Climate Adaptation Plan for Bekwai Municipal Assembly: Ghana

January, 2024

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Photos: IISD

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Foreword

As climate change continues to impact local communities around the world and in Ghana, subnational governments are compelled to provide proactive leadership to develop and implement plans that respond to current and predicted future impacts of climate change.

Working in collaboration with the national government and as part of a vertically integrated adaptation planning approach, the Bekwai Municipal Assembly welcomes the Bekwai Adaptation Plan as an outcome of our collective commitment and efforts to develop the requisite knowledge as a starting point for our collective quest to build resilience against climate change impacts both now and into the future.

The Bekwai Municipal Assembly and the people of Bekwai are excited and motivated by the fact that this plan is the first of its kind for a District and Municipal Assembly in Ghana and as part of Ghana's National Adaptation Planning (NAP) process. It signals the purpose of Ghana's NAP and its unyielding mission to mainstream adaptation in local governance systems.

As leader of the Assembly, I have been part of the process from the beginning as we worked assiduously together with diverse stakeholders to establish and understand climate change impacts and the diversity of vulnerabilities we face as a Municipality.

I am personally grateful and excited. The journey has undoubtedly been insightful and fulfilling and has provided us all with good reason to work even harder together to implement the suggested adaptation measures. The Bekwai Adaptation Plan is historic; it is a science and evidence-based plan that puts the Bekwai Assembly and its different communities on the path of resilience.

Hon. Kweku Kyei Baffour

(Municipal Chief Executive)

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ACRONYMS

BMA	Bekwai Municipal Assembly
BMA VA	Bekwai Municipal Assembly's Vulnerability Assessment
CAMFED	Campaign for Female Education
CHPS	Community Health-Based Planning Services
CSA	Climate-Smart Agriculture
EPA	Environmental Protection Agency
GMet	Ghana Meteorological Agency
GHG	Greenhouse Gas
GNFS	Ghana National Fire Service
MCA	Multicriteria Analysis
M&E	Monitoring and Evaluation
MASLOC	Microfinance and Loans Centre
MEL	Monitoring, Evaluation, and Learning
MMDAs	Metropolitan, Municipal and District Assemblies
MESTI	Ministry of Environment, Science, Technology and Innovation
MoFA	Ministry of Food and Agriculture
MPCU	Municipal Planning Co-ordination Unit
NDC	Nationally Determined Contribution
NDPC	National Development Planning Commission
NGOs	Non-Governmental Organizations
NAP	National Adaptation Planning
PWDs	Persons with Disabilities
SDGs	Sustainable Development Goals
UNFCCC	United Nations Framework Convention on Climate Change
VA	Vulnerability Assessment

1. Introduction

Our climate is already changing, both globally and locally. It's affecting our weather, environment, livelihoods, health, and well-being. Unless significant local climate actions are aligned with national and global efforts, climate change will have serious and continued impacts on people and places such as the Bekwai Municipality.

Growing evidence of climate change and its associated impacts across multiple sectors in Ghana have made adaptation an urgent imperative. Ghana's National Adaptation Planning (NAP) process acknowledges this urgency and has put in place processes to build national and subnational capacity to effectively plan and implement adaptation at multiple levels. Ghana's NAP process provides the requisite organizational structure for local governance systems to make the bold efforts required to build human and institutional capacity to increase local community resilience.

The first step to effective adaptation planning is to understand current and future climate risks and vulnerabilities and use this knowledge as a basis to explore adaptation options. Such knowledge also provides deeper illumination of the nature and distribution of vulnerabilities in multiple contexts. The Municipal-specific vulnerability assessment approach is consistent with the guidance set out in Ghana's NAP Framework (Environmental Protection Agency [EPA], 2018). This approach provides opportunities for tailor-made and context-specific adaptation responses premised on sound, up-to-date knowledge.

Phase I of the vulnerability assessment process focused on profiling the socio-economic context and establishing prevailing climate change impacts in Bekwai. Phase II focused on a qualitative assessment of vulnerabilities in specific places and key climate-sensitive sectors. Phase III provided a quantitative data assessment and described Municipal-specific climate projections to facilitate understanding of current and future climate scenarios (see Box 1). The resulting Climate Change Vulnerability Assessment for the Bekwai Municipal Assembly (BMA VA) provide deep insights into the level and extent of climate change-induced vulnerabilities in the Municipality.

The assessment of various data determined that the agricultural sector is the most vulnerable to the impacts of climate change in the Bekwai Municipality, which is primarily an agricultural Municipal Assembly with the majority of residents obtaining their livelihood from subsistence farming. However, the heavy reliance on rainfall and the lack of irrigation systems have made the agricultural sector susceptible to climate variability and change. This vulnerability is also a function of other drivers, such as rising temperatures, long dry spells, and very intense precipitation events with attendant flooding events, which very often cause severe damage and disruption to farming activities and infrastructure such as access roads.

As part of Ghana's NAP process, the development of this adaptation plan was the next step in the BMA adaptation planning process. The preparation of this plan was a pilot process to apply the outcomes of the BMA VA, aiming to put the BMA on a pathway that builds resilience to climate change and enables economic and social development (see Box 1). The Bekwai process was unique at the subnational level in Ghana and provided learning and guidance to inform subsequent adaptation plan development for other subnational governments. The development of the Bekwai Adaptation Plan relied on the assembly's diverse stakeholders to turn vulnerability assessment

findings into an actionable adaptation plan that will help build adaptive capacity and resilience in key sectors and across the Municipaity.

The target audience for the adaptation plan is the BMA and the EPA, who are responsible for executing it. In addition, the plan will provide guidance to stakeholders in the Bekwai Municipality who will contribute to its implementation. It also provides a framework to guide the preparation of adaptation plans in other metropolitan, municipal, and district assemblies (MMDAs).

Box 1. Climate change vulnerability assessment for the Bekwai Municipal Assembly

Ghana's EPA, with support from the BMA, prepared a climate change vulnerability assessment for the Bekwai Municipal Assembly in 2022–2023. This included an analysis of historical and project climate, participatory risk mapping to identify vulnerable locations, and an assessment of the resilience of communities through a matrix-of-functions approach. A quantitative assessment of Municipal-level climate change vulnerability drew on a survey of 200 households to assess exposure, sensitivity, and adaptive capacity, and to calculate vulnerability scores for 23 select communities. Vulnerability scores were also calculated for five sectors: agriculture; water, health, and sanitation; forests (biodiversity and ecosystems); infrastructure and transportation; and services, trade, and finance.

The assessment of vulnerability included a review of climate change impacts to date and impacts expected in the future and identified scenarios to guide adaptation responses. Priority areas for adaptation action were identified as a first step for the BMA to move forward on the preferred pathway: "Climate change resilience is built that enables economic and social development, despite changes in climate by 2050."

Source: EPA, 2023.

Aims/Objectives

This adaptation plan aims to build on the evidence of the vulnerability assessment to increase the capacity of the BMA to manage climate-related threats both now and in the future. Consistent with the guidance of the Least Developed Countries Expert Group (2012) of the United Nations Framework Convention on Climate Change (UNFCCC), the Bekwai Adaptation Plan aims to:

- reduce vulnerability to the adverse impacts of climate change by identifying priority actions to build adaptive capacity and climate resilience;
- facilitate the integration of climate change adaptation into policies, programs, and activities of the BMA.

Expected Outcomes

The adaptation plan and accompanying evidence base, as contained in the BMA VA, will assist the Bekwai Municipality to:

- respond to material climate-related threats in a timely and appropriate manner by facilitating the identification of adaptation actions that are proportional, effective, cost-effective, measurable, and timely;
- develop business and operational plans (near and long term) based on findings from the vulnerability assessment study;

- enhance the capacity of the BMA and its staff to effectively manage the complex threats and opportunities presented by climate change;
- prepare an adaptation plan that provides carefully evaluated adaptation options with clear pathways for implementation;
- facilitate a seamless alignment of the plan with the prioritized actions in the assembly's Mid-Term Development Plans (MTDPs), both now and in the future.

Time Frame

The time frame for the implementation of BMA Adaptation Plan is 2024–2030, which is in alignment with Ghana's revised nationally determined contribution (NDC) period (2020–2030). This time frame also coincides with the next iteration of the Municipality's MTDP, 2025–2030. Such timing provides opportunities for intentional mainstreaming of the adaptation strategy into programs, policies, and activities.

Guiding Principles

Builds on Ghana's NAP Process: Ghana's NAP Framework provides the overarching roadmap for climate change adaptation planning and implementation. The NAP process has identified stakeholder institutions and agencies, such as the Ministry of Food and Agriculture (MoFA).

Is Gender Responsive: Notions of gender are socially constructed. As a result, in Ghana, much as the normative implications of gender are acknowledged and respected, gender is also conceived broadly to include women, children, youth, and persons with disabilities. These groups are recognized as being uniquely vulnerable to climate change impacts, and these unique particularities were taken into serious consideration in the plan development.

Incorporates Nature-Based Adaptation Solutions: Adaptation solutions can often be found in nature, and the use of nature-based solutions is increasingly proving to positively impact the environment and build resilience against climate change.

Is Informed by Science: It is very important that adaptation actions are informed by current and future understanding of climate change impacts. This understanding, therefore, comes from a scientific appreciation of climate vulnerabilities and the vulnerability assessment process.

Uses Traditional and Indigenous Knowledge: The plan development placed a special focus on the knowledge and experiences of local people and made conscious efforts to tap into such knowledge systems to enhance the plan, especially from the perspective of selecting adaptation options.

Adopts Participatory, Inclusive, and Local Ownership: Guided by the Ghana NAP framework, processes for both the vulnerability assessment and the development of the plan have as much as possible been participatory and inclusive to ensure that the plan is led and owned by local people.

Aligns with SDGs and National Development Goals: Adaptation projects may provide benefits to or trade-offs with the United Nations Sustainable Development Goals (SDGs) and other national development priorities. As much as possible, the adaptation planning process must aim to reduce the trade-offs, as well as complement efforts to achieve the SDGs and national development goals.

Methodological Approach

Figure 1 sets out the process used to prepare this adaptation plan. The process ensures that the climate adaptation plan remains relevant as a living plan. It incorporates different stages covering the whole decision-making process, from problem or scope definition to implementation, to monitoring, evaluation, and learning from adaptation action decisions taken. The adaptation plan was developed through a three-stage process that included a desk review, stakeholder consultation, and Municipal validation, as illustrated in Figure 1 and discussed below.

Figure 1. Adaptation plan development process

Source: Author diagram.

Adaptation Plan Development Process

Phase I included an extensive review of adaptation priorities and measures in national and sectoral climate change documents (such as Ministry of Environment, Science, Technology and Innovation [MESTI], 2013, 2015), the BMA MTDP (BMA, 2022), available academic literature, and recommendations from the Municipal-specific BMA VA. This was to ensure that the plan was premised on science and aligned with national and Municipal priorities as stipulated in the MTDP to make it context specific. The findings from the desk review were used to create a catalogue of sectoral adaptation actions.

Phase II evaluated the initial adaptation option proposals from the consultants using participatory stakeholder multicriteria analysis in specially organized workshops in the Municipality. The consultation process took place in Bekwai Municipality with four key stakeholder consultation groups that analyzed adaptation options in the following priority sectors:

- agriculture and forestry (ecosystems and biodiversity)
- water, sanitation, and health
- infrastructure and trade
- gender and marginalized groups

Each group constituted key players from the BMA's different departments, non-governmental organizations (NGOs), and the private sector, who were experts in their particular sectors. The identified stakeholders included 23 women and 41 men with longstanding experience and expertise in the specific sectors. The information from the vulnerability assessment was used to generate possible adaptation options that were presented at each of the four stakeholder consultation workshops.

The consultation groups were relatively small, ranging from 15 to 20 people and were carefully created to include the right stakeholders with the relevant knowledge and insights. The small groups were created deliberately to reduce the tendency for dominant and controlling voices of certain individuals to influence the discussions and to create an enabling group environment that allowed all to contribute with confidence.

The objectives of the stakeholder consultations were to

- explain the adaptation planning process;
- present suggested adaptation options for review, screening, evaluation, and ranking;
- solicit stakeholder views and input on the suggested adaptation options;
- discuss implementation implications and approaches.

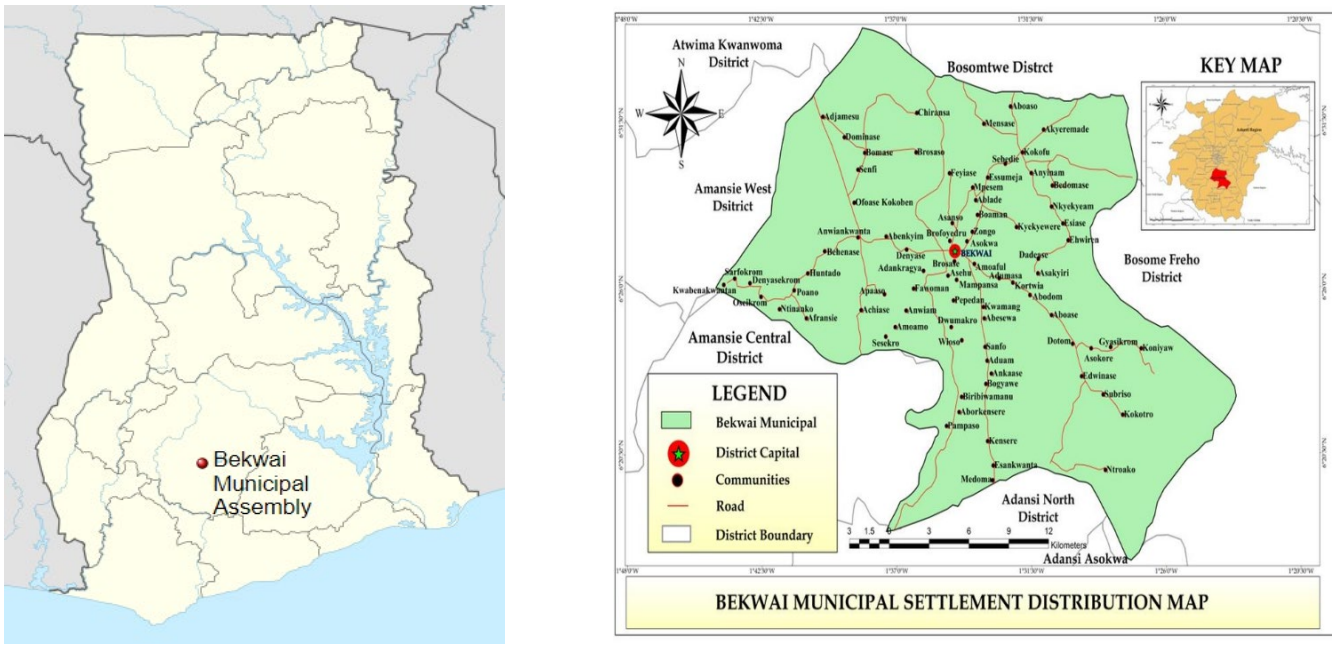
Phase III validated the adaptation plan and was carried out through a stakeholder validation workshop that brought together relevant stakeholders, consisting of 25 women and 43 men, many of whom had been consulted in Phase II to provide inputs, comments, and feedback on the draft plan. This fostered ownership of the process and plan. Stakeholder inputs were incorporated, and the final adaptation plan was produced.

This section provides a brief description of the Bekwai Municipality. The information is taken from the BMA's Municipal Profile (BMA, 2019).

Geographical Location and Size

The Bekwai Municipality is located in the southern part of the Ashanti Region within latitudes 6°00' and 6°30' north and longitudes 1°00 and 1°35 west. The boundaries of the Municipality are shared to the north with Bosomtwe District, to the South with Adansi Nort District, to the East with Bosome-Freho District, and to the West with Amansie Central District and Amansie West District. The municipality covers a total land area of 535.2 km^2, representing 2.2% of the total land area of the Ashanti Region.

Figure 2. Map of Ghana showing the location of the Bekwai Municipal Assembly



Source: Ghana map (left) from Wikipedia and Bekwai Municipal Map from Bekwai Municipal Profile.

1.2 Topography and Drainage

The Municipality lies within the forest region with an average elevation of between 150 metres and 300 metres above sea level. The topography is relatively flat with occasional undulating uplands, which rise from around 240 metres to 300 metres. The major river draining the area is the Oda River, and its tributaries (including the Dankran River) portray a dendritic pattern. The construction of small irrigation dams on the Oda and Dankran Rivers offers great potential for year-round agricultural development.

1.3 Climate

The climate in Asante Bekwai is characterized by an all-year bimodal rainy season with peaks in June and September/October. This is influenced by the north–south movement of the Inter-Tropical Convergence Zone. December and January are the driest months, with relatively low relative humidity. The Municipality is characterized by a bimodal rainfall pattern that results in major and minor cropping seasons. The major growing season spans 150 to 160 days from March to July, and the mean annual rainfall is 1,500 mm. The rainy season in March/April is associated with a high relative humidity of about 85% through to November. The mean temperature is usually about 32°C, but in 2020 and 2021, the mean temperature increased to 32.5°C. Understanding the historical and projected climate of the Asante Bekwai (see Section 3) is essential to developing any adaptation strategy since its directly linked to the people's livelihood activities.

1.4 Vegetation

The Bekwai Municipality lies within the moist semi-deciduous forest zone, whose tree species include odum, wawa, edinam, and mahogany. Chronolaena ordorata, popularly called Akyeampong shrub, is the predominant vegetative cover in many parts of the municipality. Parts of the forest have been demarcated as forest reserves (e.g., the Prampram Forest Reserve). However, ecologically incompatible agricultural and industrial activities, particularly farming and timber extraction, have reduced a considerable portion of the primary forests to secondary forests.

1.5 Soil Types

The soil types in the Municipality are the Bekwai-Oda Compound, Asikuma–Atewu-Ansum/Oda Compound, Mim-Oda Compound, Kobeda-Amuni-Bekwai Simple Association, Kumasi-Asuansi/Ntaoffin Compounds, and Juaso-Manso Asuboa Pomasua Compound Association. The predominantly loamy soils in the area support the cultivation of tree crops such as cocoa, citrus, coffee, pear, and oil palm, as well as food crops such as maize, cassava, cocoyam, and plantain. Some vegetables (e.g., garden eggs and pepper) and cereals (e.g., rice) also do well in the area. Poultry, livestock, and other ruminants are raised in the municipality along with an emerging aquaculture industry.

1.6 Demographic Profile

The demographic information of the municipality according to the 2021 Population and Housing Census (Ghana Statistical Service, 2022) is summarized in Table 1.

Table 1. Summary of Bekwai Municipality's demographics

	Number	Percentage
Gender		
Male	66,616	48.3%
Female	71,351	51.7%
Urbanization		
Rural	89,233	64.7%
Urban	48,734	35.3%
Literacy		
Literate	83,089	81.9%
Illiterate	18,336	18.1%

Source: City Population (2023), using data derived from Ghana Statistical Service, 2022.

