Climate Adaptation Plan for the Kassena Nankana Municipality: Ghana

August 2025

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Photo credit: Axel Fassio/CIFOR. Woman cleaning maize in Gwenia, Kassena Nankana District, Ghana.

About the NAP Global Network

This plan was developed with support from the NAP Global Network, an initiative created in 2014 to support developing countries in advancing their NAP processes and help accelerate adaptation efforts around the world. To achieve this, the Network facilitates South-South peer learning and exchange, supports national-level action on NAP formulation and implementation, and generates, synthesizes, and shares knowledge. The Network's members include individual participants from more than 155 countries involved in developing and implementing National Adaptation Plans. Financial support for the Network has been provided by Austria, Canada, Germany, Ireland, the Netherlands, the United Kingdom, and the United States. Additional support has been provided by ClimateWorks Foundation. The Secretariat is hosted by the International Institute for Sustainable Development (IISD). For more information, visit www.napglobalnetwork.org.

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Executive Summary

Introduction

The Climate Adaptation Plan for Kassena Nankana Municipality is a strategic framework developed to address pressing climate vulnerabilities and enhance local resilience in one of Northern Ghana's most climate-affected districts. The municipality faces a complex mix of climate-related challenges including erratic rainfall, prolonged droughts, heatwaves, high winds, and increasingly intense storms. These climate risks threaten key sectors such as agriculture, water resources, public health, infrastructure, and livelihoods, especially for vulnerable groups.

This plan was developed through extensive collaboration with local government stakeholders, including officers from key municipal directorates such as agriculture, water and sanitation, health, and gender. It builds upon findings from the Kassena Nankana Climate Vulnerability Assessment and aligns with Ghana's National Adaptation Plan process. The methodology combined scientific assessments, local knowledge, and participatory stakeholder consultations, ensuring a robust, context-specific, and inclusive adaptation planning process.

Objectives and Strategic Focus

The plan aims to

- identify and assess climate risks and vulnerabilities across key sectors;
- prioritize and implement locally relevant adaptation actions to reduce exposure and enhance resilience;
- promote inclusive governance through gender-responsive and community-driven adaptation planning;
- establish a diversified, sustainable financing strategy for implementation; and
- develop a monitoring, evaluation, and learning (MEL) framework to track progress and support adaptive management.

Climate Trends

Recent climate projections for Kassena Nankana show that average temperatures are expected to rise by 1.5°C to 2.5°C by mid-century, with more frequent and intense dry spells. A notable emerging pattern is the intensification of dry spells during the early rainy season (April–May), which significantly disrupts planting calendars and threatens food security. Rainfall variability has resulted in a paradoxical increase in both droughts and flash flooding within the same growing seasons. These overlapping hazards emphasize the urgent need for integrated adaptation strategies.

Sector-Specific Adaptation Measures

The Climate Adaptation Plan outlines comprehensive adaptation strategies across five thematic sectors:

Agriculture: Key measures include agroforestry, soil conservation, climate-resilient seeds, efficient irrigation technologies, and micro-insurance schemes. Agroforestry, in particular, emerged as a top priority for its dual role in flood mitigation and drought resilience.

Water resources and sanitation: The plan supports small-scale irrigation systems, community-led water governance, rainwater harvesting, and the use of digital tools for climate information dissemination. Community-preferred actions included training local extension officers as climate information ambassadors.

Gender and livelihoods: Adaptation actions promote women's empowerment through access to finance, alternative livelihoods, leadership platforms, and targeted climate-smart agricultural training. Mental health support for women and displaced persons was flagged as an important, though often overlooked, adaptation need.

Health: The health strategy includes climate-sensitive disease prevention, early warning systems, infrastructure upgrades, and expanded vaccination programs. It also prioritizes mental health support and surveillance of climate-induced diseases such as malaria.

Infrastructure and human settlements: Priorities include training in resilient construction methods, drainage improvement, climate-proof transport networks, and disaster preparedness. A key insight was the strong grassroots demand for training in climate-resilient building techniques.

Strategic Funding and Investment Framework

Implementation of the plan relies on a blended financing approach that includes national and local government allocations, international grants (e.g., Green Climate Fund, Global Environment Facility, Adaptation Fund), public-private partnerships, and community fundraising mechanisms. Innovative tools such as green bonds, carbon markets, and payments for ecosystem services are also proposed to ensure financial sustainability.

