests as an adaptation strategy to climate change, helping to protect vulnerable communities.	It recognizes the interlinkages between forestry and agriculture, advocating for sustainable land management practices that benefit both sectors.	The policy calls for gender-sensitive approaches in forest management, ensuring that women have equal access to forest resources and decision-making processes.
1999	National Land Policy	Ensures sustainable land use and management for socio-economic development and environmental protection.	The policy does not directly address climate change but focuses on sustainable land management, which indirectly supports climate resilience.	The policy supports land-use planning and management strategies that can help communities adapt to environmental changes, including those caused by climate change.	It emphasizes the importance of land for agricultural development, promoting secure land tenure and sustainable land use practices to support food security.	The policy recognizes the need for gender equity in land ownership and access, promoting women's rights to land and participation in land management decisions.
1996	District Medium-Term Development Plans	Provides a framework for integrating local development priorities into national development strategies.	The plans do not directly address climate change but focus on sustainable development, which may include environmental considerations.	While not explicitly focused on adaptation, the plans promote strategies for improving agricultural productivity and managing local environmental challenges.	The plans emphasize agricultural development as a key driver for economic growth and poverty reduction in rural areas.	The plans encourage gender-inclusive development, aiming to ensure that both men and women benefit from development projects and access to resources.



2020	Climate-Smart Agriculture Investment Plan for Ghana (CSAIP)	Supports climate-smart agriculture practices for sustainable production and adaptation in Ghana's agricultural sector.	The plan focuses on integrating climate change considerations into agricultural development to ensure resilience and sustainability.	The CSAIP prioritizes adaptation strategies, particularly to address climate change impacts on agriculture, ensuring that farmers can adapt to changing climatic conditions.	It emphasizes promoting climate-smart agricultural practices to improve productivity, food security, and climate resilience.	The plan incorporates gender-sensitive approaches, recognizing the important role of women in agriculture and aiming to ensure they have equal access to resources and opportunities.
2018	Ghana Agricultural Sector Investment Plan: Investing for Food and Jobs	Achieves agricultural transformation by increasing productivity, employment, and food security.	The plan highlights the importance of addressing climate change in agriculture through climate-resilient farming practices and sustainable agricultural development.	The plan includes adaptation strategies aimed at improving resilience to climate change, especially in vulnerable agricultural communities.	It focuses on transforming the agricultural sector to enhance food security, increase productivity, and create jobs, with a particular emphasis on smallholder farmers.	The plan recognizes the critical role of women in agriculture and promotes gender equality by ensuring women have access to agricultural resources, services, and decision-making processes.
2016	National Climate-smart Agriculture and Food Security Action Plan	Integrates climate-smart agriculture into Ghana's policies and enhances food security.	The plan focuses on integrating climate-smart agriculture to address the challenges posed by climate change on food security and agricultural productivity.	The plan outlines specific adaptation measures to improve food security and help farmers adapt to changing climatic conditions.	It emphasizes the need for sustainable agricultural practices that increase productivity while ensuring resilience to climate change.	The plan highlights the importance of incorporating gender-sensitive approaches in climate-smart agriculture to ensure equitable access to resources and opportunities for both men and women.



2018	Ghana National Adaptation Plan Framework	Integrates climate adaptation into development planning to enhance resilience in agriculture.	The framework focuses on enhancing national resilience to climate change through comprehensive adaptation strategies across various sectors.	The framework outlines specific adaptation actions to reduce vulnerability and build resilience to climate change, with a focus on sectors like agriculture, water, and health.	It prioritizes agriculture as a key sector for adaptation, aiming to improve the resilience of agricultural systems to climate impacts.	The framework emphasizes the need for gender-responsive adaptation strategies to ensure that both men and women benefit equally from climate action and have access to resources.
2015	Gender and Agriculture Development Strategy	Ensure that gender considerations are integrated into agricultural development to promote equal opportunities and empower both women and men in the agricultural sector.	Build the resilience of both women and men farmers to climate change by providing them with the necessary resources, information, and skills to adapt.	It ensures that adaptation strategies are gender-sensitive, addressing the unique needs and challenges faced by women and men farmers in adapting to climate impacts.	The strategy supports agricultural development by promoting gender equality in access to resources, technology, and decision-making processes within the agricultural sector.	It focuses on reducing gender disparities in agriculture by empowering women, improving their access to agricultural resources, and ensuring their active participation in agricultural decision-making processes.
2011	Ghana's National Adaptation Plan Framework	Enhance the development and management of irrigation systems to increase agricultural productivity, ensure water security, and improve resilience to climate change.	The policy aims to mitigate the impacts of climate change by promoting efficient water use and sustainable irrigation practices, helping farmers adapt to changing rainfall patterns.	It supports climate adaptation by ensuring that farmers, particularly in vulnerable regions, have access to irrigation systems that enable them to cope with erratic rainfall and droughts.	The policy focuses on improving agricultural productivity by expanding and maintaining irrigation infrastructure, supporting more reliable crop production.	It ensures gender equity in irrigation access, recognizing the role of women in agriculture and promoting their involvement in water management and decision-making processes.