1.7 Economic Profile

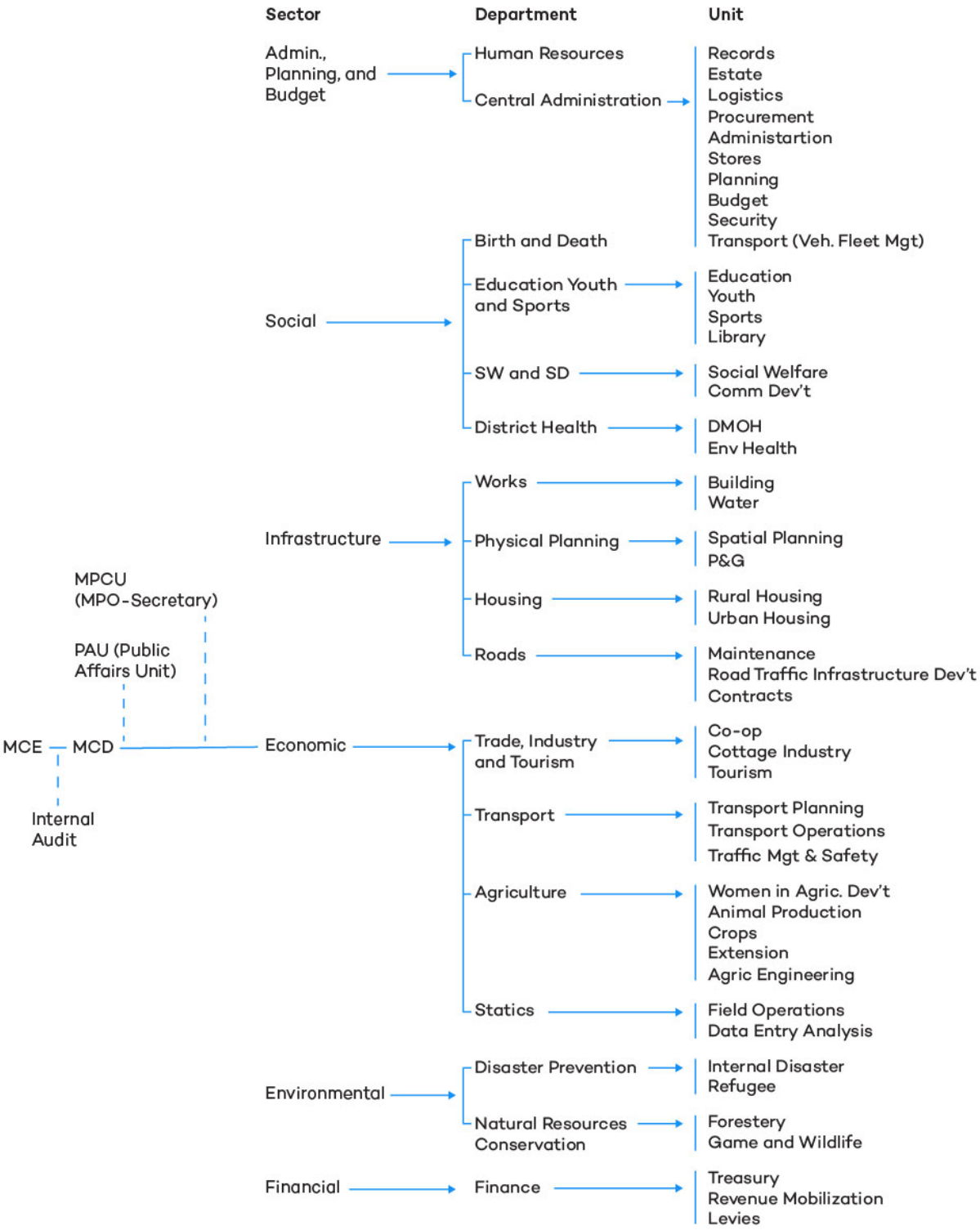
Agriculture is the largest primary production sector of the Municipality and employs about half of the population. Its importance cannot be underestimated, as it plays a key role in the socio-economic transformation of the local economy of the municipality. Agricultural production is focused in the areas of subsistence cropping, poultry, livestock, and aquaculture. The service sector employs 30% of the population (and is dominated by women), followed by the commerce (12%) and industrial sectors (8%).

2. Institutional Arrangements and Municipal-Level Adaptation Governance

2.1 Current Institutional Arrangements

The central government started promoting decentralization in 1988, and since then, District, Municipal and Metropolitan development planning has focused on addressing local issues and utilizing local resources to drive the national development agenda. According to Section 12 of the Local Governance Act, 2016 of Ghana, MMDAs are responsible for developing plans to guide local development as the political, administrative, and planning authorities at the local level. The BMA's MTDPs are strategic documents to provide guidance for all development programs and projects of the Municipality for a 3-year period. They are also the composite documents for all planned and intended activities of all departments, units, and stakeholders of the assembly. Figure 3 depicts the current governance structure of the BMA.

Figure 3. Municipal departments organogram



Source: BMA, 2019.

2.2 Relevant National/Municipal-Level Policies

The need for a national climate response has been recognized by the Government of Ghana through the enactment of the National Climate Change Adaptation Strategy (2011), the National Climate Change Policy (2013), and the National Climate Change Master Plan (2015–2020). The National Climate Change Adaptation Strategy is focused on enhancing Ghana's current and long-term development by bolstering its capacity to adapt and fortifying the resilience to climate change impacts of its communities and ecosystems. The National Climate Change Policy is the country's integrated response to climate change, and its underlying vision is "to ensure a climate-resilient and climate-compatible economy while achieving sustainable development through equitable low-carbon economic growth for Ghana" (MESTI, 2013, p. ix). Additionally, Ghana's NAP Framework provides overall guidance for the country in the coordination, development, and implementation of adaptation plans by clarifying the overarching vision and structure for the different processes (EPA, 2018).

As a member of the UNFCCC and as a signatory to the landmark Paris Agreement, Ghana submitted an updated NDC in 2021 as part of its commitment to complement global efforts to fight climate change (Government of Ghana, 2021a). The updated NDC highlighted 19 policy actions that translate into 13 adaptation and 34 mitigation programs of action. These seek to maximize the synergies between adaptation and economic diversification, resulting in mitigation co-benefits and building climate change resilience in Ghana.

Recognizing the socio-economic impacts and the development challenges arising from climate change, the Government of Ghana, through the National Development Planning Commission (NDPC), has resolved to mainstream these climate change policies into the country's development agenda and key planning processes at the national, Municipal, and local levels. The NDPC facilitates the incorporation and mainstreaming of the country's adaptation priorities into national development plans as well as the MTDPs of subnational governments, such as the Bekwai Assembly. The National Medium-Term Development Policy Framework 2022–2025 is informed by the Paris Agreement and includes a focus on climate change, including a medium-term objective to accelerate the implementation of the NAP program (Government of Ghana, 2021b)

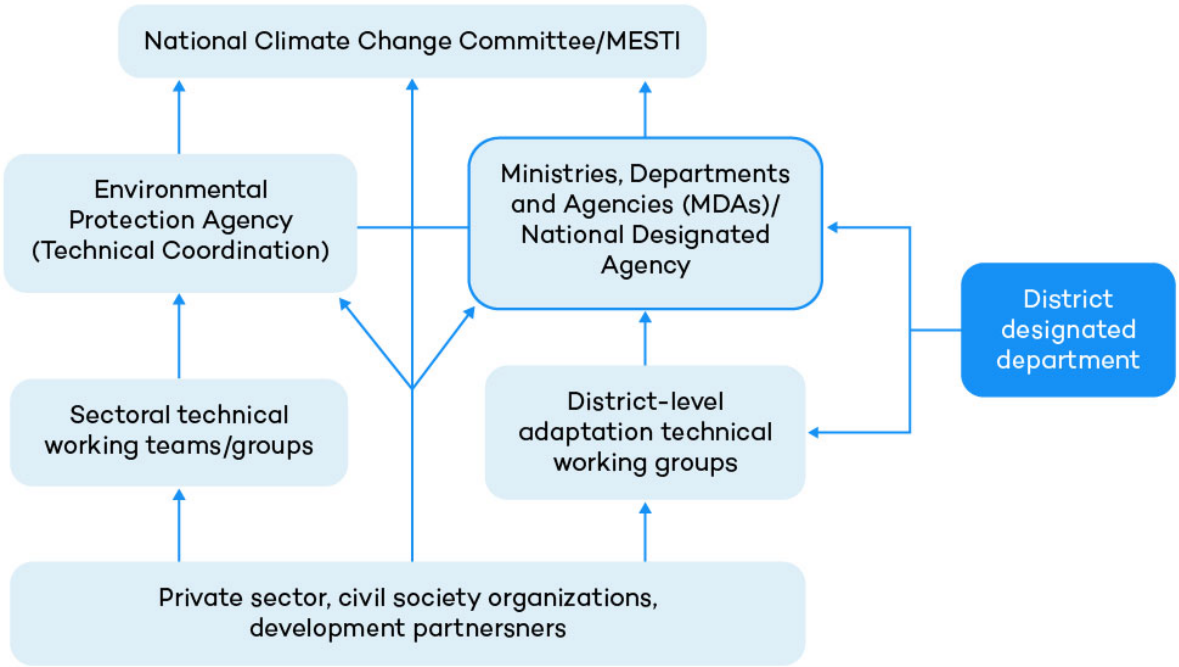
The NDPC is required to facilitate and build the capacity of MMDAs, including the BMA, on how to mainstream these climate change policies into Municipal MTDPs. The MTDP, therefore, serves as the main planning document to guide the implementation of programs and projects within the plan period in a particular Municipality to help create wealth, increase the income levels of the people, reduce poverty, and improve the living standards of people at the subnational level. The BMA MTDP recognizes the threat of climate change to its development efforts and includes climate adaptation-related actions (BMA, 2018, p. 61). This includes recognizing the adverse effects of climate change on agricultural activity (since farming in the municipality is rain dependent) and proposing education and awareness raising for farmers as an adaptation measure.

2.3 Proposed Arrangements for Adaptation Governance

To ensure an effective mainstreaming process for climate change in the municipality, the BMA's governance structure must plug into the proposed broader institutional arrangement under the NAP

framework (EPA, 2018). The proposed structure of the NAP framework ensures that the Municipal assembly is engaged and connected to the national process through the MDAs (circled blue in the organogram in Figure 4). Addressing climate change impacts is new for many Municipal governments, and it is currently unclear which department of the Municipal Assembly's current structure is the focal point for driving climate action. This hinders the provision of leadership and sustainable adaptation implementation. According to the NAP framework, the EPA is tasked with coordinating the creation of a comprehensive NAP, which will include adaptation priorities in crucial sectors like agriculture, forestry, water, energy, gender, and health. Concurrently, the NDPC will be responsible for coordinating adaptation planning at the Municipal level and integrating these plans into broader development strategies. The appointment or assignment of a Municipal-designated department will allow efficient and effective coordination and mainstreaming of climate action at the local level. In the BMA, the Municipal Planning Co-ordination Unit (MPCU) has been tasked with leading on the implementation of this adaptation plan by setting up a climate change desk in the assembly, the first of its kind in the country at the subnational level.

Figure 4. Proposed institutional arrangement for Ghana's NAP, including the role of the Municipal-designated lead department



Source: Adapted from Figure 1 in Ghana's NAP Framework (EPA, 2018, p. 18).

2.4 Implementation Roles and Responsibilities

Climate change is no longer solely an environmental issue; it is cross-cutting and requires cross-sectoral coordinating responsibilities. Siloed and uncoordinated approaches between and across sectors may lead to a multiplicity of efforts and, in some instances, maladaptation. To maximize efficiency through cross-sectoral synergies, a wide range of institutional stakeholder arrangements are required.

Table 2. Relevant stakeholders, their key roles, responsibilities, and expected outcomes from their engagement in the implementation of the NAP

Name of institution	Role/responsibility	Expected outcome from engagement
Public sector		
Municipal Planning Co-ordinating Unit, BMA	• Facilitates and coordinates the preparation of climate action plans of the BMA. • Leads monitoring and evaluation activities of the Municipality. • Coordinates implementation of climate change programs, projects, and activities in the Municipality.	• Effective and coordinated mainstreaming of climate change adaptation. • BMA is empowered to integrate climate change adaptation into its development plans. • Improved BMA capacities to undertake monitoring and evaluation of climate change adaptation actions. • Improved adaptation financing and outreach through improved BMA engagement with development partners, the private sector, and civil society organizations.
Bekwai Departments, such as Agriculture, Disaster Prevention; Health; and Natural Resources Conservation, Forestry, Game and Wildlife	• Leads the implementation of priority adaptation actions in their sector.	• Sectors and communities have reduced climate change vulnerability and improved adaptive capacity as a result of engagement in adaptation programs.
National Disaster Management Organisation	• Promotes disaster risk reduction and climate change risk management. • Contributes to effective social mobilization for disaster prevention and poverty reduction. • Provides disaster relief and assistance during disasters in the Municipality.	• Reduction in vulnerability related to climate change and disasters. • Programs/projects of the Municipal disaster plans will be incorporated into their adaptation plans.
NDPC	• Formulates national development policy frameworks and ensures that the strategies, including consequential policies and programs, are effectively carried out. • Ensures effective coordination of the preparation, implementation, monitoring and evaluation of national policies, projects, and plans in the Municipality. • Coordinates adaptation planning and mainstreaming across Districts, and Municipalities, including BMA.	• Full integration of climate change into economic, environmental, and social decision making of the BMA. • Adaptation planning and mainstreaming coordinated across Municipals.

Name of institution	Role/responsibility	Expected outcome from engagement
Ghana Meteorological Agency (GMet)	• Provides efficient and reliable meteorological information by collecting, processing, archiving, analyzing and dissemination of findings/meteorological information.	• Access to Municipal-level climate and weather data.
EPA	• Serves as the lead on the NAP process. • Acts as an environmental check on pollution and sanitation, environmental protection, and climate action. • Coordinates the development of an overarching national adaptation plan with adaptation priorities identified in key sectors.	• Support for the development of strategic and holistic vulnerability reports for key sectors in the Bekwai Municipality. • Sectoral priorities and local adaptation priorities are identified to support the NAP process.
Forestry Commission	• Regulates the utilization of forest and wildlife resources, the conservation and management of those resources and the coordination of policies related to them.	• Technical support for the implementation of adaptation actions.
MoFA	• Coordinates and implements agricultural policies and practices in the Bekwai Municipality. • Facilitates technology transfer.	• Capacity of extension staff will be built at regional and Municipal levels to be able to appropriately mainstream climate change in their extension messaging.
National Commission on Civic Education	• Educates residents on concept of climate change, measures to adopt to mitigate and adapt to its effect and other civic matters.	• Increased awareness raising and climate change education.
Regional Coordinating Council	• Conducts monitoring and evaluating of BMA Climate Change Adaptation Strategy. • Coordinates from a regional level by formulating, monitoring, and evaluating all plans and programs of the BMA.	• Close liaison with monitoring staff of the National Climate Change Committee will help to remove bottlenecks in the implementation of Municipal programs.
Gender Department	• Promotes the implementation of activities that address the rights of women, children, and youth.	• Strategic focus to address priority gender vulnerabilities to climate change.

Name of institution	Role/responsibility	Expected outcome from engagement
Ghana Health Service	• Supports the integration of climate change into the management of priority health risks in the Bekwai Municipality in harmony with national health development priorities.	• Strategic focus to address priority health vulnerabilities.
UNFCCC Focal Point	• Coordinates UNFCCC-led policies and programs. • Reports on Ghana's contribution to the global response to the threat of climate change.	• Guidance on climate change and development priorities.
Ministry of Finance	• Supports identification and categorization of multi-scalar assessment of vulnerability and adaptation options. • Oversees, coordinates, and manages financing and support in natural resources and climate change activities.	• Budget support for vulnerability assessments and implementation of adaptation strategies.
Research/academia		
None identified yet	• Provides technical support and contributes research findings in the development of the vulnerability assessments and adaptation planning and implementation for the BMA. • Delivers climate change education and capacity building, and undertakes research.	• Increased climate change education and capacity building. • Enhanced engagement in studies and projects where they explore solutions to improve the climate resilience of the municipality.
Development partners		
Green Climate Fund and other mechanisms under the UNFCCC Bilateral organizations, such as Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), United States Agency for International Development, and Global Affairs Canada	• Mobilizes resources, and support capacity development and technology development and transfer for current and future adaptation action.	• Financial and technical support for successful adaptation actions.

Name of institution	Role/responsibility	Expected outcome from engagement
Delivery partners such as the United Nations Development Programme (UNDP), UNICEF, and the NAP Global Network.		
NGOs/civil society organizations		
E.g., Green Africa Youth Organisation	• Undertakes planning, advocacy, education, awareness raising, evidence-based research as well as monitoring and evaluation of adaptation efforts. • Initiates and funds adaptation projects.	• Effective planning, implementation, and monitoring of adaptation actions. • Improved capacity building and information sharing about adaptation.
Vulnerable groups		
Women	• Participates in the design and implementation of activities under the BMA NAP.	• Increased awareness of the public and policymakers on the impacts of climate change on vulnerable groups, especially women, youth, and persons with disabilities (PWDs), and the roles the each can play in the development and implementation of climate change mitigation and adaptation strategies. • Stronger advocacy, public engagement, awareness creation, and other technical support. • Identification of the greater risks to these groups from climate change impacts and programs to address those risks. • Cooperation for effective implementation of climate adaptation practices.
Private sector		
Farm input dealers	• Promotes adoption of improved and resilient technological farm inputs.	• Improved access to information through their communication networks; uptake of improved technologies.
Financial institutions	• Provides access to credit facilities.	• Access to financial and technical support.

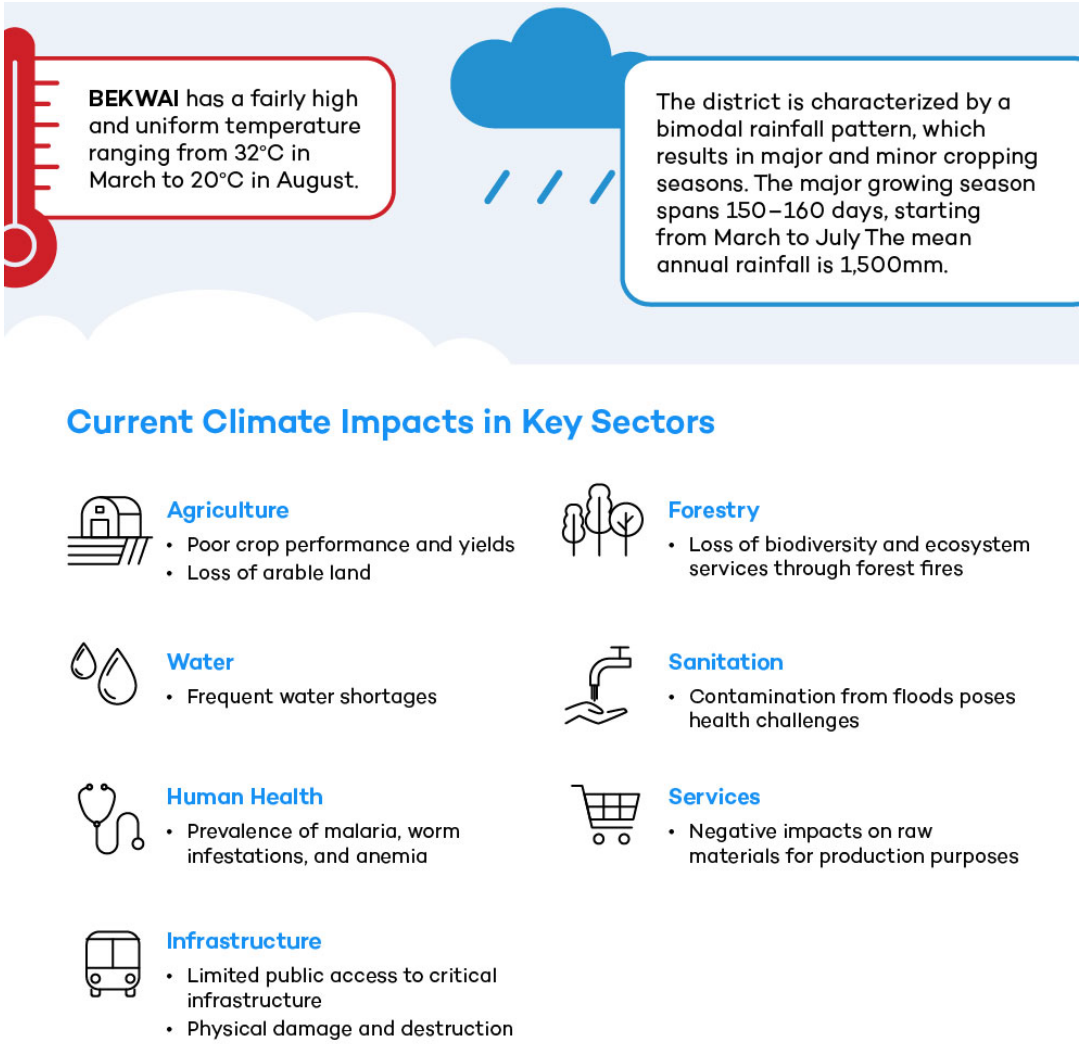
Name of institution	Role/responsibility	Expected outcome from engagement
Traditional authorities		
Traditional councils	• Mobilizes communities and grants permission to enter a community and to engage the community members.	• Identification of the greatest risks to communities from climate change impacts. • Cooperation for effective implementation of climate adaptation practices.
Other relevant groups		
Farmer-based organizations	• Provides opportunities for farmers to benefit from economies of scale, better bargaining power, and a stronger voice in policy development.	• Identification of the greatest risks to farmers from climate change impacts.
Faith-based organizations	• Mobilizes communities and undertakes advocacy.	• Effective implementation of climate adaptation practices.
Opinion leaders		• Champion community awareness creation of climate change.
Assembly members		• Advocacy, public engagement.
Town/area councils and unit committees		• Preparation of their own climate change adaptation plans that are submitted to BMA.
Media		
Local media (e.g., Dess FM, community information centres)	• Undertakes advocacy and communicates climate change information. • Engages the community by sensitizing and educating on the BMA NAP and measures to adapt to the impacts of climate change.	• Increased community awareness of climate change. • Dissemination of information about climate change adaptation measures. • Advocacy, public engagement.

Source: Adapted from Bekwai Vulnerability Assessment Report.

3. Current Climate and Future Climate Scenarios

This section provides a summary of current and future climate projections and scenarios, with a fuller and more complete assessment contained in the Bekwai Phase III Vulnerability Assessment report that provides deeper and broader insights into climate change and scenarios in the Municipality. It is advised that this adaptation plan be used in direct reference to the vulnerability assessment report and, in particular, with the climate information detailed in the VA. This adaptation plan is premised on observed and anticipated climate changes in the Bekwai region and in ways that should facilitate the making of climate-informed decisions. The climate projections are, therefore, context specific and place responsive, and they respond to the unique needs and particularities of the of Bekwai Municipality.