Monitoring, Evaluation, and Learning

A robust MEL framework has been designed to support adaptive implementation. The MEL system includes baseline setting, progress tracking, participatory reviews, and the integration of lessons learned into future planning cycles. It emphasizes transparency, inclusivity, and data-driven decision making in line with Ghana's national MEL systems.

Conclusion and Recommendations

The Kassena Nankana Climate Adaptation Plan provides a comprehensive, actionable roadmap for strengthening climate resilience. Its successful implementation will depend on

- mainstreaming adaptation into municipal development and budgeting processes,
- enhancing multi-stakeholder coordination and capacity building,
- securing long-term financing through diverse funding streams, and
- operationalizing the MEL system for adaptive and accountable planning.

By integrating scientific knowledge, traditional practices, and participatory governance, the plan positions Kassena Nankana as a proactive municipality in building resilience to climate change in Ghana.

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Abbreviations and Acronyms

AfDB	African Development Bank
CIF	Climate Investment Funds
CIS	Climate Information Services
DACF	District Assemblies Common Fund
FCDO	Foreign, Commonwealth and Development Office
GCCF	Ghana Climate Change Fund
GCF	Green Climate Fund
GEF	Global Environment Facility
GIIF	Ghana Infrastructure Investment Fund
GIS	Geographic Information Systems
GMet	Ghana Meteorological Agency
IPCC	Intergovernmental Panel on Climate Change
MDB	multilateral development bank
MEL	monitoring, evaluation, and learning
MESTI	Ministry of Environment, Science, Technology, and Innovation
MoFA	Ministry of Food and Agriculture
NAP	national adaptation plan
NGO	non-governmental organization
PES	Payments for Ecosystem Services
PPCR	Pilot Program for Climate Resilience
PPP	public-private partnership
SDG	Sustainable Development Goal
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations International Children's Emergency Fund
WHO	World Health Organization

1.0 Climate Change in the Kassena Nankana Municipality

1.1 Introduction

Climate change has emerged as one of the most pressing challenges of our time, with profound implications for ecosystems, economies, and societies worldwide. The Intergovernmental Panel on Climate Change's (IPCC) Sixth Assessment Report (2021) highlights the increasing severity of climate change, emphasizing rising global temperatures, shifts in ecosystems, and the growing frequency and intensity of extreme weather events such as floods, droughts, and heatwaves (IPCC, 2022). These climate risks have direct consequences for communities dependent on climate-sensitive sectors such as agriculture, water resources, health, forestry, and infrastructure.

In Ghana, the impacts of climate change are already evident, with rising temperatures, unpredictable rainfall patterns, and prolonged droughts threatening food security, water availability, ecosystem integrity, and economic stability. Northern Ghana, including the Kassena Nankana Municipality, is particularly vulnerable due to its location in the Sudan savannah agro-ecological zone, characterized by erratic rainfall and high temperatures. Climate variability in the Kassena Nankana Municipality is already affecting agricultural productivity, water availability, forestry resources, human health, and livelihoods, exacerbating socio-economic vulnerabilities (Acheampong et al., 2014; Atanga & Tankpa, 2021).

1.2 Current and Future Climate Scenarios

The historical climate patterns and future climate projections for the Kassena Nankana Municipality provide insights into expected changes, enabling policy-makers and stakeholders to develop climate-informed adaptation strategies. These projections are based on meteorological data from the Ghana Meteorological Agency and the Kassena Nankana Climate Vulnerability Assessment Report.

These projected changes indicate that the Kassena Nankana Municipality is likely to face increasing climate risks, making it essential to implement proactive adaptation strategies.

Table 1. Historical and future climate in the Kassena Nankana Municipality

Climate parameter	Historical climate	Future climate (mid-21st century projections)
Temperature	Warm tropical climate with average temperatures between 27°C and 33°C. Peak temperatures occur in March and April.	Projected temperature rise of 1.5°C to 2.5°C. Increased frequency and intensity of heatwaves.
Rainfall patterns	Single rainy season from May to October, followed by a prolonged dry season from November to April. Annual rainfall ranges from 850 mm to 1,200 mm. Irregular rainfall distribution, with some years experiencing droughts.	Increased rainfall variability, with more intense rainfall events. Higher likelihood of prolonged dry spells and shifts in seasonal rainfall patterns.