2018	Ghana's National Adaptation Plan Framework	Guide the country's efforts in adapting to the impacts of climate change through strategic, inclusive, and sustainable measures across sectors, including agriculture and water resources.	The framework addresses the impacts of climate change by identifying priority areas for adaptation and guiding the implementation of climate-resilient strategies.	It provides a structured approach to adapting to climate change, with specific actions to enhance resilience in vulnerable sectors and communities.	The framework outlines strategies to improve agricultural resilience, promoting sustainable practices to safeguard food security in the face of climate change.	It ensures that adaptation strategies are gender-sensitive, recognizing the distinct vulnerabilities and roles of men and women in the agricultural sector and ensuring equal access to adaptation resources.
2016	National Climate Change and Green Economy Learning Strategy, 2016	Build capacity and raise awareness on climate change and green economy practices, promoting sustainable development and resilience to climate impacts across sectors.	The strategy seeks to enhance understanding of climate change issues and solutions, fostering a green economy that mitigates climate change impacts.	It supports adaptation by providing education and training on climate-resilient practices, helping communities and industries adapt to changing environmental conditions.	The strategy promotes sustainable agricultural practices as part of a green economy, supporting farmers in adopting climate-smart agricultural techniques.	It ensures gender-sensitive training and capacity-building, empowering both women and men in agricultural and climate change adaptation efforts, with a focus on equitable participation.



2018	An Agenda for Jobs: Creating Prosperity and Equal Opportunities for All	Create inclusive economic growth, reduce poverty, and provide equal job opportunities for all, with a focus on empowering vulnerable groups, including women, in various sectors, including agriculture.	The agenda supports climate-resilient economic development by promoting green jobs and sustainable practices that address the impacts of climate change.	It emphasizes the creation of jobs and opportunities that help communities adapt to climate change, particularly through climate-smart industries and practices.	The agenda fosters job creation in agriculture, encouraging sustainable practices and empowering farmers with skills and opportunities for greater productivity and resilience.	The agenda fosters job creation in agriculture, encouraging sustainable practices and empowering farmers with skills and opportunities for greater productivity and resilience.
2013	Ghana's Seed Policy	Ensure the availability, accessibility, and affordability of high-quality seeds to improve agricultural productivity and food security in Ghana.	The policy addresses climate change by promoting the use of climate-resilient seed varieties that can withstand changing environmental conditions.	It supports adaptation by encouraging the adoption of drought- and pest-resistant seed varieties that help farmers cope with climate-induced challenges.	The policy enhances agricultural productivity by ensuring farmers have access to high-quality seeds, which are critical for improving crop yields.	It ensures gender equality in seed access, recognizing that both men and women farmers need equal opportunities to access improved seeds for enhanced agricultural productivity.
2016	Ghana Livestock Development Policy and Strategy	Promote sustainable livestock farming, improve productivity, and enhance the socio-economic benefits of livestock for farmers and the broader economy.	The policy addresses climate change by promoting climate-resilient livestock management practices that reduce the vulnerability of livestock to changing weather patterns and environmental stresses.	It supports adaptation by encouraging farmers to adopt improved livestock management techniques that increase resilience to climate-related challenges like drought and diseases.	The policy enhances agricultural productivity by improving livestock health, breeding, and management practices, contributing to food security and economic development.	It promotes gender equity by ensuring both men and women have equal access to livestock resources, training, and support for improving their livestock production systems.

Source: Author's construct (2024)



8.2. Institutional Arrangements for the Implementation of the Sectoral Plan

The implementation of the Adaptation Action Plan for the Agricultural Sector is the responsibility of a range of institutions and these are identified indicating the role of each institution (Table 12).