Figure 5. Current climate overview and impacts



Source: EPA, 2023.

Table 3. Current versus future climate

Historical climate	Future climate
• Rainfall in Bekwai has generally been variable, and heavy rainfall events were variable and differing year to year for the period 1980–2020. • The period 1980–2005 was drier than the period 2006–2020, with an increasing trend (although insignificant) of a greater number of rainy days and longer wet spell duration. • The period 2001–2020 was warmer than the period 1980–2000. Both mean minimum and maximum temperatures have varied and exhibited a significant increasing trend. Nine of 10 years from 2010 to 2020 were warmer than the mean.	• Bekwai is expected to experience annual variability of rainfall that will likely translate into intermittent rainfall as well as prolonged dry and wet spells over the municipality. The prolonged wet spells create a higher risk of an increased occurrence of floods. • The variation in rainfall will mean that some years may have an early onset of the rainy season while others may experience a delay. • Annual rainfall is expected to increase from 1,320 mm in 2020 to 1,490 mm in 2080. Thereafter, amounts of rainfall to 2100 will slightly decrease under a Representative Concentration Pathway 4.5 (RCP4.5) greenhouse gas (GHG) emissions scenario and increase to 1,700 mm under an RCP8.5 scenario. • Warmer days and nights are expected to result from rising temperatures, with annual mean temperatures expected to increase from 31.5°C in 2020 to 32.5°C by 2050, and to over 33°C by 2100 under an RCP 8.5 scenario. The rate of warming is expected to be higher for minimum (nighttime) temperatures. The number of warm nights and days is expected to increase.

Source: EPA, 2023.

Summary of Climate Hazards, Vulnerabilities, Risks, and Impacts in Bekwai Municipality

An overview of the climate hazards, key vulnerability factors, and climate impacts and risks in six priority sectors is included in Table 4, which summarizes the information set out in the Climate Change Vulnerability Assessment for the BMA. It reviews the six priority sectors and particularly vulnerable groups and areas. Taken together, the climate vulnerabilities—including particularly vulnerable groups, communities, and areas—and the expected impacts and risks for each sector help identify priority adaptation actions.

Table 4. Summary of climate hazards, climate vulnerability, and climate risks in the Bekwai Municipality

Climate hazards	Key vulnerability factors
Acute Increased rainfall variability and likelihood of heavy rainfall events Increased frequency and severity of • extreme weather events • high temperatures/heat waves • longer dry spells • floods **Chronic/slow onset** • increased intensity of droughts • changes in precipitation patterns	• High dependence on small-scale agriculture, with most farms on less than 5 acres of land. • Limited diversification from agriculture to other forms of income/livelihoods. • High reliance on natural rainfall and insufficient irrigation systems. • Reliance on groundwater resources for domestic and commercial activity and low water storage. • Frequent water shortages in communities, with long queues at water supply points • Illegal mining, which leads to high levels of deforestation, disruption of ecosystem services (including pollution of water sources), reduction of agricultural land, and an increased number of accidents due to abandoned mining pits filling with water during rainy seasons.. • High levels of deforestation, exacerbated by unsustainable human activities such as timber extraction, logging, and illegal chainsaw operation. • Inadequate but improving governance structures. • Poor health infrastructure. • High levels of illiteracy. • Limited ability to uptake and act on science and improved technologies. • Inadequate evidence and knowledge base. • Low levels of gender equality, with women having limited access to financial resources. **Particularly vulnerable areas** • **Climate-vulnerable communities:** Boni, Dotom, Koneyaw, and Afransie. • **Flooding:** Communities along the Oda River—Awiankwanta, Senfi, Ofoase Kokoben, Boni, Huntado, Poanu, Daa, Akyiase, Aframsie, and Abenkyim. • **Deforestation/changes in forest ecosystem:** Aboase, Dotom, Asokore, Gyasikrom, and Kokofrom. **Particularly vulnerable groups** • Women, youth, children, senior citizens, persons with disabilities, pregnant women, and incapacitated or disadvantaged persons or groups. • Farmers with small landholdings dependent on rain-fed agriculture. • Communities in the east that are impacted by high levels of illegal deforestation. **Particularly vulnerable assets** • Farms. • Schools. • Hospitals (Abenkyim). • Transport infrastructure (e.g., bridges).
Priority sectors	**Climate impacts/risks**
Agriculture and food security Vulnerable communities: Communities along the Oda River	• Higher weather uncertainties. • Increase in flooding, destruction of crops and infrastructure. • Uncertainties in timing of rains and increasing rainfall variability, impacting farmers' ability to plan/time the planting and harvesting of crops. • Extreme rainstorms, windstorms, and dust storms rarely occur; however, they damage and uproot crops and cause soil erosion and declines in soil quality.

Climate hazards	Key vulnerability factors
Senfi, Ofoase, Kokoben, Boni, Huntado, Poano, Daa, Akyiase, Afransie, Abenkyim, Aboase, Dotom, Asokore, Gyasikrom, Kokotro	• Increase in disease and pests, including increase in Fall Armyworm. • Declining crop production due to reliance on rainfed agriculture contributes to the decrease in food availability and nutrition/food security, and potentially a decrease in incomes. • Destruction of crops and agricultural activities, such as aquaculture, due to flooding that results from the Oda River overflowing its banks.
Forests (biodiversity and ecosystems) Vulnerable communities: Aboase, Dotom, Asokore, Gyasikrom, Kokofrom	• Projected increasing temperatures expected to increase the frequency of bush fires and forest fires. Excessive logging means that forests are more susceptible to fires. • Increase in damage and destruction from forest fires and bush fires, exacerbating already existing impacts such as disappearance of some communal resources such as snails, mushrooms, and wildlife. • Increased food insecurity and loss of livelihoods. • Decline in and depletion of ecosystem services such as those provided by forests (e.g., fuel wood, habitat). • Higher incidence of forest pests and disease outbreaks. • Deforestation is expected to impact the ability of the forest to influence the local climate (e.g., reduced evapotranspiration will affect the forest's moderation of higher temperatures and heatwaves).
Water, health, and sanitation	• Declining water levels of the Oda River. • Increased water shortages could lead to tensions and conflict. • Reduced quantity and quality of water for domestic, agricultural, and industrial uses. • Damaged water infrastructure. • Higher incidence of water-borne diseases, such as diarrhea and cholera, after severe precipitation events. • Greater risk of vector-borne diseases, such as malaria and worms, especially during rainy seasons. • Increased incidence of skin rashes and respiratory infections during the dry season. • Increased incidence of snake bites during the rainy season. • Increased risk of food insecurity.
Infrastructure and transport	• Damage to and destruction of physical infrastructure, including schools, hospitals, fuel stations, and houses, due to flooding, particularly along the Oda River. • Disruption of transportation networks, including washing out of bridges (including the bridge linking Awiankwanta to Bekwai) and washing away of gravel road surfaces. • Destruction of forests removes windbreaks, leaving the housing of the impoverished vulnerable to damage from storms. • Increased financial expenditure to rebuild and reconstruct damaged and destroyed infrastructure.
Services, trade, and finance	• Building and property damage and destruction. • Reduced agricultural productivity could impact the quantity and supply of agricultural raw materials that are available for industrial purposes. • Loss of employment from declines in agricultural productivity, including in palm oil processing. • Increase in loan defaults and difficulties accessing credit due to declining production and subsequent reductions in income.

Climate hazards	Key vulnerability factors
Gender equality	• Women comprise the majority of the agricultural labour force and will be impacted by declines in agriculture productivity. • Potential declines in employment opportunities in the processing of palm oil, which employs a significant number of women. • Declining incomes for women-led households with limited access to essentials such as food, health care, and finance.

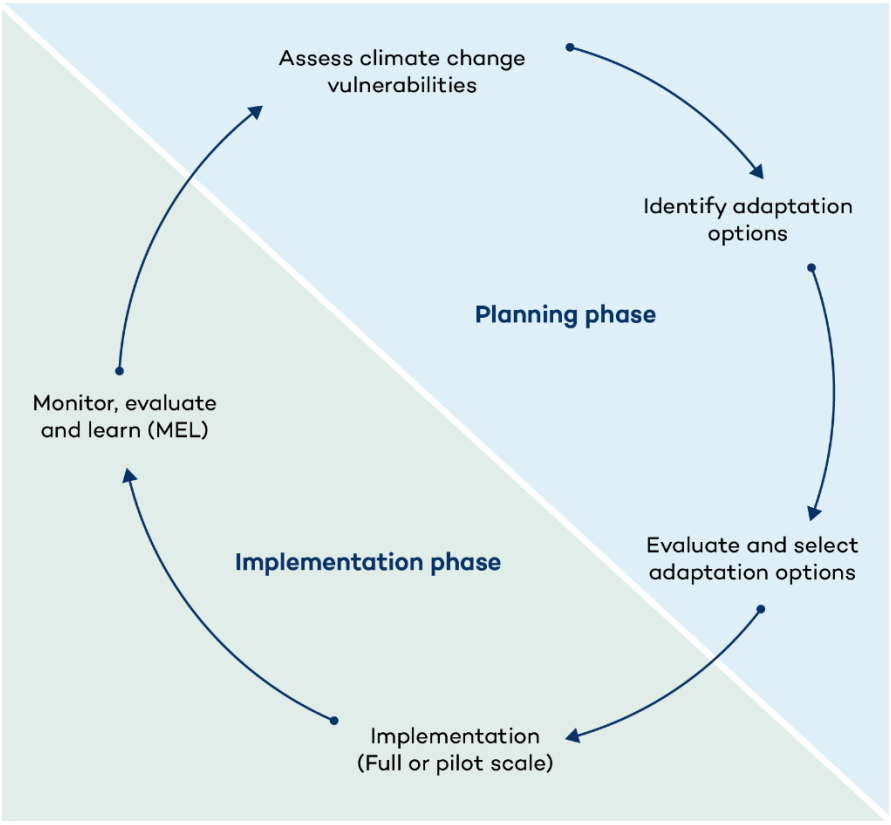
Notes: The information in the table is based on EPA, 2023. The framework is adapted from and informed by Dazé & Echeverria, 2016, and Government of Nepal, 2021.

4. Adaptation Action Planning

4.1 Introduction

Constrained by limited resources and the need to allocate those resources to various developmental priorities, the BMA must be strategic in identifying and prioritizing which adaptation measures to implement. Adaptation measures are those actions that can be taken to address the challenges posed by climate change. These actions not only help mitigate the negative impacts but also allow for the exploitation of any potential benefits (opportunities) resulting from the changing climate. Adaptation actions can encompass a wide range of options, from building resilience through enhancing knowledge and creating supportive institutions to establishing effective management systems and mechanisms, such as land management plans or insurance. The selection of adaptation actions/measures is informed by current and future vulnerabilities set out in the vulnerability assessment, which is based on historical data on climate changes, future projections, and socio-economic circumstances. This section focuses on identifying, assessing, and prioritizing adaptation options, as well as implementation needs and opportunities for resource mobilization. The framework for adaptation planning in the BMA adopted the process illustrated in Figure 6.

Figure 6. Approach to BMA adaptation planning



Source: Author diagram based on the Bekwai Adaptation Plan.

4.2 Identification and Compilation of Sector-Specific Adaptation Actions

The detailed plan of action for climate change adaptation in Bekwai Municipality identified and compiled Municipal-specific adaptation options. This facilitated an exploration of potential adaptation options and helped identify relevant actions. The adaptation planning team utilized the methods listed in Table 5 to identify adaptation options.

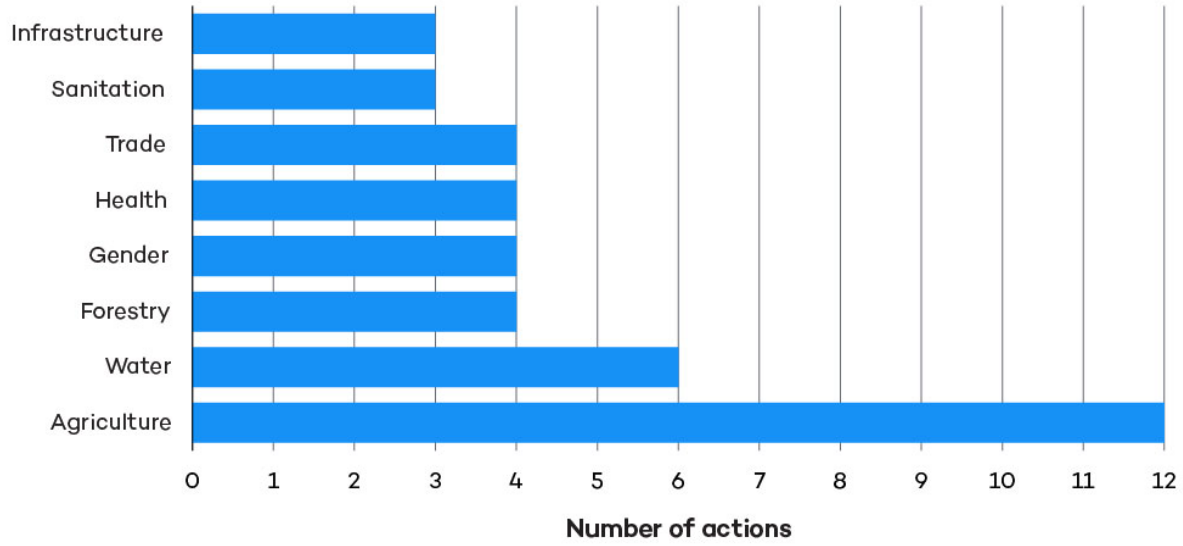
Table 5. Methodology to identify adaptation options

Vulnerability assessment report recommendations	The climate change vulnerability assessment for the Bekwai Municipal Assembly made recommendations in regard to 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, Municipal 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. In Bekwai, sector-specific stakeholders were consulted. The stakeholders were organized into four groups that addressed eight sectors: 1. Agriculture and Forestry Group (two sectors) 2. Water, Sanitation, and Human Health Group (three sectors) 3. Trade and Infrastructure Group (two sectors) 4. Gender Group (one cross-cutting sector)

Source: Author diagram based on the Bekwai Adaptation Plan.

The measures discussed in Figure 6 were used to create a catalogue of relevant adaptation options that are presented in the tables in Appendix B. Overall, 40 adaptation options were identified across the eight sectors: agriculture, forestry, water, sanitation, health, trade, infrastructure, and gender. The distribution of the identified actions is represented in Figure 7. Agriculture, unsurprisingly, constitutes the sector with the highest number of actions (12), followed by water (six).

Figure 7. Distribution of adaptation actions by sector



Source: Author diagram based on the Bekwai Adaptation Plan.

4.3 Methodology to Assess and Select Adaptation Options

4.3.1 Adaptation Assessment Criteria

After identifying and compiling the list of 40 potential adaptation options, the next step was to evaluate and prioritize them based on well-defined information and criteria. This includes assessing the suitability of options for the Bekwai Municipal context, their ability to improve resilience and reduce vulnerabilities identified in the Bekwai vulnerability assessment report, and their overall impact on sustainable development. The goal of the prioritization process was to make informed decisions that lead to effective adaptation and avoid maladaptation. To achieve this, relevant actors and stakeholders were engaged in the assessment process to ensure that the chosen adaptation options are suitable and without any potentially negative outcomes. Each of the four stakeholder groups (Agriculture and Forestry Group; Water, Sanitation and Health Group; Trade and Infrastructure Group; and Gender Group) screened the proposed adaptation options using a multicriteria analysis (MCA) (see Appendix A). This is because, in practice, each of the adaptation measures may perform differently on multiple criteria and may be associated with trade-offs. They must, therefore, be closely and critically evaluated, and the results of the analysis integrated into decision making about priority options.

MCA, also known as multi-objective decision making, is a decision-making tool designed for situations where a single-criterion method, like cost-benefit analysis, falls short in addressing all pertinent factors. This is particularly true in scenarios where environmental and social impacts are significant but cannot be quantified in monetary terms. MCA provides a platform for evaluating a comprehensive array of criteria encompassing social, environmental, technical, economic, and financial aspects (Ngara, 2011). In this approach, desired outcomes are clearly defined, and relevant attributes or indicators are established. The evaluation of these indicators is not necessarily monetary; it often involves a quantitative approach that includes scoring, ranking, and weighting a

variety of qualitative impacts and criteria. The criteria for the assessment of adaptation options are outlined in Table 6.

Table 6. Criteria for assessment of adaptation actions

Criteria	Description
Adaptation type	This criterion evaluates the risk reduction or risk transfer potential of an identified adaptation option. For example, while an irrigation system has a drought risk reduction potential, a crop insurance program would transfer the risk.
Implementation level	This identifies the level at which the implementation of an identified adaptation option is carried out. This could be at the community level, Municipal/government level, or autonomous.
Risk gradient	This evaluates whether an identified adaptation option has a "risk-specific" gradient or could be useful beyond the risk. "Risk-specific" gradient refers to the fact that certain adaptation strategies are designed to address specific risks, making them cost-effective only if those risks materialize. If the anticipated impacts do not occur, the investment in these strategies, or at least a portion of it, may not yield the intended benefits and could be considered a loss. For example, crop insurance only mitigates the risk in the event of crop loss and the investment (or premium) is lost in the event of no impact. Post-harvest loss technology, on the other hand, could mitigate the risk of crop loss at all times.
SDGs and development co-benefit	This evaluates how Municipal development programs align with different SDGs for co-benefits.
Risk mitigation potential	This assesses the ability of the adaptation option to mitigate the specific climate impact.
Upscaling and replicability potential	This evaluates the extent to which a particular adaptation intervention can be expanded.
Cost-effectiveness	This evaluates planning and implementation cost-effectiveness.
Social and cultural acceptance	A project must be socially and culturally accepted to ensure local buy-in. This criterion evaluates the social and cultural acceptance of the project.
Cross-sectoral maladaptation	This evaluates the potential of an adaptation option in one sector to have unintended negative impacts on another sector.
Deliverability and feasibility	This evaluates the general deliverability and feasibility.
Technical feasibility	This evaluates the availability of technical know-how and capacity needed for the implementation of a particular adaptation intervention.
Governance implications	This evaluates whether the adaptation intervention aligns with an existing governance structure or requires amendments, or even the establishment of new governance structures or processes.
Social considerations	This evaluates the impacts of the adaptation option on social inclusion and cohesion.
Environmental considerations	This evaluates the potential of the intervention to reduce GHG emissions and improve biodiversity, human health, soil quality, water quality, air quality, climate, and landscape.
Stakeholder interest	This evaluates stakeholders' interests in the adaptation intervention.

Criteria	Description
Potential negative outcomes	This identifies potential negative outcomes that may result from the implementation of the adaptation option.
Barriers to implementation	This identifies potential institutional, economic, and social barriers to the implementation of the adaptation option.

Source: Author diagram based on the Bekwai Adaptation Plan.

As presented in Appendix B, indicators were derived for each criterion and applied through scoring, ranking, and weighting. The stakeholder groups ranked the criteria for each of the 40 adaptation options identified during the sector group consultations. The results of the full assessment are presented in Appendix A.

The results of the MCA were used as inputs to identify adaptation options to be further developed into concrete actions. This was based on their aggregated score from the sum of the variables of each indicator. In addition, expert judgment, the results of the literature review, and consultations with authorities from the BMA and EPA informed the identification of priority adaptation options.

In each sector, about half of the actions were prioritized and selected to be developed further for implementation considerations. The identification of priority adaptation actions was based on the vulnerability and relative relevance of the sector in Bekwai and the alignment of the action with the BMA's developmental priorities as set out in the MTDP 2022–2025.

4.4 Adaptation Options

The prioritized adaptation options are described in this section, setting out the adaptation objective, justification, and key considerations for each action. The estimated costs for the actions each year from 2024 to 2030 are included. These estimated costs were calculated based on experiences from the assembly's budgeting procedures that take into consideration year-on-year inflationary considerations.

4.4.1 Agriculture

According to the BMA Vulnerability Assessment, agriculture is the most vulnerable sector and needs the most attention. Out of the 12 adaptation actions that were identified and assessed through the MCA, six were selected and prioritized as discussed below. These actions are aimed at small-scale farmers who currently rely on rainfed agriculture and will address the need to increase or maintain agricultural productivity as the climate changes. The adaptation objective, justification, and estimated cost of implementation for each of these actions are further discussed.

Figure 8. Consultation with agriculture and forestry sector players

4.4.1.1 Early Warning System/Climate Information Services

Adaptation Objective

To maintain or increase productivity and ensure food security by addressing rainfall variability and its consequences through the provision of requisite information early on to inform farmers' decision making on climate change impacts.