Climate parameter	Historical climate	Future climate (mid-21st century projections)
Dry periods	Harmattan season from November to February characterized by low humidity, dusty conditions, and cold nights. Extended dry periods frequently impact agriculture.	More frequent and intense dry spells, leading to longer drought periods. Rainfall onset delays may prolong initial dry spells, affecting planting seasons.
Humidity	Moderate to low humidity during the dry season; high humidity during the rainy season.	Increased humidity in some periods due to rising temperatures, potentially worsening heat stress.
Extreme weather events	Occasional heavy storms and localized flooding during peak rainfall periods. Strong winds associated with thunderstorms.	Increased frequency of extreme weather events, including flash floods, severe storms, and prolonged droughts. Higher risk of infrastructure damage and crop failures.
Wind patterns	Predominantly influenced by the Harmattan winds during the dry season. Moderate to strong winds occur during storm events.	Stronger wind gusts during storm periods, increasing infrastructure and crop damage. Possible alterations in seasonal wind patterns due to broader climate shifts.

Source: Authors

1.3 Climate Hazards, Vulnerabilities, and Risks

The Kassena Nankana Municipality is highly vulnerable to erratic rainfall patterns, prolonged droughts, extreme heat, and storm events. These climate hazards pose significant risks to agriculture, water resources, biodiversity, infrastructure, and human health.

Table 2. Climate hazards and key vulnerability factors

Climate hazards	Key vulnerability factors
Rainfall variability and flooding	Unreliable rainfall patterns affect agricultural planning. Poor drainage systems in urban and peri-urban areas increase flood risks. Low-lying agricultural areas are prone to crop damage due to flooding. Limited access to rainfall prediction tools hampers early preparation for extreme weather events.
Temperature increase and heatwaves	Rising temperatures reduce soil moisture, affecting crop growth and food production. Increased risk of heat stress among humans and livestock. Heat-induced evaporation leads to water scarcity, reducing irrigation and drinking water supply. Vulnerable groups, such as the elderly and children, face higher health risks from extreme heat.
Droughts and water scarcity	Prolonged dry periods reduce water availability for drinking, sanitation, and agriculture. Reliance on rain-fed agriculture makes the region highly susceptible to droughts. Poor water storage and irrigation infrastructure exacerbates water scarcity.
Storms and high winds	Strong winds damage homes, schools, and public buildings. High winds contribute to soil erosion and land degradation, further reducing agricultural productivity. Weak infrastructure, including roads and communication lines, is at risk of storm damage.

Source: Authors

1.4 Purpose of the Climate Adaptation Plan

To address these climate risks and sectoral vulnerabilities, the Kassena Nankana Municipal Assembly has developed this Climate Adaptation Plan to guide local adaptation actions. The plan was developed through a climate vulnerability assessment using both biophysical analysis and participatory stakeholder consultations, ensuring that the proposed interventions are contextually relevant and inclusive.

The adaptation plan focuses on four critical areas:

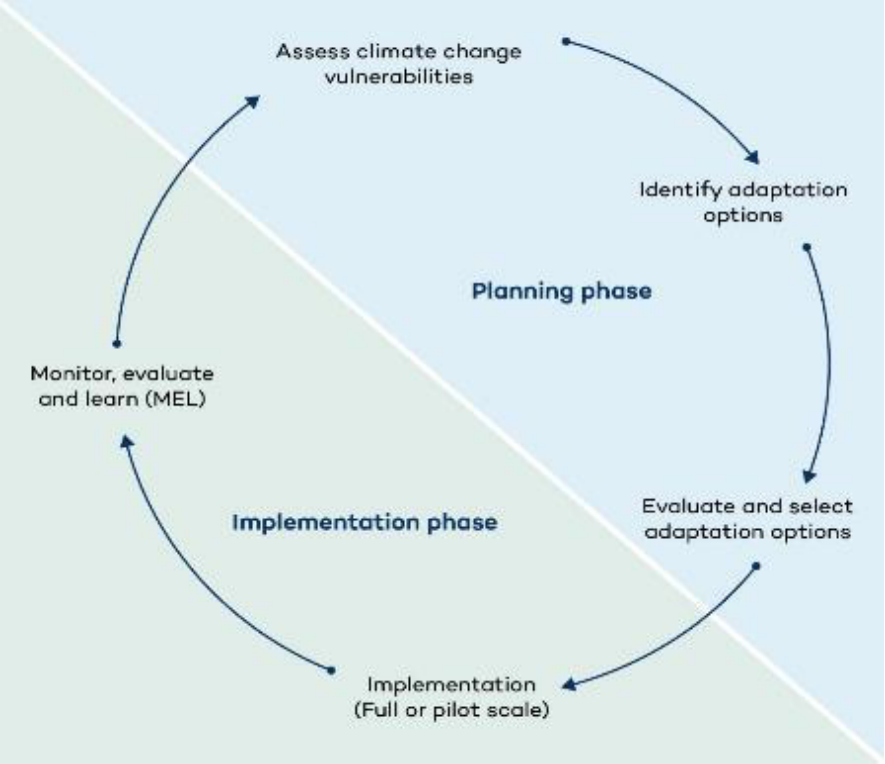
Risk Assessment and vulnerability analysis: Identifying and analyzing the most critical climate risks and vulnerabilities in sectors such as agriculture, water resources, forestry, health, gender, and infrastructure. This analysis provides the foundation for targeted interventions to reduce exposure and enhance adaptive capacity.

Stakeholder engagement: Emphasizing active participation of diverse stakeholders, including marginalized groups, in the planning, design, and implementation process to ensure broad support, inclusivity, and effectiveness.

Implementation of adaptation measures: Introducing practical and scalable interventions such as conservation agriculture, agroforestry initiatives, irrigation improvements, sustainable forestry practices, gender-sensitive interventions, and early warning systems to address identified climate risks.

Monitoring and evaluation: Establishing a dynamic framework to track progress, evaluate outcomes, and refine strategies, ensuring the plan's long-term sustainability and relevance in changing climate scenarios. This framework will also facilitate resource mobilization from government programs, international donors, and private investments to support ongoing and future adaptation initiatives.

Figure 1. Approach to the Kassena Nankana Municipal Assembly's adaptation planning



Source: Authors

1.5 Identification and Compilation of Sector-Specific Adaptation Actions

The identification of adaptation actions for the Kassena Nankana Municipality employed a rigorous and participatory approach, ensuring relevance, feasibility, and effectiveness. The comprehensive process aimed to address specific vulnerabilities and enhance climate resilience, drawing on vulnerability assessments, literature reviews, and extensive stakeholder engagement.

Methodologies included vulnerability assessments, detailed literature reviews, and stakeholder consultations summarized as follows:

Vulnerability assessment recommendations: The Climate Vulnerability Assessment identified critical climate impacts affecting agriculture, water resources, health, biodiversity, and infrastructure. Recommended adaptation strategies were integrated directly into the planning process to address prioritized vulnerabilities and risks.

Literature review: A thorough review of government policies, scientific publications, municipal reports, and relevant grey literature was conducted. This review provided insights into effective adaptation measures from similar regions.

Stakeholder consultations: Stakeholder involvement was essential to ensure adaptation measures were context-specific and viable. Participatory workshops included representatives from agriculture, water resources, human health, disaster risk reduction, biodiversity and forestry, fisheries, infrastructure and human settlements, and gender sectors.

Identified adaptation measures were grouped as follows:

Agriculture

- On-farm adaptation actions
    - Agroforestry and soil conservation
    - Irrigation and water management
    - Climate-resilient crops and input accessibility
    - Agricultural insurance and risk management
- Off-farm adaptation actions
    - Access to financial support and insurance schemes
    - Awareness creation and training programs
    - Access to climate information services (CIS) and early warning systems

Water resources and sanitation

- Climate-resilient water management
- Sustainable water infrastructure and governance
- Climate information services and early warning systems
- Digital solutions for water adaptation

Infrastructure and human settlements

- Climate-resilient building and construction
- Drainage and flood control infrastructure
- Disaster preparedness and early warning systems
- Climate-proofing transportation infrastructure