Table 12: Institutional Arrangements for the Agricultural Sector Plan

Government Ministries and Agencies		
SN	Name of institution	Mandate
1	Ministry of Environment, Science, Technology, and Innovation (MESTI)	- Leads and coordinates the NAP process, ensuring that climate change adaptation strategies are integrated into the agricultural sector's policies and development plans. - Collaborates with key stakeholders, including the Ministry of Food and Agriculture (MOFA), to promote climate-smart agriculture practices and provide technical support to farmers for climate resilience. - Responsible for monitoring and evaluating the implementation of adaptation actions in the agricultural sector, ensuring that progress is tracked and resources are effectively allocated. - Leads in formulating climate and environmental policies and programs. - Hosts the national climate change committee to oversee the implementation of the Innovation national climate change policy. - Coordinates the regular preparation and implementation of the Nationally Determined Contribution.

2	Environmental Protection Agency (EPA)	- Implementing entity of the NAP project, which is funded by the Green Climate Fund (GCF). - Provides technical expertise and guidance on environmental impact assessments, ensuring that agricultural practices are climate-resilient and environmentally sustainable.
3	Ministry of Food and Agriculture (MoFA)	- Leads in policy formulation related to agriculture and implementation of climate-smart agriculture. - Integrates climate change adaptation strategies into agricultural policies and programs to enhance the sector's resilience. - Collaborates with other government agencies, stakeholders, and farmers to promote climate-smart agricultural practices, providing technical support and resources to enable farmers to adapt to changing climate conditions. - Responsible for monitoring and evaluating the progress of adaptation actions in agriculture, ensuring that interventions are effective, and facilitating the scaling up of successful climate-resilient agricultural practices across the country.



4	Ministry of Lands and Natural Resources (MLNR)	• Collaborates with other relevant ministries, agencies, and stakeholders, such as MESTI, MoFA, the EPA, the private sector, civil society, and local communities, to ensure the effective coordination and integration of the NAP for the agricultural sector. • Provides leadership and guidance in the management of land, forest, wildlife, and mineral resources, which are essential for the resilience and productivity of the agricultural sector. • Ensures sustainable and equitable land delivery services, which facilitates the access and tenure security of farmers, especially women and vulnerable groups.
5	Ministry of Finance (MoF)	• Facilitate the domestication of the SDGs in the country. • Prepares SDG-compliant budget including climate change. • Tracks domestic and international climate change inflows.

6	Ministry of Local Government and Rural Development (MLGRD)	• Responsible for supporting the Metropolitan, Municipal, and District Assemblies (MMDAs) to integrate climate change adaptation into their local planning and budgeting processes and to access and manage climate finance. • Enhances the capacity and coordination of the MMDAs and other local stakeholders, such as traditional authorities, civil society organizations, and community groups, to implement and monitor adaptation actions. • Facilitates the participation and empowerment of the local population, especially women, youth, and vulnerable groups, in the identification and prioritization of their adaptation needs and solutions. • Strengthens the linkages and synergies between the national and local levels of governance and fosters multi-sectoral and multi-level collaboration on climate change adaptation.
7	Ministry of Fisheries and Aquaculture Development (MoFAD)	• Ensures the sustainable management and development of fisheries resources. • Supports the growth of aquaculture to improve fish production and food security. • Enforces laws and policies to combat illegal, unreported, and unregulated fishing practices. • Provides training and resources to stakeholders to improve livelihoods in the fisheries sector.



8	Ministry of Water Resources and Sanitation (MWRS)	• Ensures sustainable use and management of water resources for agriculture. • Facilitates the development and maintenance of irrigation infrastructure. • Promotes sanitation practices to safeguard water quality for agricultural use. • Develops and enforces policies for equitable water access and conservation.
9	Ministry of Trade and Industry (MoTI)	• Supports the establishment and growth of agro-industries. • Facilitates access to domestic and international markets for agricultural products. • Promotes value addition to raw agricultural produce for economic growth. • Develops and enforces trade policies to enhance competitiveness in the agricultural sector.
10	Ministry of Gender, Children, and Social Protection (MoGCSP)	• Aligns agricultural policies with the unique needs and priorities of men and women farmers. • Addresses gender disparities in access to climate information, financial resources, and agricultural inputs under the NAP. • Provides training and support tailored to enhance the resilience of women farmers to climate impacts as outlined in the NAP. • Includes targeted interventions in the NAP to safeguard vulnerable groups, particularly women and children, against climate risks.