Justification

Early warning systems and climate information services are critical tools for farmers in the face of climate change. Accurate, timely, relevant, accessible, downscaled, and usable information can help farmers to manage risks proactively, adapt to changing climatic conditions, and undertake sustainable agriculture. Early warning systems provide farmers with information about extreme weather events and upcoming weather patterns, including droughts, floods, and extreme temperatures. Climate information services can provide downscaled and local information, including information about the timing of the onset of rains. Armed with such information, farmers in the Bekwai Municipality can make informed decisions about what crops to plant, when to plant them, and how to manage them, thereby reducing the risks associated with climate change (Antwi-Agyei et al., 2021).

In recognition of its importance, early warning and climate information services have been included in major climate change policies and strategies such as the *National Climate Change Adaptation Strategy* (Climate Change and Development – Adaptation by Reducing Vulnerability, 2012), *Ghana National Climate Change Policy* (MESTI, 2013), *Ghana National Climate Change Policy Action Programme for Implementation: 2015–2020* (MESTI, 2015, p. 44), and *Ghana: Updated Nationally Determined Contribution Under the Paris Agreement: 2020–2030* (Government of Ghana, 2021a, p. 25). The measure has a high level of stakeholder acceptance and supports several sustainable

development objectives. It also has significant potential to address the climate risks associated with rainfall variability, and—most importantly—the action is highly scalable and replicable.

The vulnerability assessment revealed that about 45% of households surveyed had no access to climate information services, which reduced their adaptive capacity to deal with climate variability. In the face of unprecedented changes in future weather patterns, including changes in the onset of the rains and greater frequency and severity of extreme weather events leading to droughts and floods, the establishment and strengthening of early warning and climate information services is imperative.

Key Considerations

Key considerations in implementing early warning systems and climate information services are as follows:

Local Context

It is essential to consider the local context of the Bekwai municipal area, where the early warning system and climate information services will be implemented. The vulnerability assessment assessed network connectivity, which implied a functional cell phone with access to network services. The average network connectivity across all communities is 56% of the respondents, which is higher than the average cell phone ownership for the Ashanti Region (54%) (National Communications Authority and Ghana Statistical Service, 2020). The adoption of early warning and climate information services among farmers is anticipated to be slow in the municipality due to the fact that 44% of the people lack connectivity, as well as cultural, financial, and capacity issues. To hasten adoption, such barriers need to be removed through the use of available technologies, such as conveying information through radio and SMS/texts that can be accessed through so-called “yam” phones (basic mobile phones that can be used for calls and text). The implementation must consider local downscaled weather patterns, agricultural practices, cultural norms, and local or traditional Indigenous Knowledge to ensure local buy-in.

Stakeholder Engagement and Partnership

To ensure the success of the system, engagement is required with a range of stakeholders, including farmers, government agencies, and civil society organizations. For example, the GMet seasonal bulletin provides an outlook of the season’s rainfall distribution, which is utilized as an information source for seasonal activities. It is also important to leverage and plug into existing partnerships such as those established by Esoko, GMet, MoFA, and the Centre for Scientific and Industrial Research. Community broadcasting centre owners and farmer-based organizations are important stakeholders to engage. Also, state agencies such GMet, Ghana Hydrological Services, National Disaster Management Organisation, and the BMA will require effective collaboration in the event of flooding of the Oda River to evacuate residents along the river in a timely manner that minimizes the impact on people. Engaging with various stakeholders will help build support for the system and ensure that it is tailored to the needs of local communities.

Capacity Building

Capacity building is critical to ensuring that farmers and other stakeholders have the knowledge and skills to effectively use the early warning system and climate information services. This training can be incorporated or mainstreamed into the current agricultural extension agents’ training programs

and into the extension agent training for farmers in the municipality. This can include training on how to interpret weather forecasts and how to implement climate-smart agriculture (CSA) practices.

Infrastructure

The success of the system will also depend on the availability of adequate infrastructure, such as reliable communication networks, mobile phones, and weather monitoring equipment. Currently, the Bekwai Municipality and most of its neighbouring districts have no weather station to collect localized weather information. The installation of an automated weather station is critical to advancing accurate and timely climate information in the Municipal Assembly.

Sustainability

The sustainability of the system over the long term can be enhanced through local ownership. The implementation of early warning and climate information systems could be led by the BMA and through community initiatives such as community broadcast centres (commonly called community information centres).[1] A good collaboration between the assembly, owners of the broadcasting centres, and GMet is important to ensure a sustainable community initiative. A good case study is the establishment of climate information service at the community level under the CARE Adaptation Learning Programme in Ghana (CARE, 2016). This may involve exploring innovative financing mechanisms or partnerships with private sector organizations.

Gender Sensitivity

Gender sensitivity is crucial to ensuring that the system is inclusive and accessible to all members of the community. The stakeholder engagement process identified that illiterate farmers may face access barriers unless the technology dissemination plan particularly addresses their needs. The vulnerability assessment survey revealed that women have lower access to climate information services (35% of respondents) compared to men (65% of respondents). Partey et al. (2020) have shown that men have more access to financial resources and have control of household income, which allows them to purchase mobile phones. Women, on the other hand, generally accessed their husbands' mobile phones. It is, therefore, important to ensure that women and other marginalized groups have equal access to information and are involved in decision-making processes. The Bekwai vulnerability assessment reported that 50% of women belonged to farmer-based organizations, which may provide a platform for the dissemination of climate information. Weekly/monthly (or at the beginning of cropping season) meetings can be leveraged to ensure that information is communicated in a language that women understand.

[1] A community broadcast centre is a local broadcast facility aimed at disseminating essential information for education and awareness within a community. These centres are typically housed in a small room, possibly in a temporary structure, and are equipped with basic broadcasting tools, such as a microphone, recorder, amplifier, and an external horn speaker mounted on a pole to project sound toward densely populated areas. This setup allows for effective communication with residents in a focused community setting. See: https://www.modernghana.com/news/930160/making-community-information-centers-less-of-an-evil-where.html

4.4.1.6 Promotion and Construction of Irrigation Systems

Adaptation Objective

To lessen the impacts of drought and long dry spells on crop production by allowing farmers to practice year-round production, which would guarantee incomes and allow for investments in adaptation measures, such as irrigation.

Justification

Irrigation systems, which currently rely on the Oda and minor rivers and benefit farmers in these locations, are crucial for agriculture in Bekwai in the face of climate change. Changes in rainfall patterns, including increased variability and unpredictability of rainfall, have had a significant impact on crop yields and food security. Irrigation systems can help farmers cope with droughts, increase crop yields, improve food security, promote sustainable water use, and enable diversification of crops. With irrigation, farmers can continue to grow crops even during periods of low rainfall, reducing their dependence on rainfed agriculture and increasing their resilience to drought. Irrigation systems can also allow farmers to diversify their crop production, allowing them to grow crops that require more water and that are less tolerant to drought. This can help farmers adapt to the effects of climate change and reduce their vulnerability to climate-related risks.

Key Considerations

Water Availability

Irrigation development in Bekwai must be implemented with caution, taking into consideration limited water availability, the dependence on underground water resources, and the possibility of water being polluted by heavy metals because of illegal mining activities (Okofo et al., 2021). Stakeholders consulted recommended rainwater harvesting and storage for irrigation as a viable option; however, it is important that this option be further investigated to reduce any incidence of maladaptation.

Land Availability

Mechanized and commercial irrigation systems require a significant amount of land, and it is important to ensure that there is enough land available to accommodate the system. Land tenure and ownership should also be considered to avoid conflicts and disputes.

Technical Capacity

Adequate technical capacity is required for the successful implementation and maintenance of irrigation systems. Skilled technicians and trained farmers are required to manage the system effectively. Currently, farmers have indigenous ways of irrigating, such as using plastic bottles as sprinklers. Such traditional technologies should be considered during implementation.

Financial Resources

The implementation of irrigation systems requires significant financial resources. Potential sources of funding need to be identified and a financial plan developed that is sustainable over the long term. Currently, GIZ's sustainable energy solutions for agriculture projects promote and provide funding support for the installation of solar irrigation systems (Volta Premier 98.1 FM, 2017).

Community Participation

Community participation is essential for the success of any irrigation project. It is important to involve community members in the planning and implementation of the project and to ensure that they have a sense of ownership and commitment to the project.

Environmental Impacts

The implementation of irrigation systems can have significant environmental impacts, such as changes in soil structure and erosion. It is important to consider the potential environmental impacts and to develop mitigation strategies to minimize these impacts. Solar irrigation systems offer mitigation co-benefits as they avoid GHG emissions associated with the burning of fossil fuels in generators to power irrigation systems.

Market Access

Irrigation systems can increase crop yields, but it is important to ensure that there is a market for the additional produce. Potential markets should be identified and marketing strategies developed that will ensure that farmers can sell their produce at a fair price.

Gender and Social Inequality

There is a risk that larger farmers or wealthier individuals might benefit more from the irrigation systems, exacerbating social inequalities within the community. Also, participation in several interventions is through household heads, who tend to be men in the Bekwai Municipality (i.e., 56% of respondents in the vulnerability assessment survey reported that a male was the head of household). Since men have greater negotiation power, care must be taken so that women and youth farmers are also enrolled in programs that deploy irrigation systems for farmers.

4.4.1.7 Promotion of Adoption of Drought-Resistant Varieties and Early Planting/Cultivation

Adaptation Objective

To lessen the impacts of droughts or long dry spells on crop production and to serve as an alternative avenue for farmers to better cope with water scarcity during droughts.

Justification

In the face of climate change, adopting drought-resistant varieties and early planting/cultivation practices is essential for agriculture in the Bekwai Municipality. Climate change is likely to increase the risk of drought, and drought-resistant varieties of crops are better adapted to these conditions and can continue to produce yields even in the face of reduced rainfall. Agriculture is a major source of livelihood and food security for many people in the municipality, and the adoption of drought-resistant varieties can help ensure that farmers can continue to produce food even during periods of drought. Furthermore, by reducing reliance on fertilizers and other inputs, farmers can mitigate their climate impact and increase their resilience to weather extremes.

Key Considerations

Adopting drought-resistant varieties and early planting/cultivation practices requires several key considerations, including the following.

Local Environmental Conditions

The selection of drought-resistant varieties and early planting/cultivation practices should be tailored or suited to local environmental conditions, such as rainfall patterns, soil type, and temperature. Major crops grown in the municipality are maize, rice, cassava, pepper, garden egg, cocoa, citrus, oil palm, and cocoyam. There are currently drought-resistant varieties for maize and rice. However, these are very expensive, and farmers will need support programs to purchase these varieties.

Availability of Inputs

The availability of inputs, such as seeds, fertilizers, and water, is essential for the successful adoption of drought-resistant varieties and early planting/cultivation practices. The implementation process must ensure that farmers have access to these inputs and that they are affordable.

Farmer Knowledge and Skills

Farmers must have the knowledge and skills necessary to adopt drought-resistant varieties and early planting/cultivation practices successfully. Training and extension services must be featured in the implementation to build these capacities.

Access to Credit

The stakeholders indicated during the consultation that available drought- resistant varieties of maize, for instance, are currently very expensive, which limits their adoption. The adoption of drought-resistant varieties and early planting/cultivation practices often requires upfront investments, such as purchasing seeds and fertilizer. The vulnerability assessment household survey revealed that only 15% of households had access to credit facilities, with more men (55%) having access than women (45%). Farmers should have access to credit to finance these investments, and the provision of credit must be gender responsive. This could be achieved through the Ghana Incentive-Based Risk Sharing System for Agricultural Lending. This program provides credit risk guarantees to financial institutions to increase lending to the agricultural sector in Ghana.

Market Demand

Farmers must consider market demand for crops when selecting drought-resistant varieties and deciding when to plant. It is essential to choose varieties that are marketable and will fetch higher prices.

Government Policies and Support

Government policies and support can play an essential role in promoting the adoption of drought-resistant varieties and early planting/cultivation practices. Policies that promote access to credit, training, and extension services can facilitate adoption, while incentives such as subsidies and price guarantees can help offset the upfront costs.

4.4.1.8 Increase Sensitization and Farmers' Education on Climate Change

Adaptation Objective

To raise awareness and build the capacity of farmers to understand and respond effectively to the impacts of climate change.

Justification

In the face of climate change, sensitization and farmers' education are essential for several reasons. First, such campaigns will help raise awareness about how agriculture activities are impacted by climate change and the need for adaptation measures. This increased awareness can help farmers understand the risks they face and take appropriate action to mitigate these risks. Secondly, education will help farmers improve their knowledge and skills in adapting to the changing climate. This can include learning about new varieties of crops that are more resistant to drought and other extreme weather events; early planting/cultivation practices that can help to reduce the impact of droughts; climate-smart practices that reduce GHG emissions, such as conservation agriculture, agroforestry, and integrated pest management that also have adaptation benefits; diversifying their crops; developing alternative livelihoods; and investing in infrastructure that can withstand extreme weather events.

Key Considerations

Implementing a sensitization and education campaign on climate change in Ghana requires several key considerations, including the following.

Target Audience

The campaign must target farmers through farmer-based organizations in the municipality and other stakeholders in the agricultural sector, including extension workers, agricultural cooperatives, and municipal assembly officials. The training can firstly target extension service providers, who can then go to train the farmers.

Message

The campaign message must be clear, concise, and relevant to the target audience, highlighting the impacts of climate change on agriculture, available adaptation measures, and their benefits.

Delivery Method

The campaign must use appropriate delivery methods that are accessible to the target audience, such as radio broadcasts, community meetings, and mobile phone messages.

Local Context

The campaign must be tailored to the Bekwai context, considering local language, culture, and traditions, as well as the specific climate change impacts and adaptation needs of the target area.

Partnerships

The campaign must involve partnerships with local organizations and stakeholders, including agricultural extension services, farmer-based organizations, research institutions, and civil society groups, to ensure that the message is effectively delivered and widely disseminated.

Sustainability

The campaign must be designed to ensure long-term sustainability and impact. This may involve incorporating monitoring and evaluation mechanisms to track progress, as well as building the capacity of local organizations and stakeholders to continue the campaign beyond its initial phase.

4.4.1.9 Improve Extension and Education on Climate-Smart Agriculture

Adaptation Objective

To promote sustainable and climate-resilient agriculture.

Justification

Against the background of current climate variability and change, improving extension and education on CSA is important for several reasons. First, it can enhance the knowledge and skills of farmers in adopting sustainable and climate-resilient agricultural practices, such as crop diversification and integrated soil fertility management. Secondly, CSA practices can help build resilience to climate change by improving farmers' adaptive capacity and ability to cope with the impacts of extreme weather events such as drought. Also, CSA practices can reduce GHG emissions by promoting sustainable land use practices and the use of renewable energy sources that have adaptation co-benefits. The adoption of CSA practices can also improve food security by increasing the productivity and profitability of agriculture and enhancing the nutritional value of crops.

Key Considerations

Target Audience

The program must target small-scale farmers, particularly those in areas that are most vulnerable to the impacts of climate change, such as drought-prone areas in the Bekwai Municipality.

Partnerships

Partnerships with agricultural extension services, research institutions, and civil society groups are necessary to effectively deliver the program and ensure its long-term sustainability.

Language and Culture

The program must be tailored to the local context, including local languages, cultural practices, and traditions.

Delivery Method

The program must use appropriate delivery methods that are accessible to the target audience, such as radio broadcasts, community meetings, community information centres, and mobile phone messages.

Training and Capacity Building

Training and capacity building must be provided to extension workers, farmers, and other stakeholders to ensure that they have the knowledge and skills needed to implement climate-smart agricultural practices effectively.

Monitoring and Evaluation

Monitoring and evaluation mechanisms must be put in place to track progress and ensure that the program is achieving its intended outcomes.

Financial Support

Financial support may be necessary to help farmers adopt new practices and technologies, particularly those that require initial investment.

4.4.1.10 Provide Alternative Livelihoods

Adaptation Objective

To reduce the sole dependence on climate-sensitive agriculture for livelihoods and build the resilience of farmers to the impacts of climate change.

Justification

Heavy dependence on climate-sensitive sectors in the face of climate change necessitates conscious efforts to diversify livelihood sources in the Bekwai municipality for several reasons.

Firstly, by providing diverse income sources, households relying on agriculture become less susceptible to the impacts of climate change on agriculture. Also, alternative livelihoods promote adaptation by encouraging communities to shift their economic activities to more climate-resilient sectors. Finally, providing alternative livelihoods can empower women and girls, who are often disproportionately affected by climate change and have limited economic opportunities.

Key Considerations

The following factors need to be considered when implementing alternative livelihood programs to support households affected by climate change in the Bekwai Municipality.

Local Context

The design of alternative livelihood programs should consider the specific social, economic, and cultural contexts of the communities they are intended to support. In the context of Bekwai, which is not economically active in other sectors apart from the production of raw materials and food produce, the implementation of an alternative livelihood program becomes a necessity.

Market Demand

Alternative livelihood programs should be designed to meet market demand, ensuring that the products and services produced are relevant and competitive.

Access to Finance

Alternative livelihood programs require adequate financing to support the start-up and maintenance of the proposed activities. The Microfinance and Loans Centre (MASLOC) program is accessible in all Districts and Municipalities in Ghana and provides an opportunity to finance small to medium enterprises. This platform can be leveraged at the Municipal level to provide financial support to people who want to start or expand a business.

Monitoring and Evaluation

To ensure the effectiveness of alternative livelihood programs, it is essential to monitor and evaluate their implementation, outcomes, and impacts regularly.

Participation and Ownership

Communities should be actively involved in the design and implementation of alternative livelihood programs to ensure their ownership and sustainability. The participation of communities can also inform which alternative livelihood activities best suit which group or community.

Environmental Sustainability

Alternative livelihood programs should be designed to promote environmental sustainability and, where possible, mitigation co-benefits, ensuring that they do not degrade natural resources.

Gender Equity

Alternative livelihood programs should promote gender equity by ensuring that women and men have equal access to resources, training, and opportunities.

Government Support

Alternative livelihood programs require local government support, such as policies and regulations that create an enabling environment for their implementation and operation.

Table 7. Estimated cost of agriculture sector prioritized adaptation actions

Adaptation option	Estimated Cost (USD)							
	2024	2025	2026	2027	2028	2029	2030	Total
Early warning/ climate information system	7,500	7,900	8,300	8,900	9,400	9,900	10,400	62,300
Promoting and constructing of irrigation system	65,000	65,000	65,000	65,000	60,000	60,000	60,000	440,000
Promoting the adoption of drought-resistant varieties and early planting/ cultivation	5,000	5,200	5,400	5,600	5,800	6,000	6,200	87,800
Providing sensitization and education of farmers on climate change	2,500	2,700	2,900	3,300	3,600	3,900	4,200	23,100
Improving extension and education on CSA	5,500	5,700	5,800	5,900	6,200	6,400	6,500	42,000
Providing alternative livelihoods through	23,500	23,900	30,500	30,700	30,900	31,000	31,800	202,300

Adaptation option	Estimated Cost (USD)							
	2024	2025	2026	2027	2028	2029	2030	Total
awareness creation and incentives to invest in other crops and business								
Total	109,000	110,400	166,500	119,400	115,900	117,200	119,100	857,500

Source: BMA Finance Department.

4.4.2 Forestry (Biodiversity and Ecosystems)

Climate change vulnerability in this sector is largely due to deforestation and forest degradation, driven by unsustainable human activities dominated by illegal mining and improper land use. The two adaptation actions selected for implementation focus on addressing these issues.

4.4.2.1 Undertake Afforestation Program and Ensure Effective Monitoring

Adaptation Objective

To address deforestation and forest degradation and enhance the climate resilience of the local ecosystem and communities.

Justification

This measure is of utmost importance considering how deforestation and forest degradation are exacerbating climate change impacts in the Bekwai Municipality, especially in relation to agriculture, water, and communities whose livelihoods are derived from forest-based ecosystem services, such as selling mushrooms, snails, and game. Afforestation and effective monitoring will prevent soil erosion and protect soil fertility, which is important for agricultural productivity. Trees also help to regulate the water cycle and maintain soil moisture, which is important in areas prone to drought. Afforestation can provide habitat for a variety of species and help to conserve biodiversity. Forests are home to many plant and animal species, and their conservation is important for maintaining healthy ecosystems.

Afforestation programs can provide alternative livelihoods for communities, such as through the production of non-timber forest products. This can help reduce pressure on existing forests and support sustainable development. Afforestation programs can help mitigate climate change by increasing the amount of carbon stored in forests and reducing the amount of carbon in the atmosphere. Around waterbodies such as the Oda River, afforestation will play an important role in regulating the water cycle and maintaining water quality. This will, in turn, reduce the risk of flooding, regulate stream flow, and provide water for drinking, irrigation, and other uses. Effective monitoring of afforestation programs is important to ensure that they are successful in achieving their objectives. Monitoring can help to track the progress of the program, identify areas where improvements are needed, and evaluate the impact of the program on the environment and local communities.