Health adaptation measures

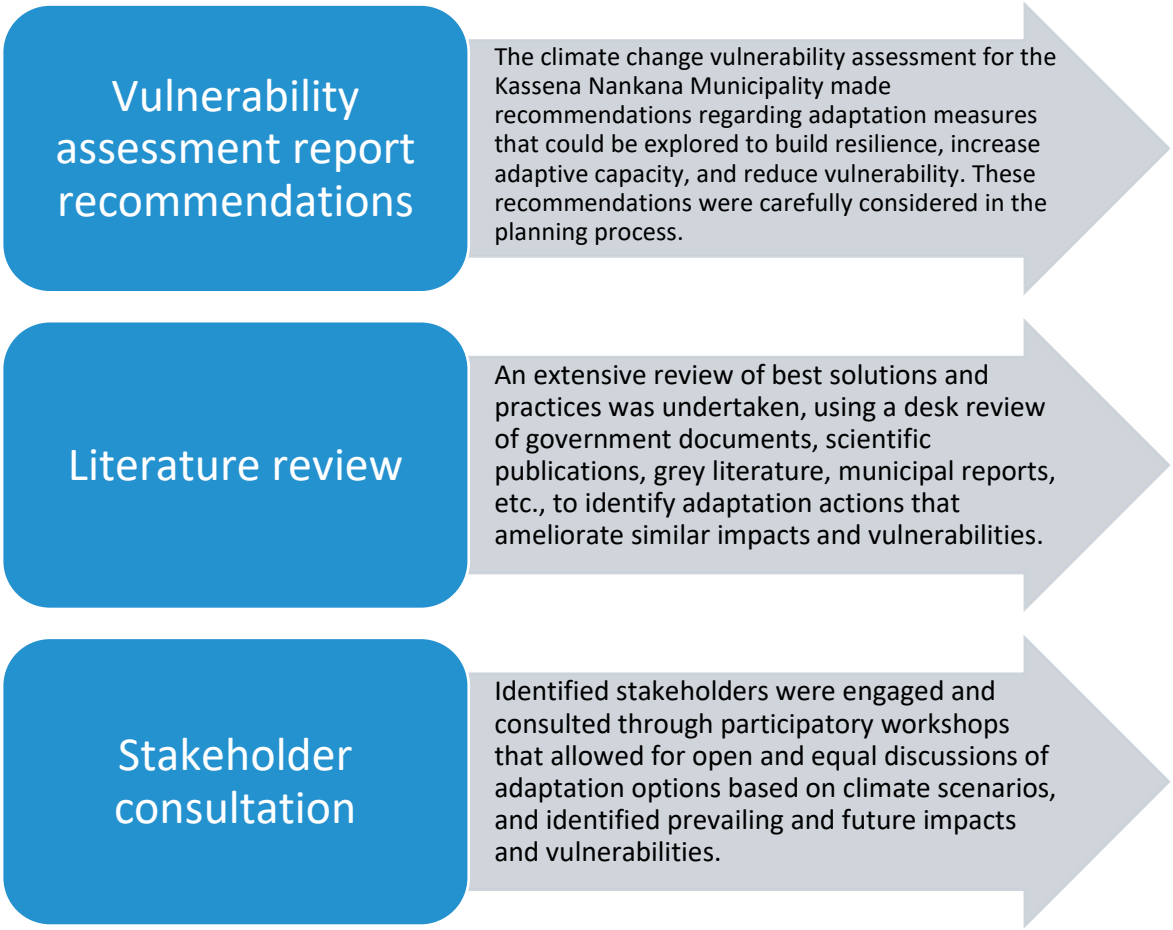
- Capacity building and disease prevention
- Vector-borne disease control

- Climate-sensitive health surveillance
- Strengthening health infrastructure
- Mental health and climate resilience

Gender and livelihoods

- Economic empowerment and livelihood diversification
- Gender-inclusive governance and leadership
- Capacity building and women-focused training
- Women's cooperatives and resource access

Figure 2. Steps for the Kassena Nankana Climate Adaptation Plan



Source: Authors

2.0 Methodological Approach for Ranking Adaptation Options

Based on the key vulnerabilities and climate risks identified in the Kassena Nankana Municipality, a comprehensive list of potential adaptation options was developed through detailed desk reviews, literature searches, and interactions with key stakeholders. These adaptation options were validated and refined through participatory stakeholder workshops, ensuring alignment with local priorities and realities.