11	Ministry of Energy	• Incorporates renewable energy solutions into the NAP to support agricultural adaptation in rural areas. • Develops energy-efficient irrigation technologies to enhance climate resilience in farming under the NAP. • Expands energy access for smallholder farmers to improve productivity and resilience to climate change. • Facilitates the integration of clean energy technologies in agricultural practices as part of the NAP.
12	Ministry of Health	• Supports the NAP by strengthening health systems to respond to climate-induced health risks in farming communities. • Implements programs to reduce climate-related diseases that affect farmers, such as heat stress and waterborne diseases, within the NAP framework. • Ensures that the NAP includes strategies for improving the nutrition and health of agricultural communities affected by climate change. • Incorporates climate health education into the NAP to increase awareness of health risks linked to climate impacts on agriculture.
13	Department of Gender (DoG) under the Ministry of Gender, Children, and Social Protection (MoGCSP)	• Ensure that the NAP is gender-responsive and addresses the different needs, capacities, and priorities of men and women farmers • Works in collaboration with other ministries, departments, and agencies, such as MESTI, MoFA, the EPA, and the Department of Climate Change, to ensure the effective integration and coordination of gender and climate change adaptation in the agricultural sector



14	National Development and Planning Commission (NDPC)	- Ensures the integration of climate change issues into national development policy, planning, and budgeting processes. - Coordinates the preparation of sectoral and national annual progress reports, which also cover climate change issues. - Provides strategic direction and oversight for the integration of climate change adaptation into the national, sectoral, and sub-national development plans and policies. - Mobilizes and allocates resources for the implementation, monitoring, and evaluation of the NAP and its related programs and projects. - Facilitates the alignment of the NAP with the Sustainable Development Goals (SDGs), the African Union Agenda 2063, and other relevant regional and international frameworks.
15	Ghana Meteorological Agency (GMet)	- Collaborates with other relevant institutions, such as MESTI, MoFA, the EPA, and the NDPC, to ensure the coordination and integration of weather and climate services into the NAP process. - Enhances the capacity and awareness of the agricultural sector and the general public on the use and application of weather and climate services for adaptation decision-making.
Non-governmental organizations (NGOs) and Civil Society Organizations (CSOs)		
	Name of institutions	Mandate
1	CARE International	Supports the implementation of the NAP project and promotes gender-responsive and ecosystem-based adaptation approaches.

2	Oxfam	Implements community-based adaptation projects and influences national and international policies on climate change adaptation.
3	World Vision	Implements the Farmer Managed Natural Regeneration (FMNR) project to restore degraded lands and improve food security and livelihoods.
4	Environmental Protection Association of Ghana (EPAG)	Engages in advocacy, education, and research on environmental and climate change issues.
5	Ghana Civil Society Platform on Sustainable Development Goals (SDGs)	Coordinates the efforts of various CSOs to monitor and report on the progress of the SDGs, including the climate action goal.

8.3. Gender Considerations for the Agricultural Sector Adaptation Plan

The Intergovernmental Panel on Climate Change (IPCC) predicted that “climate change impacts will be differently distributed among different regions, generations, age classes, income groups, occupations and genders” (IPCC, 2001). In addition, the IPCC (2007) Assessment Report confirmed that the impacts of climate change would vary depending on gender, age, and class with the poor most likely to suffer. It further noted that because of gender inequalities, women and girls are disproportionately vulnerable. The IPCC, therefore, recognizes that gender plays a critical role in climate change and most of the key areas of the negative consequences of climate change are strongly connected to gender equality issues. Women in developing countries are mostly considered as part of the vulnerable group.

The Government of Ghana has ratified several international frameworks and protocols for the promotion of Gender Equality, Women’s Empowerment, and Social Development issues. The frameworks and protocols include the Sustainable



Development Goals (SDGs), the Millennium Development Goals (MDGs); the Universal Declaration of Human Rights; the Convention on the Elimination of all Forms of Discrimination Against Women (CEDAW); the International Covenant on Economic, Social and Cultural Rights (ICESCR); the Beijing Declaration and Platform for Action of 1995; the African Charter on Human and People's Rights (ACHPR) and the Protocol on the Rights of Women in Africa.