Key Considerations

This action can be plugged into the annual Green Day celebration and afforestation actions in the Bekwai Municipality where trees are planted. It must be done with the following considerations.

Site Selection

Suitable sites need to be selected for afforestation, considering factors such as soil type, slope, and water availability. The selection of sites must also consider the potential impact of afforestation on existing ecosystems, biodiversity, and local communities.

Tree Species Selection

The selection of tree species must be based on their suitability for the site, their growth rate, and their potential for carbon sequestration. It is important to select a mix of species to ensure biodiversity and reduce the risk of disease or pests affecting the entire forest.

Community Involvement

Community involvement is important for the success of an afforestation program. Local communities must be involved in the planning, implementation, and monitoring of the program and must be provided with alternative livelihood options to reduce the pressure on existing forests.

Monitoring and Evaluation

Monitoring and evaluation of the afforestation program must be conducted to track progress, identify areas where improvements are needed and evaluate the impact of the program on the environment and local communities. This can help ensure the success of the program and identify opportunities for improvement.

Sustainable Management Practices

Sustainable management practices must be employed to ensure the long-term success of the afforestation program. This includes practices such as selective harvesting, reforestation, and the use of non-timber forest products.

Funding and Resources

Adequate funding and resources are necessary to implement and maintain an afforestation program. This includes resources for site preparation, seedling production, planting, monitoring, and evaluation.

4.4.2.2 Strengthen Forest Governance Structures

Adaptation Objective

To reduce deforestation and forest degradation by strengthening existing laws, as well as introducing new laws to regulate human interactions and impacts on forests and associated resources.

Justification

Weak forest governance structures in Bekwai have perpetuated forest and forest resource degradation. Establishing effective forest governance structures can help enforce laws and

regulations aimed at conserving and restoring forests, which, in turn, can mitigate the impact of climate change by promoting carbon sequestration, preserving biodiversity, and protecting watersheds. This will promote sustainable forest management practices, such as selective harvesting and reforestation, which can reduce deforestation and forest degradation. In a nationally notorious illegal mining area like Bekwai, strong forest governance structures are necessary to help identify, arrest, and punish perpetrators of illegal mining to serve as a deterrent to others. Forest governance structures can facilitate the involvement of local communities in forest management, which can help ensure that their livelihoods are sustained while promoting forest conservation and restoration. Robust forest governance structures can ensure effective monitoring and evaluation of forest management practices, which can help identify areas where improvements are needed and provide opportunities for scaling up successful initiatives.

Key Considerations

These are several important factors to consider during implementation.

Legal Framework

There is a need to ensure that a clear legal framework for forest governance exists at the Municipal level, including laws, regulations, and policies that promote sustainable forest management practices.

Institutional Capacity

It is important to build the capacity of departments responsible for forest management to effectively enforce laws and regulations and promote sustainable forest management practices.

Community Engagement

Local communities must be actively engaged in forest management decision-making processes to ensure that their needs and interests are taken into consideration.

Stakeholder Collaboration

Collaboration among stakeholders, including departments, civil society organizations, and the private sector, is essential to leverage resources and expertise and achieve shared goals.

Monitoring and Evaluation

Monitoring and evaluating the effectiveness of forest governance structures is critical to identifying areas where improvements are needed and opportunities for scaling up successful initiatives.

Financing

Adequate financing is necessary to support forest governance structures and promote sustainable forest management practices.

Transparency and Accountability

Forest governance structures should be transparent and accountable to ensure that they effectively address the challenges of deforestation and forest degradation.

Indigenous and Local Knowledge

Indigenous and local knowledge must be incorporated into forest governance structures to ensure that they are culturally appropriate and effective.

Table 8. Estimated cost of forest sector prioritized adaptation actions

Adaptation option	Estimated Cost (USD)							
	2024	2025	2026	2027	2028	2029	2030	Total
Undertake afforestation program and ensure effective monitoring	12,800	12,800	12,800	12,800	12,800	12,800	12,800	76,800
Strengthen forest governance structures	5,120	5,120	5,120	5,120	5,120	5,120	5,120	30,720
Total	17,920	17,920	17,920	17,920	17,920	17,920	17,920	107,520

Source: BMA Finance Department.

4.4.3 Water

Water is one of the sectors most vulnerable to climate change in the Bekwai Municipality. Out of the six adaptation actions identified by the consultants through the vulnerability assessment report, literature review, and consultation, three were selected as priority actions through the MCA analysis undertaken by a group of local stakeholders with expertise in the water sector. The three priority interventions are presented in Table A9 in Appendix A. The adaptation objective, justification, and estimated cost of implementation for each of these actions are further discussed below.

Figure 9. Consultation with water, sanitation, and human health sector stakeholders

4.4.3.1 Wise Use and Conservation of Water Through Public Education and Behaviour Change

Adaptation Objective

To ensure water security (quality and availability) and universal access.

Justification

Wise use and conservation of water through public education and behaviour change is critical to addressing the climate vulnerability of limited water resources and frequent water shortages in the Bekwai Municipality. Groundwater resources serve as the primary water source for domestic and commercial activities in the municipality. Overall, 85% of the population has access to potable water. Small-town water systems serve about 50% of the population of the municipality, with the remainder served by mechanized boreholes, boreholes with hand pumps, and hand-dug wells fitted with pumps (BMA, 2019). However, due to the lack of diverse water sources, the rising temperatures are causing water scarcity in both wet and dry years. This is attributed to the limited water storage capacity and high evapotranspiration rates. Participants in a stakeholder workshop reported that the water levels of Oda River, the main water body in the Municipality, are currently declining. The combination of increasing temperatures and unsustainable practices, such as excessive clearing of riverbanks for farming, particularly among vegetable farmers, exposes a large surface area of the river to evapotranspiration, posing significant threats to water security in the municipality. The water-related impacts, such as water scarcity, will affect the entire Municipality.

Key Considerations

There are several factors to consider when implementing an action to promote the wise use and conservation of water through public education and behaviour change:

Stakeholder Engagement

It is essential to engage stakeholders, such as community leaders, water user groups (i.e., domestic and commercial), and municipal assembly departments, to ensure their participation and support in promoting the wise use and conservation of water.

Target Audience

Water usage is different for different people, and management practices will, therefore, vary. The design of the campaign must target specific groups, such as farmers, households, businesses, and industries, to tailor the message and approach to their needs and behaviours.

Communication Strategy

The communication strategy must use appropriate channels, messages, and materials to reach the target audience effectively. The message needs to be tailored to different target audiences.

Monitoring and Evaluation

The campaign must have a monitoring and evaluation framework to assess the effectiveness of the intervention and adjust the approach as needed.

Policy and Regulatory Framework

The campaign must align with existing policies and regulations on water conservation and sustainable water management.

Financial Resources

The campaign must have adequate financial resources to support the implementation and sustainability of the intervention.

Capacity Building

The campaign must provide capacity building for local communities and stakeholders to ensure their understanding and ownership of the intervention.

Cultural and Social Context

The campaign must consider the cultural and social context of the various target audiences to ensure that the intervention is culturally appropriate and acceptable.

4.4.3.2 Increasing Municipal Water Storage Capacity

Adaptation Objective

To ensure a more secure and reliable water supply, even during periods of water scarcity induced by climate change.

Justification

A key climate vulnerability in the Bekwai Municipality is water insecurity due to rampant and frequent shortages. Bekwai has a water storage facility that serves the municipality, but increased capacity is needed in the face of climate change and to mitigate the impacts of unpredictable and extreme weather patterns, such as prolonged droughts and floods, which have adversely affected water availability and quality. Increasing municipal water storage capacity will help address water availability and safety challenges currently faced by many in the municipality.

Secondly, increased municipal water storage capacity can help meet the growing demand for water resulting from population growth and urbanization. Thirdly, increased water storage capacity can improve the efficiency of water distribution, reducing water loss and improving the overall reliability of the water supply system. This can help reduce the cost of water supply and increase access to safe and reliable water for households, businesses, and industries. Additionally, increasing the Municipality's water storage facility's capacity can support agricultural production by providing a reliable source of water for irrigation during the dry season. This can increase food security and support the livelihoods of farmers and rural communities. Increasing municipal water storage capacity can support climate adaptation and reduce the vulnerability of communities and ecosystems to the impacts of climate change by providing a reliable source of water, which enables communities to better cope with the effects of droughts, floods, and other extreme weather events.

Key Considerations

There are several key considerations when implementing a project to increase municipal water storage capacity.

Infrastructure

Building or expanding water storage facilities requires significant infrastructure development, such as constructing new dams, reservoirs, or tanks. Factors such as location, design, and construction materials must be considered to ensure the infrastructure is durable, sustainable, and cost-effective.

Water Quality

Adequate water treatment and management measures must be implemented to ensure that the stored water is safe for human consumption and use. This is of greater significance in Bekwai, where heavy chemicals from illegal mining activities pollute water sources. This may involve regular water quality testing, treatment, and disinfection to prevent contamination.

Maintenance and Operation

Regular maintenance and operation of water storage facilities are critical to ensure their longevity and effectiveness. This may involve the employment of skilled staff, regular inspections, and repair or replacement of aging infrastructure.

Community Involvement

Community involvement and participation are essential for the success of any water storage project. Engaging with local communities to gather feedback, address concerns, and encourage responsible water use can help ensure the project's sustainability and effectiveness.

Financing

Increasing municipal water storage capacity can be costly, and identifying sustainable financing mechanisms is critical. This might involve exploring public–private partnerships, seeking funding from government or international donors, or implementing user fees.

Climate-Change Resilience

Increasing municipal water storage capacity must be done with consideration for the future impacts of climate change. This may involve incorporating climate change adaptation measures into the design and management of the infrastructure to ensure it is resilient to extreme weather events and changing climate patterns.

4.4.3.3 Construction and Mechanization of Boreholes

Adaptation Objective

To provide communities with reliable and resilient water supply systems that contribute to improved water security in the face of changing climatic conditions.

Justification

The BMA has shown great commitment to increasing clean water accessibility in rural communities in the municipality through the construction of mechanized boreholes (BMA, 2021). Boreholes provide a reliable and accessible source of water, especially in areas where pipe and surface water sources are limited, unreliable, or contaminated. This is especially important in the face of climate change, where droughts and other extreme weather events are becoming more frequent. It also

promotes access to clean and safe water, essential for maintaining good health and preventing water-borne diseases in rural communities in the municipality that lack access to piped water.

Boreholes can help farmers and others in rural communities increase their productivity by providing a reliable source of water for irrigation, livestock watering, and other agricultural activities. This can help reduce the impact of climate change on agricultural production and livelihoods and bring economic benefits, such as increased crop yields, improved livestock health, and the development of alternative livelihoods that rely on water, such as laundry services or car washes. Mechanizing boreholes with solar pumps can also help ensure their sustainability by reducing the burden of manual labour and increasing their efficiency and lifespans. Constructing and mechanizing boreholes can help communities adapt to the impacts of climate change by providing a reliable source of water in times of drought or other extreme weather events.

Key Considerations

When constructing and mechanizing boreholes in Ghana, the following factors should be considered:

Site Selection

The location of the borehole must be carefully chosen to ensure that it is accessible to the community it will serve and that there is sufficient groundwater available. BMA has constructed boreholes in the municipality and allocated budget to this priority action. It has a priority list of sites and communities that require boreholes.

Hydrogeological Surveys

Before construction, a hydrogeological survey must be conducted to determine the depth, yield, and quality of groundwater at the selected site. The Community and Water Sanitation Agency, with its vast experience in delivering boreholes in communities in Ghana, should be engaged and may have hydrological surveys that pertain to areas of the Bekwai Municipality. This will ensure that the borehole is constructed in a suitable location and that the water source is reliable and sustainable.

Technology

The appropriate technology for borehole construction and mechanization must be selected based on factors such as the depth of the borehole, the expected yield of the groundwater, and the terrain of the site. The pumps of the boreholes can be powered by solar energy, which is becoming cheaper in Ghana. Solar-powered boreholes will provide mitigation co-benefits by avoiding GHGs that could result from burning fossil fuel in generators or connecting to the national grid.

Community Involvement

The community, with significant input from women, must be involved in the selection of the site and the planning and implementation of the borehole project. This will ensure that the project meets their needs and is sustainable in the long term.

Maintenance and Repair

The borehole must be regularly maintained and repaired to ensure that it continues to function effectively. The community, including women, should be trained in the maintenance and repair of the borehole to ensure its sustainability.

Cost

The costs of construction, mechanization, and maintenance must be carefully considered to ensure that the project is financially feasible and sustainable. Learning from the previous drilling of boreholes in Bekwai Municipality can inform planning, and the Community and Water Sanitation Agency would have data and information based on its great experience in providing boreholes with solar pumps.

Sustainability

The project should be designed and implemented with a focus on long-term sustainability. This includes factors such as the selection of a reliable groundwater source, the use of appropriate technology, and community involvement, including women and youth, in maintenance and repair.

Table 9. Estimated cost of water sector-prioritized adaptation actions

Adaptation option	Estimated Cost (USD)							
	2024	2025	2026	2027	2028	2029	2030	Total
Wise use and water conservation through public education and behaviour change	3,000	3,500	4,000	4,500	5,000	5,500	6,000	31,500
Increasing municipal water storage capacity	8,000	8,500	9,000	9,500	10,000	10,500	11,000	66,500
Construction and mechanization of borehole	2,500	3,000	3,500	4,000	4,500	5,000	5,500	98,000
Total	13,500	15,000	16,500	18,000	19,500	21,000	22,500	126,000

Source: Authors, with data from the BMA Finance Department.

4.4.4 Sanitation

Sanitation and hygiene are water driven and remain critical social, environmental, and health concerns of the Bekwai Municipality. Addressing issues of sanitation is critically important because of its ripple effects on human health. Two actions have been prioritized out of the three adaptation options considered for implementation.

4.4.4.1 Provision of Climate-Resilient Sanitation Infrastructure

Adaptation Objectives

To provide climate-resilient toilet facilities to withstand the impacts of climate change, as well as to address associated issues of open defecation and water contamination.

Justification

The lack of proper toilet facilities has led to open defecation. Some toilets are dilapidated and may collapse under pressure from floods or any form of water inundation. Because climate change is expected to increase extreme events, especially flooding, it is important that existing facilities are made more resilient to withstand any such impacts. It is also important that new facilities are built with climate change considerations in mind. Additionally, it becomes critically important that people using these facilities are also equipped with knowledge about climate change to guide their behaviours and attitudes regarding water, sanitation, and hygiene in their communities.

Key Considerations

Siting public toilets in the Bekwai Municipality requires careful consideration of a variety of factors to ensure that the facilities are accessible, effective, resilient, and sustainable. These include the following aspects.

Accessibility

Public toilets must be in areas that are easily accessible to the community, particularly for vulnerable groups such as women, children, persons with disabilities (PWDs), and the elderly. This may involve siting public toilets near community gathering places, schools, or health clinics.

Water Source

Public toilets must be located at a safe distance from any nearby water sources to prevent contamination.

Climate Resilience

The facility must be able to cope with extreme climate events, such as storms, and needs to be sited in locations that are not flood prone so that people can have access even when it rains.

Cultural Considerations

The cultural beliefs and practices of the community must be taken into account when siting public toilets. For example, in some communities, it may be considered taboo to locate toilets near homes or places of worship.

Sustainability

The long-term sustainability of public toilet facilities must be considered when they are being constructed. This includes factors such as the availability of maintenance resources, the ability of the community to manage and maintain the facility, and the potential for the facility to generate income to support its operation and maintenance.

Cost

The cost of construction and maintenance must be considered in the selection of locations for public toilets. It may be more cost-effective to site public toilets near existing infrastructure such as water supply systems, transportation networks, or other public facilities.

4.4.4.2 Making New Bylaws That Have Climate Change Considerations

Adaptation Objective

To increase good public sanitation and waste disposal behaviours that reduce the impact of flooding in communities.

Justification

Public misbehaviour contributes to the community-based sanitation and hygiene challenges. This includes indiscriminate waste disposal which chokes gutters and drainages and prevents water flow during rains. This increases the chances of flooding and water contamination that lead to different health consequences. For the most part, these behaviours result from a lack of enforcement of existing bylaws by the BMA. The assembly currently has no bylaws on sanitation that include climate change considerations: these are needed to encourage proper waste disposal to reduce the impacts of flooding. These efforts can contribute to the achievement of SDGs, including improved health and well-being, environmental sustainability, and reduced poverty and inequality.

Key Considerations

Implementing bylaws on sanitation and waste disposal that take climate change into consideration requires a collaborative effort involving multiple stakeholders. Key considerations include the following aspects.

Community Participation

Communities must be involved in the development and implementation of bylaws on sanitation to ensure that their needs and concerns are considered. By involving a diverse range of stakeholders, including community members, local businesses, NGOs, government agencies, and vulnerable groups, decisions and actions can be more representative and inclusive. This creates a sense of ownership, legitimacy, and fairness in the decision-making process and the use of the toilet facility.

Capacity Building

Capacity-building activities, such as training and education, must be provided to stakeholders to build their knowledge and skills on climate change and sanitation. This can help ensure effective implementation and compliance with the bylaws.

Monitoring and Evaluation

A monitoring and evaluation system must be established to track progress and assess the effectiveness of the bylaws. This can help identify areas for improvement and ensure that the bylaws are achieving their intended objectives.

Enforcement

Effective enforcement mechanisms must be put in place to ensure compliance with the bylaws. This may include penalties for noncompliance and regular inspections to ensure that sanitation facilities and services meet the required standards.

Financing

Funds should be solicited from MMDAs, donor partners, and corporate organizations for the financing of climate-resilient toilet facilities. Major offenders who violate sanitation laws should be fined, and the money used to finance climate change-related projects.

Adaptability

The bylaws should be designed to be adaptable to changing climate conditions and evolving sanitation technologies and practices. This can help ensure that the bylaws remain relevant and effective over time.

Table 10. Estimated cost of sanitation sector prioritized adaptation actions

Adaptation option	Estimated Cost (USD)							
	2024	2025	2026	2027	2028	2029	2030	Total
Provision of climate-resilient toilet facilities	80,000	100,000	120,000	140,000	160,000	180,000	200,000	980,000
Making and enforcing bylaws that have climate change considerations	50,000	60,000	70,000	80,000	90,000	100,000	110,000	560,000
Total	130,000	160,000	190,000	220,000	250,000	280,000	310,000	1,540,000

Source: Authors, with data from the BMA Finance Department.

4.4.5 Human Health

Climate change impacts identified on human health in the Bekwai municipality emanate from direct impacts of extreme events such as heatwaves and storms, and indirect impacts from its linkage to other sectors such as waste, sanitation, and agriculture (food insecurity). Two out of four identified adaptation actions have been selected and prioritized for implementation, as follows.

4.4.5.1 Integrating Climate Change Considerations into Public Health Campaigns, Education, and Training

Adaptation Objective

To increase awareness about the climate and health nexus and enhance public health preparedness and response to the health consequences of climate change.

Justification

The Bekwai vulnerability assessment highlighted the increasing prevalence of climate-related water-borne, airborne, and skin diseases in the municipality. However, there is little to no awareness about the impact of climate change on human health. Integrating climate change considerations into public health campaigns, education, and training can help raise awareness of the health risks associated

with climate change, such as the increased prevalence of vector-borne diseases, water-borne diseases, and respiratory illnesses. Training can build the capacity of health professionals, community health workers, and the public to respond to the health impacts of climate change and improve preparedness for climate-related health emergencies, such as floods, droughts, and heatwaves. Integrating climate change considerations into public health programming can help build resilience to the health impacts of climate change by promoting the use of sustainable practices, such as water conservation and waste management. Such approaches may also enhance sustainable development processes by facilitating the integration of health and environmental considerations into policy and planning.

Key Considerations

The Municipal Health Department of the BMA currently runs health and environmental campaigns and this serves as an entry point for public awareness on climate change and human and public health. Implementing a program to integrate climate change considerations into public health campaigns, education, and training in the Bekwai Municipality requires a comprehensive and coordinated effort involving multiple stakeholders. This includes the following considerations.

Community Engagement

Community engagement is critical to ensuring that public health campaigns, education, and training are tailored to the needs and contexts of the local community. Community engagement can also help build support and ownership for the initiatives.

Capacity Building

Capacity-building activities, such as training and education, must be provided to stakeholders to build their knowledge and skills on climate change and public health. This can help ensure effective implementation and sustainability of the initiatives.

Collaboration and Coordination

Collaboration and coordination among various stakeholders, including health authorities, environmental agencies, and civil society organizations, is essential to ensuring a holistic approach to public health and climate change.

Monitoring and Evaluation

A monitoring and evaluation system must be established to track progress and assess the effectiveness of the initiatives. This can help identify areas for improvement and ensure that the initiatives are achieving their intended goals.

Partnerships and Financing

Partnerships and adequate financing should be secured to support the implementation and maintenance of the initiatives. This may include exploring innovative financing mechanisms, such as public–private partnerships, to ensure sustainability.

Adapting to Local Context

The initiatives must be designed to be adaptable to the local context and the unique challenges and opportunities of the Municipality. This can help ensure that the initiatives are relevant and effective over time.

4.4.5.2 Construction of Climate-Resilient Health Facilities, Retrofitting of Existing Health Facilities, and Adoption of New Building Standards (Green Buildings)

Adaptation Objective

To strengthen the health care sector's capacity to withstand climate-related challenges and provide uninterrupted, high-quality health care services in the face of changing climatic conditions.

Justification

Many communities in the municipality lack access to health facilities, including Community Health-Based Planning Services (CHPS) compounds. The BMA's development agenda includes the expansion and rehabilitation of CHPS compounds to promote universal access to health care (BMA, 2021). Addressing climate resilience considerations in the implementation of this program could help the municipality achieve climate-compatible development that addresses climate change and development issues. Climate-resilient health facilities can contribute to enhanced preparedness for climate-related emergencies by providing a secure and reliable infrastructure for emergency response and recovery efforts. They will also protect patients and health workers from the impacts of extreme weather events, such as floods, storms, and heatwaves. This can help ensure that health care services remain accessible and available during and after climate-related disasters. By providing a safe and healthy environment for patients and health workers, climate-resilient health facilities can reduce the incidence of climate-sensitive health conditions, such as respiratory illnesses and water- and vector-borne diseases. Constructing climate-resilient health facilities and retrofitting existing facilities can be cost-effective in the long run, as they can reduce the need for repairs and replacements due to climate-related damage.

Key Considerations

Implementing the construction of climate-resilient health facilities and retrofitting existing health facilities in the Bekwai municipality must consider the following aspects during implementation.

Adapting to Local Context

The construction and retrofitting of health facilities must be designed to be adaptable to the municipal context and the unique challenges and opportunities of the community. This can help ensure that the facilities are relevant and effective over time. A first step could be to ensure that BMA's planned rehabilitation of the CHPS compounds in Bodoa and Asamang is undertaken in a manner that addresses climate resilience and then uses the learning on what is needed (and the cost) to inform future programs.

Building Design

The building and design of climate-resilient health facilities must incorporate Ghana's new building standards, as well as include features such as elevated foundations, flood-resistant materials,

reinforced roofing, and passive cooling techniques. This can help ensure that the facilities can withstand the impacts of climate-related hazards.

Risk Assessment

Targeted risk assessments should be conducted to identify the potential climate-related hazards that could impact health facilities, including floods, storms, and heatwaves. This can help inform the design and construction of climate-resilient health facilities.

Maintenance and Repair

Regular maintenance and repair of health facilities are critical to ensuring their climate resilience. This includes regular inspections, repair of any damage, and replacement of any worn-out components.

Energy Efficiency

The construction of climate-resilient health facilities should also prioritize energy efficiency and the use of renewable energy sources. This can help reduce the carbon footprint of the health care sector and contribute to climate change mitigation efforts.

Financing

Adequate financing should be secured to support the construction of climate-resilient health facilities and retrofitting of existing health facilities. This may include exploring innovative financing mechanisms, such as public–private partnerships and support from international development partners to ensure sustainability.

Capacity Building

Capacity-building activities, such as training and education, should be provided to stakeholders to build their knowledge and skills on climate-resilient infrastructure. This can help ensure effective implementation and sustainability of the initiatives.

Table 51. Estimated cost of health sector prioritized adaptation actions

Adaptation option	Estimated Cost (USD):							
	2024	2025	2026	2027	2028	2029	2030	Total
Integrating climate change considerations into public health campaigns, education, and training	30,000	15,000	18,000	21,000	25,000	30,000	35,000	174,000
Construction of climate-resilient health facilities and retrofitting of existing health facilities and adoption of new building standards (green buildings)	1,000,000	1,500,000	2,000,000	2,500,000	3,000,000	3,500,000	4,000,000	17,500,000
Total	1,030,000	1,515,000	2,018,000	2,521,000	3,025,000	3,530,000	4,035,000	17,674,000

Source: Authors, with data from the BMA Finance Department.

4.4.6 Infrastructure

Infrastructure-related adaptation measures have partly been addressed in other sectors, such as sanitation, health, and agriculture. Key climate change vulnerabilities lie in the removal of rooftops by rainstorms and windstorms and the engineering of the Oda River bridge that hinders the flow of tributary rivers and causes flooding. Two out of three adaptation actions have been prioritized to address these challenges.

4.4.6.1 Planting of Tall Trees to Serve as Windbreak

Adaptation Objective

To lessen the impact of storms and extreme weather events on buildings.

Justification

Poor housing conditions, such as exposed foundations, leaking roofs, cracked walls, and dilapidated wooden structures exist in some communities of the municipality. Key infrastructure, such as school buildings, often experiences the removal of rooftops and building collapse as a result of rainstorms and windstorms. Climate change is expected to bring more extreme weather events, including stronger winds and more frequent storms. Planting tall trees as windbreaks can help rural

communities adapt to these changes by providing some protection from the impacts of climate change, such as protecting homes, crops, and other infrastructure from wind damage during storms (Weiskopf et al., 2021). This can help communities save money on repairs and prevent disruptions to their daily lives. Planting tall trees can provide additional benefits, such as absorbing carbon dioxide from the atmosphere through photosynthesis, which also increases the amount of carbon stored in the trees and in the soil. It can also protect the soil from erosion caused by strong winds, which is particularly important for rural communities that rely on agriculture as a source of livelihood.

Key Considerations

The assembly must take into consideration the following during implementation.

Choosing the Right Tree Species

The type of tree chosen for windbreaks must be well-suited to the local climate, soil conditions, and water availability. Some species may be more effective at protecting against wind, while others may be better at carbon sequestration. The stakeholders consulted considered collaboration with the Forestry Commission and the BMA to select the best trees to plant as crucial for implementation. The Forestry Commission is to be informed about the purpose of the intervention by the Planning Department so as to raise the right tree species in nurseries.

Proper Tree Spacing

The distance between trees must be carefully considered to maximize their effectiveness at reducing wind speeds and soil erosion while avoiding competition for resources and potential disease transmission. Stakeholders also cautioned against tree species that will develop large roots and branches that can break and damage infrastructure, such as buildings and roads.

Community Involvement and Education

Awareness is key and considered by stakeholders as the first point of implementation. It is important to involve local communities in the planning and implementation process to ensure that they have a sense of ownership over the project and understand the benefits of the windbreaks. Education programs should be developed to promote sustainable management practices and ensure the long-term success of the windbreaks. The communities prioritized for implementation are Nampansa, Adjamesu, and Gyesikrom because of their higher levels of vulnerability.

Monitoring and Evaluation

Regular monitoring and evaluation of the windbreaks will be critical to assess their effectiveness, as well as to make the necessary adjustments. This should involve regularly monitoring the tree growth. School buildings are the types of public buildings that get damaged. Therefore, the planting of trees must be highly encouraged near schools. An innovative means identified by stakeholders is to assign the trees to students and inscribe or label their names on the planted seedlings. This will motivate them to take good care of the plants.

Adequate Funding and Resources

Adequate funding and resources must be made available to support the planning, implementation, and maintenance of the windbreaks. The most cost-effective way of implementation identified by stakeholders is leveraging the annual Green Ghana Day to plant trees. This will involve partnerships

with local government agencies, such as the Forestry Commission, NGOs, and private sector organizations and individuals.

4.4.6.2 Reengineering of the Oda River Bridge at Anwiankwanta

Adaptation Objective

To ensure climate-resilient transportation systems.

Justification

The existing engineering design of the bridge linking Awiankwanta to Bekwai is incompatible with current climatic conditions as it becomes submerged during persistent rainfalls. This affects the transportation of people, goods, and services along the Kumasi-Obuasi highway. The inability of the water to flow under the bridge results in flooding along the bridge, which ultimately destroys farms located near the riverbanks. Climate change is expected to bring more frequent and intense rainfall, which can lead to flooding and damage to the bridge. Reengineering with climate change in mind can help make the bridge more resilient to these expected climate hazards, reducing the risk of damage and improving safety for communities. Reengineering the bridge can help ensure that communities are not cut off from access to markets, health care, education, and other essential services during times of extreme rainfall. By reengineering bridges to better withstand the impacts of climate change, the assembly can save money on costly repairs and maintenance. This can free up resources for other important priorities, such as education and health care.

Key Considerations

The reengineering of the Oda River bridge in the face of climate change must consider several aspects.

Assessment of Vulnerability

It is important to assess all the factors coming into play to make the bridge flooded. Therefore, stakeholders recommend that the services of a qualified road engineer should be contracted to assess the condition of the bridge and make recommendations for retrofitting.

Identification of Appropriate Design Solutions

Reengineering may involve a range of design solutions, such as raising the bridge deck, increasing the size of culverts, or improving drainage systems. It is important to identify appropriate design solutions that are effective and cost-effective while considering the local climate and environment.

Involvement of Local Communities

The involvement of local communities is critical to ensure that their needs and concerns are considered in the reengineering process. Such communities include Anwiankwanta and Abenkyim.

Funding and Resources

Adequate funding and resources will be essential for the reengineering of the bridge. This may involve partnerships with local and national government agencies, international agencies, NGOs, or private sector organizations. The Green Climate Fund could be explored as an option to support the financing of the reengineering process.

Monitoring and Evaluation

Regular monitoring and evaluation of the reengineering process are essential to ensure that the solutions are effective and sustainable. Monitoring can include measurements of water levels, bridge performance, and maintenance costs, among other factors.

Table 12. Estimated cost of infrastructure sector prioritized adaptation actions

Adaptation option	Estimated Cost (USD):							
	2024	2025	2026	2027	2028	2029	2030	
Planting of tall trees to serve as windbreaks	12,500	13,000	13,500	14,000	14,500	15,000	15,500	98,000
Reengineering of the Oda River bridge at Anwiankwanta	1,500,000	2,000,000	2,500,000	3,000,000	3,500,000	4,000,000	4,500,000	21,000,000
Total	1,512,500	2,013,000	2,513,500	3,014,000	3,514,500	4,015,000	4,515,500	21,098,000

Source: BMA Finance Department.

4.4.7 Gender

The two prioritized gender actions focus on delivering economic empowerment to women and other marginalized groups (youth and PWDs).

Figure 10. Consultation with the gender and other marginalized persons group

4.4.7.1 Provide Training in Alternative Livelihoods for Women and Other Marginalized Groups

Adaptation Objective

To improve skills in manufacturing to enable women and marginal groups that are dependent on climate-sensitive agriculture crops to have alternate forms of livelihood.

Justification

The livelihoods of many women and other marginalized groups are directly dependent on climate-sensitive agriculture or indirectly on other people whose livelihoods come from agriculture. Women and other marginalized groups will be disproportionately affected by the impacts of climate change and may face greater challenges in accessing livelihoods from agriculture. In Bekwai, the processing of palm nuts into oil and soap serves as employment for a significant number of women. Projected climate change impacts on agriculture will, therefore, affect raw materials such as oil palm (Sarkar et al., 2020). Providing training in alternative livelihoods (such as in liquid soap, pomade, and balm manufacturing) can empower women and other marginalized groups to develop skills and knowledge to generate income, increasing their economic independence and social status.

Key Considerations

The BMA MTDP prioritizes training women and youth in alternative livelihoods. This adaptation action complements this training by integrating climate change considerations. Key considerations that should be taken into account include the following aspects.

Needs Assessment

It is important to conduct a needs assessment to identify the most appropriate alternative livelihood options for each gender and age bracket. This assessment must take into account the local environmental, cultural, and economic factors, as well as the skills and interests of the target groups.

Skills and Capacity Building

The training must focus on building the necessary skills and capacity to pursue alternative livelihoods, such as training in liquid soap, pomade, and balm manufacturing or entrepreneurship. It is important to ensure that the training is culturally appropriate and accessible to all participants, including PWDs.

Gender and Social Inclusion

The training should be designed to be inclusive of all community members, including women and other marginalized groups, and should consider gender-specific needs and barriers. This can include conducting the training at times that are convenient for women who have caregiving responsibilities.

Access to Resources

Access to resources, such as land, capital, and equipment, is critical for the success of alternative livelihoods. It is important to ensure that participants have access to these resources and that they are used in a sustainable and equitable manner.

Monitoring and Evaluation

Regular monitoring and evaluation of the training and alternative livelihoods are essential to ensure that they are effective and sustainable. This can include measuring changes in income, livelihood security, and environmental impact, among other factors.

Partnership and Collaboration

Collaboration with local partners, such as NGOs, government agencies, and community-based organizations, can help ensure that the training and alternative livelihoods are appropriate and responsive to local needs. Partnerships can also provide access to funding and resources to support the implementation of the training.

4.4.7.2 Create Conditions That Enhance Access to Credit for Youth, Women, and PWDs to Start or Expand Businesses

Adaptation Objective

To reduce gender inequalities in accessing credit to enable an enhanced response to adaptation needs.

Justification

Women, youth, and PWDs in the Bekwai municipality face unique challenges, including limited access to credit. Enhancing their access to credit can help promote inclusive development and ensure that all members of the municipality have the opportunity to participate in economic growth and adapt to the impacts of climate change. For example, the vulnerability assessment survey showed that more men (55%) have access to credit than women (45%). Access to credit can enable women and men to invest in climate change adaptation measures, such as purchasing drought-resistant seeds or planting trees. Access to credit can empower women, youth, and PWDs by providing them with the resources to start or expand their own businesses, generate income, and improve their social status. This can help reduce vulnerability to the impacts of climate change.

Key Considerations

Implementation of conditions that improve access to credit for youth, women, and PWDs to start or expand businesses in the face of climate change in the Bekwai municipality must consider the following.

Targeting Vulnerable Groups

It is important to identify and target vulnerable groups, such as youth, women, and PWDs, who are most in need of support. This can be done through community-based needs assessments, working with local organizations, and partnering with government agencies.

Availability of Credit

It is important to ensure that there is adequate credit available to support the targeted groups. This can involve working with microfinance institutions, community-based organizations, and other financial institutions to provide accessible credit products that are tailored to the needs of the targeted groups. The national government's MASLOC program is available in the Bekwai municipality and a partnership between the BMA and MASLOC could increase access to finance.

Financial Literacy

Providing financial literacy training to targeted groups can help ensure that they are able to effectively manage credit, make informed decisions, and improve the likelihood of success for their businesses. This can include training in budgeting, accounting, and financial management.

Business Training

Providing business training to targeted groups can help ensure that they have the skills and knowledge needed to start and run successful businesses. This can include training in entrepreneurship, marketing, and business planning.

Inclusivity

It is important to ensure that the credit products and support services are inclusive of all members of the community, including those with disabilities, and that they are designed to address the unique needs and challenges faced by these groups.

Monitoring and Evaluation

Regular monitoring and evaluation of credit products and support services are essential to ensure that they are effective and sustainable. This can include measuring changes in income, business success, and climate change adaptation measures, among other factors.

Collaboration

Collaboration with local partners, such as NGOs, government agencies, and community-based organizations, can help ensure that the credit products and support services are appropriate and responsive to local needs. Partnerships can also provide access to funding and resources to support the implementation of credit products and support services.

Table 13. Estimated cost of gender sector prioritized adaptation actions

Adaptation option	Estimated Cost (USD)							
	2024	2025	2026	2027	2028	2029	2030	Total
Provide training in alternative livelihoods for women and other marginalized groups	2,000	2,500	3,000	3,500	4,000	4,500	5,000	24,500
Create conditions that enhance youth, women, and PWD's access to credit to start or expand business	7,000	7,500	8,000	8,500	9,000	9,500	10,000	59,500
Total	9,000	10,000	11,000	12,000	13,000	14,000	15,000	84,000

Source: BMA Finance Department.

4.4.8 Trade

Adaptation measures to address vulnerabilities in the trade sector focus on creating awareness about business risks emanating from climate change and providing incentives for green and alternative solutions that address climate change. Overall, two out of four adaptation options identified were prioritized.

4.4.8.1 Provide Incentives for Green Businesses and Solutions That Address Climate Change

Adaptation Objective

To foster sustainable development, build climate resilience, and promote environmentally friendly businesses that create jobs and livelihoods for people to help them adapt to the challenges posed by climate change.

Justification

Promoting green business as a source of livelihoods or alternative livelihoods can encourage adaptation outcomes. The provision of specific incentives can encourage businesses to create new technologies, products, and services that can help reduce the impacts of climate change and mitigate GHG emissions. Green business opportunities identified in Bekwai include plastic recycling to produce the gallons/pails used to sell processed palm oil. The palm oil production process itself was associated with pollution from effluent discharges, smoke from firewood burning, and the potential conversion of forests to palm oil farms. Green business opportunities include sustainable palm plantation management, production of clean/improved stoves for cooking, and effluent

treatment. Incentives for organic and sustainable agricultural methods that minimize chemical inputs, promote biodiversity, and protect soil were also identified as a green business opportunity.

Providing incentives for these businesses can help attract investment, stimulate local economies, and improve the livelihoods of individuals and communities, thereby helping people make money to invest in climate change adaptation measures. Such green businesses and solutions are often more sustainable than traditional practices and promote sustainable development, protect natural resources, reduce the environmental impact of economic activities and pollution, and improve access to clean water and food.

Incentives can take many forms, including subsidies and technical assistance. The provision of incentives must be tailored to the specific needs and circumstances of the targeted businesses, taking into account factors such as local resources, market conditions, and government policies. It is important to note that incentives alone may not be sufficient. Other factors, such as access to finance, business training, and market access, are also critical to the success of green businesses and solutions. Therefore, it is important to provide a comprehensive package of support services to ensure that green businesses can thrive.

Key Considerations

Key considerations for implementation include the following aspects.

Targeting of Incentives

The incentives should be targeted at the specific needs and circumstances of communities. This can be done through community-based needs assessments and working with local organizations and government agencies.

Type of Incentives

The type of incentives provided should be appropriate to the specific needs and circumstances of targeted businesses. This can include tax breaks, subsidies, and technical assistance through the Business Centre programs.

Availability of Finance

Access to finance is critical for the success of green businesses and solutions. Therefore, it is vital to ensure that there is adequate finance available to support these initiatives. This can involve working with financial institutions, such as microfinance institutions and banks, to provide accessible finance products.

Business Development Support

In addition to finance, green businesses also require business development support, such as training in entrepreneurship, marketing, and business planning. This can be provided through partnerships with local organizations and government agencies.

Market Access

Access to markets is important for the success of green businesses. Therefore, it is important to provide support for market access, such as through partnerships with buyers, market research, and business networking events.

Monitoring and Evaluation

Regular monitoring and evaluation of the incentives and support services provided are essential to ensuring they are effective and sustainable. This can include measuring changes in the number of green businesses, jobs created, increases in adaptive capacity, and GHG emissions reduced.

Collaboration

Collaboration with local partners, such as NGOs, government agencies, and community-based organizations, can help ensure that the incentives and support services are appropriate and responsive to local needs. Partnerships can also provide access to funding and resources to support the implementation of the incentives and support services.

4.4.8.2 Educate, Communicate, and Sensitize Traders on Climate Hazards and Provide Early Warning Systems

Adaptation Objective

To reduce trade losses from markets due to climate variability and change.

Justification

Educating traders on climate hazards can increase their awareness of the potential impacts of climate change on their trades. This will include awareness and understanding of the implications of changes in temperature, rainfall patterns, and extreme weather events. Education can, therefore, help traders prepare for and mitigate the impacts of these hazards. Early warning systems, on the other hand, provide traders with the information they need to make informed decisions and take appropriate actions in response to climate hazards. This can help them build resilience to the impacts of climate change and reduce their vulnerability to economic losses. In essence, early warning systems help traders to anticipate and respond to climate hazards in a timely manner, which can help to reduce economic losses due to disruptions in trade, transportation, and supply chains. Also, educating traders on climate hazards and providing early warning systems can facilitate their adoption of new technologies, change production practices, and diversify their sources of income. Providing information through multiple channels, such as radio, mobile phones, and community or cooperative meetings is important to enhance preparedness.

Key Considerations

Key considerations for implementation include the following aspects.

Understanding Local Contexts

It is important to understand local cultures, practices, and beliefs when designing education and communication materials. This can involve working with local organizations and community leaders to ensure that the information provided is relevant and accessible to traders.

Accessibility

The education and communication materials should be accessible to traders who may have limited access to technology, such as radios, mobile phones, and Internet connectivity. Alternative methods of communication, such as community meetings, should be considered.

Early Warning Systems

Early warning systems should be effective, reliable, and sustainable. This can involve using a combination of traditional and modern methods to ensure that information reaches traders in a timely and accurate manner.

Training and Capacity Building

Traders may require training and capacity building to effectively use early warning systems and take appropriate actions in response to climate hazards. This can involve providing training in risk management, emergency preparedness, and adaptation strategies.