A gender-sensitive adaptation plan for the agricultural sector in Ghana is crucial for several reasons. For instance, women and men experience the impacts of climate change differently due to their distinct roles, responsibilities, and access to resources. Women, particularly in rural areas, often have less access to land, credit, and agricultural inputs, making them more vulnerable to climate change (Assan et al., 2018). Ensuring that women have equal access to resources such as finance, training, and technology is essential for effective adaptation. Gender-sensitive plans can help address these disparities and empower women to contribute more effectively to climate resilience. Additionally, women play a significant role in agriculture, and their empowerment can lead to increased agricultural productivity and food security (Mensah et al., 2022). By addressing gender-specific barriers, adaptation plans can enhance the overall productivity and sustainability of the agricultural sector. Furthermore, women are often underrepresented in decision-making processes at all levels. A gender-sensitive approach ensures that women's voices are heard and considered in the formulation and implementation of adaptation strategies, leading to more comprehensive and effective solutions (Adzawla et al., 2019). Additionally, addressing gender-specific social norms and practices that limit women's participation in agriculture and adaptation efforts is crucial. This includes challenging discriminatory practices and promoting gender equality in all aspects of agricultural development (Lawson et al., 2020). Lastly, integrating gender perspectives provides a more comprehensive understanding of community vulnerabilities and capacities, leading to more effective and sustainable adaptation outcomes (Wrigley-Asante & Dake, 2019).

By incorporating these considerations, Ghana can develop a more inclusive and effective adaptation plan that not only addresses the impacts of climate change but also promotes gender equality and empowers women in the agricultural sector.

8.4. Funding Arrangements for the Sector Plan

The implementation of the various actions proposed in this action plan would require significant investment by sector ministries, departments, and agencies. The relevant institutions are encouraged to integrate this action plan into their annual institutional plan of action and budget to facilitate the allocation of the Government of Ghana resources for its implementation. Furthermore, leveraging financial support from international donors, development partners, and private sector stakeholders will be critical to supplement government resources. Institutions should also explore innovative financing mechanisms such as public-private partnerships (PPPs), green bonds, and climate adaptation funds. Regular monitoring and reporting on financial allocations and expenditures will ensure transparency and build confidence among stakeholders, encouraging continued investment in the successful execution of this action plan.

8.5. Anticipated Implemented Challenges and Proposed Solutions

8.5.1. Financial and logistical support

This has always been a challenge in the implementation of most national programs and activities. The reliance on donor support for such important national assignments is not sustainable and often results in delays and incomplete implementation. To address this, the Government of Ghana should prioritize allocating dedicated budget lines for the action plan within its annual fiscal strategy. Additionally, ministries, departments, and agencies should explore innovative domestic financing mechanisms, including resource usage fees, environmental levies, and public-private



partnerships (PPPs). Leveraging international climate funds and regional development grants can also complement domestic funding.

8.5.2. Capacity building

Limited technical expertise, human resource capacity, and inadequate institutional knowledge, particularly at regional and district levels, are major impediments to the effective implementation of the action plan. To overcome these challenges, capacity-building programs must be prioritized to equip local government staff and community stakeholders with the necessary skills and knowledge. This can include tailored training programs, technical workshops, and the provision of educational resources. Collaboration with academic institutions, technical organizations, and international agencies can enhance the quality and accessibility of these training programs. Additionally, mentorship and exchange programs with more experienced institutions can facilitate knowledge transfer and improve long-term institutional capacity.

8.5.3. Government Commitments

Weak governmental commitment, often reflected in inconsistent policy enforcement, inadequate resource allocation, and shifting priorities, undermines the implementation of national action plans. To mitigate this, the Government of Ghana must demonstrate unwavering political will by embedding the action plan in broader national development strategies and ensuring it remains a priority across electoral cycles. This includes setting up clear accountability frameworks to track progress, ensuring adequate resource allocation in annual budgets, and promoting inter-ministerial coordination. Regular progress reviews at the highest levels of government and public reporting on milestones achieved can further strengthen commitment and build trust among stakeholders. Active engagement with civil society organizations and development partners

can also ensure sustained advocacy and pressure to maintain government focus on implementation efforts. Additionally, weak coordination amongst various ministries and departments mandated to address climate change risks in the agricultural sector could further weaken implementation arrangements for this important framework.