Collaboration

Collaboration with local partners, such as NGOs, government agencies, and community-based organizations, can help ensure that education, communication, and early warning systems are appropriate and responsive to local needs. Partnerships can also provide access to funding and resources to support the implementation of these initiatives.

Monitoring and Evaluation

Regular monitoring and evaluation of education, communication, and early warning systems are essential to ensure they are effective and sustainable. This can include measuring changes in the awareness of traders, the adoption of early warning systems, and the reduction in economic losses due to climate hazards.

Table 14. Estimated cost of trade and commerce (service sector) prioritized adaptation actions

Adaptation option		Estimated Cost (USD)						
	2024	2025	2026	2027	2028	2029	2030	Total
Providing incentives for green businesses and solutions that address climate change	4,000	4,500	5,000	6,000	7,000	7,500	8,000	42,000
Educate, communicate, and sensitize traders on climate hazards	4,000	4,500	5,000	6,000	7,000	7,500	8,000	42,000
Total	8,000	9,000	10,000	12,000	14,000	15,000	16,000	84,000

Source: BMA Finance Department.

4.4.9 Cross-Cutting Impacts and Adaptation Considerations

All sectors are interlinked and interconnected and thus require cross-cutting considerations in adaptation planning and implementation to avoid maladaptation or duplication of efforts and resources. By considering cross-cutting climate change impacts, interventions in different sectors

can be designed to address multiple challenges and create synergies across sectors and with co-benefits. This can lead to more effective and sustainable climate change adaptation and resilience building in the municipality. Identified adaptation considerations for the cross-cutting impacts identified include the following areas.

Equity

All sectors should prioritize equity considerations to ensure that the most vulnerable and marginalized groups benefit from these interventions. This can involve targeting interventions toward women, youth, and PWDs and ensuring that they have equal access to resources, information, and services.

Governance

Effective governance is crucial for the successful implementation and sustainability of these interventions. This can involve ensuring that policies, regulations, and institutional frameworks are supportive of climate change adaptation and that decision making is inclusive and participatory.

Resilience

Adaptation measures should aim to build resilience at multiple levels, including the community, institutional, and systemic levels. This can involve strengthening local capacities for adaptation, improving infrastructure and service delivery, and enhancing social safety nets.

Innovation

Innovative solutions are needed to address the complex and interconnected challenges posed by climate change. This can involve leveraging new technologies, promoting sustainable practices, and encouraging entrepreneurship and business development.

Monitoring and Evaluation

Regular monitoring and evaluation are essential to assessing the effectiveness and sustainability of these interventions. This can involve measuring changes in behaviour, knowledge, and outcomes related to climate change adaptation.

Cross- Sectoral Linkages

Climate change adaptation requires a cross-sectoral approach that recognizes the interconnectedness of different sectors and systems. This can involve promoting collaboration and coordination among different stakeholders and sectors to ensure that interventions are complementary and mutually reinforcing.

4.4.10 Implementation Needs and Resource Mobilization

The Bekwai vulnerability assessment process identified barriers to the effective participation of stakeholders in climate change adaptation, and the results were broadly captured under the following themes.

Lack of Climate Change Knowledge

The stakeholders indicated that their lack of knowledge on climate change limits their ability to participate in climate change adaptation, and they indicated they would require intensive training on climate change, its impacts, and adaptation.

Lack of Technical Capacity

Technical capacity is needed in the effective design and implementation of climate change adaptation. This includes assessing climate change vulnerability and/or appraising adaptation options. The lack of technical capacity, especially on the side of the departments of the Municipal Assembly, hinders their ability to undertake climate adaptation.

Lack of Funding and Support

Carrying out climate change adaptation of any sort involves money. Stakeholders indicated that the lack of financial support impedes their ability to participate and carry out climate change adaptation.

Successful implementation of adaptation actions would, therefore, need (a) knowledge co-creation and information sharing, (b) technical capacity building, and (c) funding and support.

4.4.11 Knowledge Co-Creation and Information Sharing

Increased knowledge co-creation and information sharing on climate change adaptation can help to build the capacity of stakeholders and promote effective and sustainable adaptation actions in the Bekwai Municipality. This can be achieved through the following.

Multistakeholder Platforms

Establishing multistakeholder platforms that bring together representatives from the BMA, civil society organizations, academia, and other relevant stakeholders can help facilitate knowledge co-creation and information sharing.

Capacity Building

Providing capacity-building opportunities to BMA staff and other stakeholders can help improve their understanding of climate change adaptation and build their skills and expertise in this area.

Workshops and Training Sessions

Organizing workshops and training sessions on climate change adaptation can help build awareness and knowledge among BMA staff and other stakeholders.

Knowledge Exchange Visits

Facilitating knowledge exchange visits between MMDAs and other organizations that have experience with climate change adaptation can help promote information sharing and learning.

Information-Sharing Platforms

Establishing information-sharing platforms, such as online portals, can help promote the sharing of knowledge and information among District Municipal and Metropolitan assembly staff and other stakeholders.

Peer-to-Peer Learning

Promoting peer-to-peer learning among BMA staff and other stakeholders can help foster collaboration and facilitate knowledge co-creation and sharing.

Community Engagement

Engaging with communities can help ensure that local knowledge and perspectives are integrated into climate change adaptation planning and implementation.

Technical Capacity Building

Developing the in-house capacity of the BMA staff on technical adaptation subjects is a sure means of ensuring a sustainable adaptation process. This can include subjects on proposal writing for funds, monitoring and evaluation of adaptation actions, vulnerability and adaptation assessment, adaptation actions appraisal, etc. Such capacity building can be achieved with the following steps.

Conducting Needs Assessments

Conducting a needs assessment can help identify the technical capacity gaps and training needs of MMDA staff.

Developing Training Programs

Developing training programs that focus on the specific technical skills and knowledge required for climate change adaptation can help to build the capacity of MMDA staff.

Providing Technical Assistance

Providing technical assistance to MMDA staff in the form of mentorship, coaching, and on-the-job training can help to improve their technical skills and expertise.

Partnering With Technical Institutions

Partnering with technical institutions, such as universities and research institutions, can provide access to technical expertise and resources to support technical capacity building.

Developing Technical Manuals

Developing technical manuals and guidelines that provide step-by-step guidance on climate change adaptation can help support technical capacity building among BMA staff**.**

Organizing Workshops and Conferences

Organizing workshops and conferences can provide opportunities for BMA staff to learn about best practices and innovative approaches to climate change adaptation from experts and peers.

Providing Access to Tools and Technologies

Providing access to tools and technologies that support climate change adaptation, such as climate data and modelling software, can help build the technical capacity of BMA staff.

Promoting Networking and Collaboration

Promoting networking and collaboration among MMDA staff and with other stakeholders can help facilitate knowledge sharing and peer-to-peer learning on technical aspects of climate change adaptation.

4.4.12 Funding and Support

The following are avenues that the BMA can explore to mobilize funds for adaptation.

Green Climate Fund

BMA can build its capacity to access climate finance through readiness programs, which provide technical assistance and support to help identify and prepare for climate finance opportunities.

Public–Private Partnerships

This is an innovative financing mechanism that allows a Municipality like the Bekwai municipal Assembly to form partnerships with private sector organizations to mobilize funds for climate change adaptation projects. Under this arrangement, the private entity can bring in capital and technical expertise while the Municipal assembly provides the enabling environment for the implementation of the project. This arrangement is particularly useful in situations where the private sector has the necessary resources and expertise to undertake climate change adaptation projects that the municipal assembly might not have the capacity to handle.

Community-Based Climate Financing

This is another innovative financing mechanism that the municipality can use to mobilize funds for climate change adaptation projects at the local level. This mechanism involves engaging communities to establish community-based climate financing mechanisms, such as community funds, to mobilize funds for climate change adaptation projects. The community-based financing mechanisms are usually managed by community members themselves, and they provide a means for communities to take ownership of climate change adaptation projects in their areas. This approach not only helps to mobilize funds for climate change adaptation projects but also helps to build community resilience to the impacts of climate change.

Establish a Dedicated Climate Adaptation Fund

The municipality can establish a separate fund specifically for financing climate adaptation actions. This can be done through the establishment of a separate fund specifically for financing climate adaptation actions. This fund can be financed from the 20% portion of the assembly's internally generated funds allocated for infrastructure and other sources such as donor grants, corporate social responsibility initiatives, and private sector investments.

Corporate Social Responsibility

This represents an effective way to finance climate change adaptation in the municipality. Companies that operate in the municipality can contribute to climate change adaptation by integrating environmental and social considerations into their business practices. This calls for special relationships and arrangements with corporate entities to support the adaptation course.

Donor Partners

External funding through international donor agencies can explored to fund adaptation. However, the municipality must develop the technical capacity to develop climate change adaptation proposals. For example, the ongoing GIZ project on solar irrigation (Volta Premier 98.1 FM, 2021) can be tapped into by the municipality to finance adaptation action on irrigation for agriculture.

5. Framework for Adaptation Monitoring, Evaluation, and Learning

Monitoring, evaluation, and learning (MEL) are crucial for effective adaptation actions because they provide a means to assess the effectiveness and efficiency of adaptation interventions, identify successes and failures, and generate knowledge and insights that can inform future decision making. MEL can also help to identify unintended consequences of adaptation actions, such as negative impacts on ecosystems or social inequalities. This information can help decision-makers adjust their strategies and ensure that adaptation actions are socially and environmentally sustainable. In recent years, MEL of adaptation has become critical as global efforts to build resilience to climate change impacts intensify (Beauchamp & Jozefiak, 2023). To be efficient, the MEL process must be integrated into existing monitoring and evaluation (M&E) systems and made iterative to facilitate learning.

5.1 Building on Existing Structures to Facilitate Mainstreaming

MEL for climate adaptation tracks the progress made in implementing adaptation actions and measures the progress toward building climate resilience. The MEL system is expected to build on and complement national and Municipal efforts to monitor and evaluate progress and results, as well as promote effective climate change learning in the implementation of actions to achieve a developmental agenda.

Several laws, policies, and plans at the national level provide guidance for the development of M&E systems for development projects and programs. In Ghana, the responsibility for M&E lies with the NDPC. The national M&E system serves as a foundation for analyzing the relationships between inputs, activities, outputs, outcomes, and impacts concerning the delivery of public goods and services. The legal framework for M&E in Ghana is provided by Articles 86 and 87 of the 1992 Constitution of the Republic of Ghana, the National Development Planning System Act of 1994 (Act 480), and the National Development Planning (System) Regulations of 2016 (LI. 2232). These regulations require every government implementing agency to undertake M&E of their respective policies, programs, and projects.

The BMA is expected to have its own M&E plan that also encompasses the sub-district level. The NDPC provides guidelines to the MMDAs to prepare such plans (NDPC, 2020). Although there is no specific M&E plan for climate change adaptation, the NDPC guidelines cover various indicators related to climate change, the SDGs, Agenda 2063, and green economy issues. Climate change concerns have been incorporated into the BMA MTDP, and it is mandatory for BMA to monitor and evaluate the performance of the indicators and targets. What is not explicit in the NDPC M&E legal framework is the learning aspect. Globally, the learning element of MEL is new and evolving and requires that conscious efforts be made to deepen the learning component.

5.2 MEL Design

The framework for BMA's adaptation MEL system is designed to achieve the following objectives

- monitor outputs, such as tracking the implementation of agreed adaptation measures;
- evaluate outcomes, such as assessing the effectiveness of adaptation actions in reducing vulnerability;
- produce learning and knowledge to guide policy development and decision making and to raise awareness among stakeholders;
- produce information for reporting at the local government and national levels;
- provide space for climate data acquisition and storage to measure and track the progress of adaptation efforts at the local level;
- provide a clear communication channel for the strategy and adaptation efforts at the local level.

Operationalizing the adaptation MEL system requires a conscious integration of climate adaptation consideration into municipal development plans and policies, such as the MTDP, and algning them with the existing M&E architecture.

Table 65. Outline of approach to MEL of Bekwai's adaptation actions

Steps	Indicative activities—to be led by the BMA Municipal Planning Co-ordination Unit
1. **Monitoring** the adaptation actions	• Identify adaptation activities that will be monitored through qualitative and quantitative performance measures to determine progress made toward the adaptation objective(s). • Define metrics and indicators for documenting progress for the adaptation activities identified for monitoring. • Collect information on the metrics and indicators throughout the adaptation process.
2. Reviewing the adaptation process to assess progress, effectiveness, and gaps – **Evaluation**	• Determine the means for measuring and communicating levels of effectiveness and assessing gaps. • Gather and combine insights from recent studies and new scientific developments, along with feedback and results from current adaptation efforts. This process is essential for evaluating and modernizing the approach or strategy in question. • Revise the adaptation activities using evaluation information and metrics.
3. Iteratively updating theNAP – **Learning**	• Update the adaptation activities based on the information collected. • Document key lessons of what worked and what did not. • Establish a basis of success and/or failure. • Implement remedial measures. • Align learning and correctional measures with broader targets within the BMA MTDP.

Steps	Indicative activities—to be led by the BMA Municipal Planning Co-ordination Unit
4. **Communication** Report progress, process effectiveness, outreach, and knowledge and information dissemination	• Disseminate adaptation documents and learning products. • Provide information in the BMA annual progress report on the progress and effectiveness of the adaptation process.

Source: Adapted (and modified) from the Government of Liberia's four-step approach to the MEL of its NAP. See Environmental Protection Agency, Republic of Liberia, 2022.

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Appendix A. Validated Sector Adaptation Action Catalogue

Four stakeholder groups assigned scores to the indicators set out in the following tables. The stakeholders undertook the ranking based on their expert assessment of the indicator's performance against the criteria. The four stakeholder groups were

- Agriculture and Forestry (Ecosystems and Biodiversity)
- Water, Sanitation, and Health
- Infrastructure and Trade
- Gender and Marginal

Table A7. Indicator scores

1	Low
2	Neutral
3	Medium
4	High
(….)	Enclose number in parentheses to show high uncertainty

Table A2. Agriculture sector adaptation measures

Adaptation action	Early warning system/ climate information services	Promote adoption of drought-resistant varieties and early planting/ cultivation	Protection of waterbodies by preventing illegal activities that disturb them	Embark on sensitization and farmer education on climate change	Build silos and other storage facilities	Value addition to produce and local industrialization
Adaptation type	Risk reduction	Risk reduction	Risk reduction	Risk reduction	Risk reduction	Risk reduction
Implementation level	Municipal or government and community	Municipal or government and community	Municipal or government and community	Municipal or government	Municipal or government and community	Municipal or government
Risk gradient	Useful beyond risk	Useful beyond risk	Useful beyond risk	Useful beyond risk	Useful beyond risk	Useful beyond risk
Governance implications	Requires amendment to existing structure	Alignment with existing structure	Alignment with existing structure	Alignment with existing structure	Requires amendment to existing structure	Alignment with existing structure
SDGs & development co-benefit	Promotes SDGs 1, 2, 3, 6, 11, 13, 17	Promotes SDGs 1, 2, 3, 5	Promotes SDGs 2, 3, 5, 6, 11, 12, 14, 15	Promotes SDGs 2, 13, 14, 15	Promotes SDGs 2, 8, 12, 13	Promotes SDGs 1, 2, 5, 9, 8, 10, 12
Risk mitigation potential	3	4	2	3	4	3
Scalability	4	4	4	4	4	3
Replicability	4	4	4	4	4	3
Cost-effectiveness	3	2	4	4	3	2
Social & cultural acceptance	4	4	4	4	4	2
Cross-sectoral maladaptation	NA	NA	NA	NA	?	3 – redirection of resources could affect other sectors

Adaptation action	Early warning system/ climate information services	Promote adoption of drought-resistant varieties and early planting/ cultivation	Protection of waterbodies by preventing illegal activities that disturb them	Embark on sensitization and farmer education on climate change	Build silos and other storage facilities	Value addition to produce and local industrialization
Deliverability and feasibility	4	4	4	4	4	3
Technical feasibility	3	2	4	4	4	3
Social considerations	4	3	4	4	3	2
Stakeholder interest	4	4	4	4	3	4
GHG emissions	NA	NA	4	NA	3	(3) – depends on process involved in value addition
Biodiversity	NA	3	4	NA	(2)	(3)
Human health	NA	4	3	NA	3	(3)
Soil quality	NA	(2) – dependent on crop	3	NA	NA	(3)
Water quality	NA	NA	3	NA	NA	(3)
Air quality	NA	NA	3	NA	NA	(3)
Climate	NA	NA	3	NA	3	(3)
Landscape	NA	NA	3	NA	(2) – depends on structure and construction methods	(1)
Prioritized communities	Municipal wide	All farming communities	Communities along the Oda River	Municipal wide	Municipal wide	Municipal wide

Adaptation action	Early warning system/ climate information services	Promote adoption of drought-resistant varieties and early planting/ cultivation	Protection of waterbodies by preventing illegal activities that disturb them	Embark on sensitization and farmer education on climate change	Build silos and other storage facilities	Value addition to produce and local industrialization
Potential negative outcomes	Potential exclusion of illiterate farmers from access if the technology for dissemination does not consider their specific needs			Potential misinformation	Poor engineering of structures could make the action ineffective. Silos and storage facilities may attract pests.	• Negative diversion of raw materials • Competing industry • Labour or qualified person shortage • High fossil fuel energy dependent
Barriers for implementation	• Cost of implementation • Lack of institutional oversight • Slow technology adoption	• Lack of education • Cost depending on type • Lack of institutional oversight	• Lack of education and awareness • Cost and availability of seedlings • Lack of institutional oversight	• Lack of capacity • Cost and availability of seedlings • Lack of institutional support and oversight	• Insufficient capacity • Lack of institutional oversight • Lack of financial resources • Land tenure and ownership issues • Lack of local buy-in	• Lack of institutional oversight • Lack of financial resources • High cost of capital • Lack of government support

Table A3. Agriculture sector adaptation measures: irrigation

Adaptation action	Construction of irrigation systems
Adaptation type	Risk reduction
Implementation level	Municipal or government and community led
Risk gradient	Useful beyond risk
Governance implications	Alignment with existing structure
SDGs & development co-benefit	Promotes SDGs 1, 2, 3, 6, 8, 13, 15
Risk mitigation potential	4
Scalability	4
Replicability	3
Cost-effectiveness	3
Social & cultural acceptance	4
Cross-sectoral maladaptation	2
Deliverability and feasibility	4
Technical feasibility	3
Social considerations	3
Stakeholder interest	3
GHG emissions	3 – if powered by solar
Biodiversity	3
Human health	3
Soil quality	3
Water quality	3
Air quality	3
Climate	3
Landscape	3
Prioritized communities	Municipal wide
Potential negative outcomes	• Land tenure issues • Pressure on underground water can lower underground water tables • A risk that larger farmers or wealthier individuals might benefit more from the irrigation systems, exacerbating social inequalities within the community
Barriers for implementation	• Lack of institutional oversight and support • High initial cost and lack of financial resources of farmers to self-implement • Lack of sufficiently qualified personnel for construction, maintenance, and repairs

Source: Authors, based on BMA Stakeholder consultation process.

Table A4. Forestry sector adaptation measures

Adaptation action	Undertake afforestation program and ensure effective monitoring	Strengthen forest governance structures	Reclamation and sustainable land management	Wildlife and species conservation
Adaptation type	Risk reduction	Risk reduction	Risk reduction	Risk reduction
Implementation level	Municipal or government and community	Municipal or government led	Municipal or government and community	Municipal or government and community
Risk gradient	Useful beyond risk	Useful beyond risk	Useful beyond risk	Useful beyond risk
Governance implications	Requires amendment to existing structure	Alignment with existing structure	Alignment with existing structure	Alignment with existing structure
SDGs & development co-benefit	Promotes SDGs 1, 2, 3, 6, 11, 13, 17	Promotes SDGs 2, 6, 15, 13	Promotes SDGs 1, 2, 6, 11, 12, 15	Promotes SDGs 2, 13, 14, 15
Risk mitigation potential	3	4	3	3
Scalability	4	4	4	4
Replicability	4	4	4	4
Cost-effectiveness	3	3	3	4
Social & cultural acceptance	4	3	3	4
Cross-sectoral maladaptation	NA	NA	NA	NA
Deliverability and feasibility	4	4	4	4
Technical feasibility	3	4	4	4
Social considerations	4	3	4	4
Stakeholder interest	4	4	4	4
GHG emissions	4	4	4	NA
Biodiversity	4	4	4	NA

Adaptation action	Undertake afforestation program and ensure effective monitoring	Strengthen forest governance structures	Reclamation and sustainable land management	Wildlife and species conservation
Human health	4	4	3	NA
Soil quality	4	4	3	NA
Water quality	3	4	3	NA
Air quality	4	4	3	NA
Climate	4	4	3	NA
Landscape	4	4	3	NA
Prioritized communities	Municipal wide	Municipal wide	Municipal wide	Municipal wide
Potential negative outcomes	• Wrong tree species • Planting at wrong places	• Job losses • Potential further forest degradation • Community conflict • Potential ecological disturbances	• Job losses • Invasive species • Community conflict • Potential ecological disturbances	• Invasive species • Community conflict • Potential ecological disturbances
Barriers for implementation	• Cost and availability of seedlings • Lack of institutional oversight/political will • Land tenure and ownership issues • Potential lack of social buy-in or participation	• Cost of implementation • Lack of institutional oversight/political will	• Potential lack of social buy-in or participation • Limited resources and capacity • Lack of institutional oversight • Cost of implementation	• Potential lack of social buy-in or participation • Limited resources and Capacity • Lack of institutional support and oversight

Source: Authors, based on BMA Stakeholder consultation process.