8.5.4. Weak Institutional Coordination

Weak institutional coordination is a significant challenge to the implementation of the national adaptation action plan for the agricultural sector in Ghana for several reasons. For instance, different institutions and ministries often have overlapping or unclear mandates, leading to confusion and inefficiencies. Poor communication channels between institutions can result in a lack of information sharing and collaboration. Limited financial and human resources can hinder the ability of institutions to effectively coordinate and implement adaptation strategies. Also, inconsistent policies and regulations across different sectors can create barriers to cohesive action. To curtail this challenge, several solutions are proposed. For example, clearly defining the roles and responsibilities of various institutions involved in the adaptation plan can reduce overlaps and improve efficiency. Establishing robust communication channels and regular inter-institutional meetings can facilitate better information sharing and collaboration. Investing in training and capacity building for staff in relevant institutions can improve their ability to implement and coordinate adaptation actions. Furthermore, ensuring adequate funding and resources for institutions involved in the adaptation plan can enhance their operational capabilities. Lastly, aligning policies and regulations across different sectors can create a more conducive environment for coordinated action.



8.6. Framework for Adaptation Monitoring and Evaluation

The National Development Planning Commission (NDPC) Act provides the legal basis for M&E in Ghana. This act mandates the establishment of robust M&E frameworks to ensure that development plans, including climate adaptation strategies, are effectively implemented and assessed. The act emphasizes the importance of accountability and transparency in the planning and execution of national development initiatives. The framework for Adaptation Monitoring and Evaluation (M&E) in Ghana's National Adaptation Plan (NAP) for the agricultural sector is designed to track progress, assess effectiveness, and facilitate learning to enhance climate resilience. The key components are:

• Objectives of the M&E Framework

- **Track Progress:** Monitor the implementation of adaptation actions and measure progress against set targets and indicators.
- **Evaluate Effectiveness:** Assess the impact of adaptation strategies on enhancing resilience and reducing vulnerabilities in the agricultural sector.
- **Facilitate Learning:** Provide insights and lessons learned to inform future adaptation planning and implementation.

• Key Components

- **Indicators and Metrics:** Develop specific, measurable, achievable, relevant, and time-bound (SMART) indicators to track adaptation actions. These indicators should cover various aspects such as crop yields, water usage efficiency, soil health, and farmer income levels.

- **Data Collection and Management:** Establish robust systems for collecting, managing, and analyzing data. This includes using remote sensing, field surveys, and farmer reports to gather relevant information.
- **Baseline Assessments:** Conduct baseline assessments to understand the current state of the agricultural sector and establish reference points for measuring progress.
- **Regular Reporting:** Implement a schedule for regular reporting on adaptation activities and outcomes. This ensures transparency and accountability in the adaptation process.

• Evaluation Processes

- **Periodic Evaluations:** Conduct evaluations at strategic intervals to assess the effectiveness of adaptation measures. This includes mid-term reviews and end-of-project evaluations.
- **Impact Assessments:** Perform impact assessments to determine the long-term effects of adaptation actions on agricultural productivity, food security, and livelihoods.
- **Stakeholder Feedback:** Incorporate feedback from stakeholders, including farmers, policymakers, and researchers, to refine and improve adaptation strategies.



- **Learning and Improvement**

- **Knowledge Sharing:** Facilitate the sharing of knowledge and best practices among stakeholders through workshops, seminars, and publications.
- **Adaptive Management:** Use the insights gained from M&E activities to make informed adjustments to adaptation strategies. This ensures that the plan remains responsive to changing climatic conditions and emerging challenges.
- **Capacity Building:** Strengthen the capacity of institutions and individuals involved in the M&E process through training and technical support.

- **Institutional Arrangements**

- **Coordination Mechanism:** Establish a coordination mechanism involving key institutions such as the Ministry of Environment, Science, Technology, and Innovation (MESTI), the Ministry of Food and Agriculture, and the Environmental Protection Agency (EPA) to oversee the M&E process.
- **Roles and Responsibilities:** Clearly define the roles and responsibilities of various stakeholders in the M&E framework to ensure effective implementation and accountability.

By implementing this comprehensive M&E framework, Ghana can ensure that its adaptation efforts in the agricultural sector are effective, efficient, and continuously improving, thereby enhancing the resilience of its agricultural systems to climate change.





9. CONCLUSION AND THE WAY FORWARD

Agriculture contributes significantly to Ghana's economy and employs a significant number of low-income families in Ghana. Yet, the sector is arguably the most vulnerable sector to climate change risks because of its over-dependence on rain-fed agricultural systems. This is particularly concerning in light of the existing socioeconomic conditions characterized by high levels of poverty, which will further drive vulnerability and compound existing inequalities. Gender inequality is known to make women suffer disproportionately from the adverse effects of climate change; with social, economic, and political barriers increasing women's exposure and susceptibility to the negative impacts of climate change. Consequently, a gender-responsive approach to climate change resilience within the agricultural sector is crucial to address the increased levels of vulnerability experienced by women and to empower women in the face of climate change, within the agricultural sector.

The National Adaptation Action Plan for the Agricultural Sector provides a comprehensive framework to address the adverse impacts of climate change on Ghana's agricultural sector. The document highlights the urgent need for gender-responsive and inclusive strategies to ensure equitable benefits for all stakeholders, particularly vulnerable groups. By leveraging a blend of nature-based, technological, and policy-driven adaptation measures, the plan emphasizes building climate resilience across the crop, livestock, and fisheries sub-sectors.

Through detailed risk assessments and vulnerability analyses, the plan identifies critical climate-related challenges such as erratic rainfall, prolonged droughts, and rising temperatures that threaten food security and livelihoods. The proposed adaptation actions, underpinned by robust policy frameworks and institutional

mechanisms, aim to safeguard the sustainability of Ghana's agriculture while enhancing productivity and livelihoods. The plan also recognizes the significance of stakeholder engagement and collaboration across governmental, private, and local entities to achieve its objectives effectively.

The report has highlighted key challenges in the implementation of the agricultural sector adaptation action plan for Ghana. Key among these challenges include financial and logistical support, lack of capacity, and inadequate governmental commitments in addressing climate change threats in Ghana.

The Way Forward

To ensure the successful implementation of the National Adaptation Action Plan, the following steps are recommended:

- 1. Strengthen Institutional Frameworks:** Establish clear roles and responsibilities for institutions involved in the plan's execution, ensuring effective coordination and accountability. This could prevent the duplication of efforts and address coordination challenges by ministries, units, and departments charged with addressing climate change threats in the agricultural sector.
- 2. Enhance Financial and Logistical Support:** The implementation of the various adaptation actions proposed in this action plan would require significant investment departments, units, and agencies within the agricultural sector in Ghana. These departments, units, and agencies are encouraged to integrate this action plan into their annual plan of action and budget to facilitate the allocation of Government of Ghana resources for its implementation. Further, efforts should be made to mobilize resources from government budgets, international funding agencies, and private sector investments to support the implementation of adaptation measures. There is the need to Establish strong partnerships with the

private sector, incentivized through tax reliefs and recognition programs, which can further ensure that logistical support, such as equipment, transportation, and infrastructure, is adequately addressed.

3. **Capacity Building:** Provide training and resources to stakeholders, particularly smallholder farmers, to enable them to adopt and sustain climate-resilient practices. Develop capacity building and livelihood diversification of women and marginalized groups working in agriculture to help them deal with the economic impacts of climate change.
4. **Promote Policy Integration:** The policy analysis reveals an array of policies for addressing climate change threats in the agricultural sector. This is important as it presents appropriate policy guidelines for climate change threats, yet, there are considerable challenges that require greater integration and alignment to ensure synergy and avoid duplications.
5. **Gender Mainstreaming:** Strengthen gender considerations by actively involving women and marginalized groups in decision-making processes and access to resources. There is a need to improve existing national information regarding the role of women in agriculture through the collection of sex-disaggregated data and the generation of gender statistics.
6. **Continuous Monitoring and Evaluation (M&E):** Develop and operationalize an M&E framework to track progress, identify challenges, and adapt strategies as needed to improve outcomes.
7. **Leverage Technology and Innovation:** Encourage the adoption of innovative technologies such as climate-smart agriculture and early warning systems to enhance resilience.

8. **Foster Stakeholder Collaboration:** Build partnerships among farmers, research institutions, development organizations, and policymakers to ensure a unified approach toward achieving climate resilience in agriculture.

9. **Enhanced policy framework for gender mainstreaming in the agricultural sector:** Inadequate policy framework for gender mainstreaming in climate change adaptation remains a significant challenge to food and livelihood security. While climate change disproportionately affects women, particularly in rural areas, existing policies often fail to fully address the gender-specific needs and contributions in agriculture and climate resilience. There is therefore the need to develop a comprehensive gender-responsive policy framework, that will address disparities and inequality against women, migrant farmers and the elderly.



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APPENDIX

Appendix A: Proposed adaptation options for the agricultural sector