Table A5. Gender sector adaptation measures

Adaptation action	Provide training in alternative livelihoods for women and other marginalized groups (liquid soap, po-made, and balm manufacturing)	Create conditions that enhance youth, women, and people with disabilities' (PWDs') access to credit to start or expand business	Education and sensitization to ensure gender equity	Provide education and training opportunities to empower marginalized groups (women, youth, PWD)
Adaptation type	Risk reduction	Risk reduction	Risk reduction	Risk reduction
Implementation level	Municipal or government	Municipal or government	Municipal or government	Municipal or government
Risk gradient	Useful beyond risk	Useful beyond risk	Useful beyond risk	Useful beyond risk
Governance implications	Alignment with existing structure	Alignment with existing structure	Alignment with existing structure	Alignment with existing structure
SDGs & development co-benefit	Promotes SDGs 1, 2, 3, 5, 8, 10, 16	Promotes SDGs 1, 2, 3, 5, 8, 10, 16	Promotes SDGs 1, 2, 3, 5, 8, 10, 16	Promotes SDGs 1, 2, 3, 5, 8, 10, 16
Risk mitigation potential	3	3	3	3
Scalability	3	3	4	4
Replicability	3	3	4	4
Cost-effectiveness	3	3	3	3
Social & cultural acceptance	4	4	4	4
Cross-sectoral maladaptation	N/A	N/A	N/A	N/A
Deliverability and feasibility	4	4	4	4
Technical feasibility	4	4	4	4
Social considerations	4	4	4	4
Stakeholder interest	4	4	4	4
GHG emissions	N/A	N/A	N/A	N/A

Adaptation action	Provide training in alternative livelihoods for women and other marginalized groups (liquid soap, po-made, and balm manufacturing)	Create conditions that enhance youth, women, and people with disabilities' (PWDs') access to credit to start or expand business	Education and sensitization to ensure gender equity	Provide education and training opportunities to empower marginalized groups (women, youth, PWD)
Biodiversity	N/A	N/A	N/A	N/A
Human health	N/A	N/A	N/A	N/A
Soil quality	N/A	N/A	N/A	N/A
Water quality	N/A	N/A	N/A	N/A
Air quality	N/A	N/A	N/A	N/A
Climate	N/A	N/A	N/A	N/A
Landscape	N/A	N/A	N/A	N/A
Prioritized communities	Municipal wide	Municipal wide	Municipal wide	Municipal wide
Potential negative outcomes	• Potential environmental degradation • Unsustainable businesses • Business failures	• Potential environmental degradation • Unsustainable businesses • Business failures	• Misinformation	• Misinformation
Barriers for implementation	• Cost implication • Lack of institutional support	• Cost implication • Lack of institutional support	• Cost implications • Lack of institutional support • Lack of qualified personnel	• Cost implications • Lack of institutional support • Lack of qualified personnel

Source: Authors, based on BMA Stakeholder consultation process.

Table A6. Health sector adaptation measures

Adaptation action	Integrating climate change considerations into public health campaigns and education	Enhance climate and health education and training	Construction of climate-resilient health facilities, retrofitting of existing health facilities, and adoption of new building standards (green buildings)	Enhance the resilience of health facilities to extreme climate events
Adaptation type	Risk reduction	Risk reduction	Risk reduction	Risk reduction
Implementation level	Municipal or government and community	Municipal or government and community	Municipal or government	Municipal or government and community
Risk gradient	Useful beyond risk	Useful beyond risk	Useful beyond risk	Useful beyond risk
Governance implications	Alignment with existing structure	Alignment with existing structure	Alignment with existing structure and requires an amendment to existing structures	Alignment with existing structure and requires an amendment to existing structures
SDGs & development co-benefit	Promotes SDGs 4, 17	Promotes SDGs 4, 17	Promotes SDGs 4, 11, 13, 17	Promotes SDGs 4, 11, 13, 17
Risk mitigation potential	3	3	2	3
Scalability	4	4	2	3
Replicability	4	4	2	3
Cost-effectiveness	3	3	2	2
Social & cultural acceptance	4	4	2	4
Cross-sectoral maladaptation	N/A	N/A	3	N/A
Deliverability and feasibility	4	4	2	3
Technical feasibility	4	4	3	3
Social considerations	3	3	2	4
Stakeholder interest	4	4	4	4

Adaptation action	Integrating climate change considerations into public health campaigns and education	Enhance climate and health education and training	Construction of climate-resilient health facilities, retrofitting of existing health facilities, and adoption of new building standards (green buildings)	Enhance the resilience of health facilities to extreme climate events
GHG emissions	2	2	2	2
Biodiversity	2	2	2	2
Human health	2	2	2	3
Soil quality	2	2	2	2
Water quality	2	2	2	2
Air quality	2	2	2	2
Climate	3	3	3	3
Landscape	2	2	2	2
Prioritized communities	Community wide	Community wide	Community wide	Community wide
Potential negative outcomes	Misinformation	Misinformation	Poor engineering and construction	Poor engineering and construction
Barriers for implementation	• Lack of qualified personnel • Lack of institutional support	• Lack of qualified personnel • Lack of institutional support	• Lack of qualified personnel • Lack of institutional support • High cost • Cultural/social acceptance	• Lack of qualified personnel • Lack of institutional support • High cost

Source: Authors, based on BMA Stakeholder consultation process.

Table A7. Infrastructure sector adaptation measures

Adaptation action	Planting of tall trees to serve as windbreaks	Reengineering of the Oda River bridge at Anwiankwanta	Enforce building codes and education
Adaptation type	Risk reduction	Risk reduction	Risk reduction
Implementation level	Municipal or government and community	Municipal or government led	Municipal or government and community
Risk gradient	Useful beyond risk	Useful beyond risk	Useful beyond risk
Governance implications	Requires amendment to existing structure	Alignment with existing structure	Alignment with existing structure
SDGs & development co-benefit	Promotes SDGs 15, 13, 11	Promotes SDGs 9, 16	Promotes SDG 16
Risk mitigation potential	3	3	3
Scalability	4	NA	4
Replicability	4	NA	4
Cost-effectiveness	4	2	3
Social & cultural acceptance	4	4	3
Cross-sectoral maladaptation	N/A	N/A	3-
Deliverability and feasibility	4	4	3
Technical feasibility	4	2	2
Social considerations	4	4	2
Stakeholder interest	4	4	4
GHG emissions	4	(1)	(2)
Biodiversity	4	(2)	(2)
Human health	3	N/A	(2)
Soil quality	3	N/A	(2)

Adaptation action	Planting of tall trees to serve as windbreaks	Reengineering of the Oda River bridge at Anwiankwanta	Enforce building codes and education
Water quality	3	N/A	(2)
Air quality	3	N/A	(2)
Climate	4	(1)	(3)
Landscape	3	2	(3)
Prioritized communities	Municipal wide	Municipal wide	(2)
Potential negative outcomes	• Wrong tree species • Planting at the wrong places	• Poor engineering can lead to greater disasters	• Insisting on certain standards • Market implications for new standards
Barriers for implementation	• Cost and availability of seedlings • Lack of institutional oversight/political will • Potential lack of social buy-in or participation	• Lack of financial resources • Lack of institutional oversight/political will	• Poor regulatory oversight • Sociocultural challenges • Lack of institutional oversight • Cost of implementation • Lack of financial resources

Source: Authors, based on BMA Stakeholder consultation process.

Table A8. Sanitation sector adaptation measures

Adaptation action	Provision of climate-resilient toilet facilities	Making and enforcing bylaws that have climate change considerations	Enhance social and behaviour change education
Adaptation type	Risk reduction	Risk reduction	Risk reduction
Implementation level	Municipal or government and community	Municipal or government	Municipal or government and community
Risk gradient	Useful beyond risk	Useful beyond risk	Useful beyond risk
Governance implications	Alignment with existing structure	Alignment with existing structure	Alignment with existing structure
SDGs & development co-benefit	Promotes SDGs 3, 9, 11, 13, 17	Promotes SDGs 4, 13, 16, 17	Promotes SDGs 4, 13
Risk mitigation potential	3	2	3
Scalability	4	4	4
Replicability	4	4	4
Cost-effectiveness	3	3	3
Social & cultural acceptance	4	3	4
Cross-sectoral maladaptation	N/A	N/A	N/A
Deliverability and feasibility	4	4	4
Technical feasibility	4	4	4
Social considerations	4	4	4
Stakeholder interest	4	4	4
GHG emissions	1	N/A	2
Biodiversity	1	N/A	2
Human health	3	3	2
Soil quality	1	N/A	2

Adaptation action	Provision of climate-resilient toilet facilities	Making and enforcing bylaws that have climate change considerations	Enhance social and behaviour change education
Water quality	2	N/A	3
Air quality	N/A	N/A	2
Climate	2	2	2
Landscape	2	N/A	2
Prioritized communities	Community wide	Community wide	Community wide
Potential negative outcomes	Poor engineering	Poor engineering	Misinformation
Barriers for implementation	• Cost implications • Lack of institutional support	• Cost implication • Lack of institutional support	• Lack of qualified personnel • Lack of institutional support

Source: Authors, based on BMA Stakeholder consultation process.

Table A9. Trade sector adaptation measures

Adaptation action	Incentive for green businesses and solutions that address climate change	Ensure livelihoods diversification	Encourage businesses to have insurance	Educate, communicate, and sensitize traders on climate hazards and provide early warning systems
Adaptation type	Risk reduction	Risk reduction	Risk transfer	Risk reduction
Implementation level	Municipal or government and community	Municipal or government	Municipal or government led	Municipal or government and community
Risk gradient	Useful beyond risk	Useful beyond risk	Risk specific	Useful beyond risk
Governance implications	Requires amendment to existing structure	Alignment with existing structure	Requires amendment to existing structure	Alignment with existing structure
SDGs & development co-benefit	Promotes SDGs 7, 9, 13, 14	Promotes SDGs 1, 2, 5, 8, 9, 10, 12,	Promotes SDGs 1, 2, 5, 8, 9, 10, 12,	Promotes SDGs 1, 2, 3, 6, 11, 13, 17
Risk mitigation potential	3	3	3	3
Scalability	4	3	3	4
Replicability	4	4	4	4
Cost-effectiveness	4	3	3	3
Social & cultural acceptance	4	3	3	4
Cross-sectoral maladaptation	N/A	N/A	N/A	N/A
Deliverability and feasibility	4	4	4	4
Technical feasibility	4	3	3	3
Social considerations	4	3	3	4
Stakeholder interest	4	4	4	4
Environmental considerations				

Adaptation action	Incentive for green businesses and solutions that address climate change	Ensure livelihoods diversification	Encourage businesses to have insurance	Educate, communicate, and sensitize traders on climate hazards and provide early warning systems
GHG emissions	(3)	(3)	N/A	(2)
Biodiversity	(3)	(3)	N/A	(2)
Human health	3	3	NA	(2)
Soil quality	(3)	(3)	NA	(2)
Water quality	(3)	(3)	NA	(2)
Air quality	(3)	(3)	NA	(2)
Climate	(3)	(3)	NA	(3)
Landscape	(3)	(3)	NA	(3)
Prioritized communities	Municipal wide	Municipal wide	Municipal wide	(2)
Potential negative outcomes	• Resource competition leading to scarcity • Capacity losses • Market competitions	• Resource competition leading to scarcity • Capacity losses • Market competitions	• High premiums • Lack of patronage	• Potential barrier to access for illiterate farmers if the technology dissemination doesn't consider their needs
Barriers for implementation	• Lack of institutional oversight/political will • Lack of financial resources • Unexpected market challenges	• Lack of institutional oversight/political will • Lack of financial resources • Lack of local government support • Unexpected market challenges • Resource scarcity	• Lack of awareness • Lack of institutional oversight/ political will • High cost of premium • Lack of policy support • Lack of education and understanding	• Lack of institutional oversight • Cost of implementation • Slow technology adoption

Source: Authors, based on BMA Stakeholder consultation process

Table A10. Water sector adaptation measures

Adaptation action	Wise use and water conservation through public education and behaviour change	Increasing municipal water storage capacity	Protection of existing water bodies	Water management regulation (for example through increasing the cost of water)	Take preventive actions to reduce water- and vector-borne diseases	Construction and mechanization of boreholes
Adaptation type	Risk reduction	Risk reduction	Risk reduction	Risk reduction	Risk reduction	Risk reduction
Implementation level	Municipal or government and community	Municipal or government and community	Municipal or government and community	Municipal or government and community	Municipal or government and community	Municipal or government
Risk gradient	Useful beyond risk	Useful beyond risk	Useful beyond risk	Useful beyond risk	Useful beyond risk	Useful beyond risk
Governance implications	Alignment with existing structure	Alignment with existing structure	Alignment with existing structure	Alignment with existing structure	Requires amendment to existing structure	Alignment with existing structure
SDGs & development co-benefit	Promotes SDGs 2, 3, 6	Promotes SDGs 2, 6	Promotes SDGs 2, 6, 11	Promotes SDGs 2, 6, 11	Promotes SDGs 3, 6, 11	Promotes SDGs 2, 6, 11
Risk mitigation potential	2	3	3	3	3	3
Scalability	2	3	4	4	4	4
Replicability	3	2	4	4	4	4
Cost-effectiveness	3	2	3	3	3	3
Social & cultural acceptance	3	4	4	2	4	4
Cross-sectoral maladaptation	N/A	N/A	N/A	N/A	N/A	N/A
Deliverability and feasibility	2	3	4	4	4	4

Adaptation action	Wise use and water conservation through public education and behaviour change	Increasing municipal water storage capacity	Protection of existing water bodies	Water management regulation (for example through increasing the cost of water)	Take preventive actions to reduce water- and vector-borne diseases	Construction and mechanization of boreholes
Technical feasibility	3	3	4	4	4	4
Social considerations	3	4	4	2	4	4
Stakeholder interest	4	4	4	4	3	4
GHG emissions	N/A	N/A	3	N/A		N/A
Biodiversity	N/A	N/A	3	N/A	N/A	N/A
Human health	2	N/A	3	N/A	N/A	3
Soil quality	N/A	3	3	N/A	N/A	N/A
Water quality	N/A	N/A	3	2	3	2
Air quality	N/A	3	3	N/A	N/A	N/A
Climate	3	N/A	3	2	N/A	N/A
Landscape	2	N/A	3	N/A	N/A	N/A
Prioritized communities	Municipal wide	Municipal wide	Municipal wide	Municipal wide	Municipal wide	Municipal wide
Potential negative outcomes	• Wrong use of receptacles • Potential flooding • Potential grounds for the breeding of mosquitoes and malaria	• Poor construction/engineering	• Poor conservation approaches	• High cost of water • Potential exclusion of the poor and vulnerable	• Misinformation • Poor educational approaches	• Poor engineering • Siting at wrong locations • Community conflicts

Adaptation action	Wise use and water conservation through public education and behaviour change	Increasing municipal water storage capacity	Protection of existing water bodies	Water management regulation (for example through increasing the cost of water)	Take preventive actions to reduce water- and vector-borne diseases	Construction and mechanization of boreholes
				• Use of unconventional means because of cost		
Barriers for implementation	• Cost of implementation • Lack of political support • Lack of technical know-how • Lack of resources/capacity	• Cost • Lack of political support • Lack of technical know-how • Lack of resources/capacity	• Cost • Lack of political support • Lack of technical know-how • Lack of Resources/ capacity	• Lack of political support • Social resistance • Lack of resources/capacity	• Cost • Lack of political support • Lack of technical know-how • Lack of resources/capacity	• Cost • Lack of political support • Lack of technical know-how • Lack of resources/capacity

Source: Authors, based on BMA Stakeholder consultation process.

Appendix B. Multicriteria Analysis (MCA) Score Sheet

Name of Sector:

Adaptation Action:

The assessment is divided into two depending on whether weight or score is applied to the indicator of the criteria.

Weighting

Certain adaptation actions by their nature may carry more weight or be more effective than others. For example, a community-led action would generate higher ownership and sustainability and should carry more weight than other actions that are autonomous or institution-led. Secondly, an action that has established structures for implementation already may carry greater weight than those that require new structures.

Table B1. MCA score sheet

Criteria	Description	Indicator	Which of the indicators apply	Weight
Adaptation type	This criterion evaluates the risk reduction or risk transfer potential of an identified adaptation option. For example, an irrigation system has a drought risk reduction potential, while crop insurance would transfer the risk.	Risk reduction		
		Risk transfer		
Implementation level	The level of implementation of an identified adaptation option.	Municipal/ government level led		
		Place or community led		
		Autonomous		
Risk gradient	This evaluates whether an identified adaptation option has "risk-specific" gradient or could be useful beyond the risk. "Risk-specific" gradient refers to the fact that some adaptation strategies mitigate specific risks and thus can only be cost-effective if impacts occur. In the absence of impact, the investment (or a part of it) will be lost. For example, crop insurance only mitigates the risk in the event of crop loss and the investment (or premium) is lost in the event of no impact. Post-harvest loss technology on the other hand could mitigate the risk of crop loss all times.	Risk-specific gradient		
		Useful beyond risk		
Governance implications of the measure	The adaptation option is aligned with, or requires amendments to the existing governance structures, or necessitates the establishment of new governance structures or processes.	Alignment with existing structure		
		Requires amendment to existing structure		
		Establishment of new governance structure		

Scoring

Score is assigned to an indicator based on the stakeholders' assessment of the indicator's performance against the criteria.

Table B2. Indicator scoring

1	Low
2	Neutral
3	Medium
4	High
(….)	Enclose number in parentheses to show high **uncertainty**

Table B3. Criteria and indicators

Criteria	Description	Indicator	Score (1-4)
SDGs and development co-benefit	How the adaptation option aligns with the SDGs and Municipal development agenda.	Number of SDGs that it addresses	Excluded
Risk mitigation potential	The ability of the adaptation option to mitigate the specific climate impact	Level of risk mitigation potential	
Upscaling and replicability potential	The extent to which a particular adaptation intervention can be expanded	Level of scalability	
		Level of replicability	
Cost-effectiveness	Cost associated with the implementation of the identified option. Cost covers from planning to implementation.		
Social and cultural acceptance	A project must be socially and culturally accepted to ensure local buy-in	level of social and cultural acceptance.	
Cross-sectoral maladaptation	Actions intended to reduce the impacts of climate change in one sector may end up creating more risk and vulnerability in the same or other sectors– (i.e., it can literally do more harm than good).	Level of perceived cross-sectoral maladaptation	

Criteria	Description	Indicator	Score (1-4)
Deliverability and feasibility	Delivered with existing institutional structures	Level of feasibility	
Technical feasibility	The technical know-how, capacity, and availability needed for the implementation of a particular adaptation intervention	Level of technical feasibility	
Social considerations,	Impacts on social inclusion and cohesion	Level of positive impact on social inclusion	
Environmental considerations	Improving or worsening		
	GHG emissions	Level of lowering GHG emissions	
	Biodiversity	Level of enhancing biodiversity	
	Human health	Level of improving human health	
	Soil quality	Level of enhancing soil quality	
	Water quality	Level of enhancing water quality	
	Air quality	Level of enhancing air quality	
	Climate	Level of improving climate	
	Landscape	Level of enhancing landscape	
Stakeholder interest		Stakeholders buy-in potential	
Prioritized communities			

Further Discussion

Potential negative outcomes

Barriers for implementation

Appendix C. Stakeholder List

1. Farmers Group
2. Ghana Federation of Disability Organization
3. Bekwai Youth Group
4. Ghana Education Service
5. Ghana Health Service
6. Zoomlion Ghana Limited
7. Bekwai Municipal Assembly
8. Ministry of Food and Agriculture
9. Forestry Commission
10. National Disaster Management Organization
11. Department of Parks and Gardens
12. Ghana National Fire Service (GNFS)
13. Statistical Service
14. University Ghana
15. Kwame Nkrumah University of Science and Technology
16. Assembly Men
17. Traditional Authority
18. Bekwai Women Farmers Association
19. Meteorological Service
20. Campaign for Female Education (CAMFED)
21. Environmental Protection Agency (EPA)


BEKWAI MUNICIPAL ASSEMBLY
AMANSIE PIESIE


FREEDOM AND JUSTICE


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