Stakeholder workshops were organized on October 28, 2024, and March 27, 2025, bringing together representatives from nine key stakeholder groups: agriculture, biodiversity, water resources, human health, tourism, fisheries, disaster risk reduction, forestry, and gender. Participants were grouped based on expertise and sectoral focus to facilitate structured assessments. The adaptation options were categorized into thematic groups to address sector-specific challenges effectively.

This structured categorization enabled focused discussions and evaluation of adaptation options, ensuring that prioritized actions were suitable for the Kassena Nankana Municipality's unique socio-economic and environmental contexts.

The prioritization exercise considered various factors such as implementation feasibility, potential resilience enhancement, vulnerability reduction, and sustainable development contributions. Particular emphasis was placed on avoiding maladaptation by integrating diverse perspectives and rigorously evaluating both beneficial and potentially unintended consequences.

To objectively rank the adaptation options, a multi-criteria decision-making (MCDM) analysis framework was adopted. This systematic approach allowed stakeholders to assess each adaptation measure against multiple criteria, acknowledging variable performance across criteria and facilitating transparent decisions. The methodological steps included identifying evaluation criteria, assigning relative weights, and scoring adaptation options accordingly.

Table 3. Criteria for assessment of climate change adaptation options

S/N	Dimension	Indicator	Description
1	Effectiveness	Reduction of climate vulnerabilities	Assesses risk mitigation potential
2	Economic	Cost-efficiency	Evaluates financial feasibility and long-term benefits
3	Technical feasibility	Availability of technology/expertise	Determines the existence of resources and skills for implementation
4	Social acceptability	Cultural and traditional alignment	Examines community acceptance and alignment with traditional practices

S/N	Dimension	Indicator	Description
5	Institutional feasibility	Alignment with policies/institutions	Ensures compatibility with existing governance structures and regulatory frameworks
6	Environmental sustainability	Biodiversity/ecosystem impact	Assesses positive or negative environmental impacts
7	Equity and inclusiveness	Benefit to marginalized groups	Considers impacts on women, youth, and vulnerable populations
8	Scalability and replicability	Potential for expansion	Evaluates the potential for adaptation options to be scaled or replicated elsewhere
9	Flexibility	Adaptability to changing conditions	Measures ability to adjust in response to evolving climate conditions
10	Social co-benefits	Alignment with existing practices	Evaluates additional social benefits and integration with local customs
11	Gender responsiveness	Gender-related impacts	Assesses the extent to which adaptation addresses gender-related vulnerabilities
12	Barriers to implementation	Potential obstacles	Identifies possible institutional, economic, technical, and social barriers to implementation

Source: Adapted from Dixit & McGray, 2013.

Following indicator identification and ranking, weights were assigned reflecting their relative importance using a five-point Likert scale (Table 4). Climate change experts, municipal officials, agricultural specialists, water resource managers, and relevant stakeholders ranked these indicators based on perceived significance. Indicator weighting considered citation frequency during consultations, ensuring informed prioritization.

These weighted indicators guided the prioritization of adaptation actions, directing resources toward the most urgent and impactful interventions.

An essential step was estimating the costs of implementing prioritized adaptation options. After ranking adaptation actions, the list was forwarded to the municipal planning and finance departments of the Kassena Nankana Municipality. A specialized committee within the Finance Department was established to provide accurate cost estimates for each adaptation measure, forming a critical basis for financial planning and resource allocation.

Table 4. Likert scale for assigning indicator weights

Likert scale score	Description
1	Low
2	Neutral
3	Medium
4	High
(X)	High uncertainty

Source: Authors

Photos from workshops. Credit: Bob. O. Manteaw.

3.0 Adaptation Options for the Kassena Nankana Municipality

The adaptation options for the Kassena Nankana Municipality were developed based on a Climate Vulnerability Assessment and stakeholder consultations. These adaptation measures address the specific climate risks affecting critical sectors such as agriculture, water resources, health, infrastructure, and gender-related livelihoods. Each action has been assessed and prioritized based on its relevance to the socio-economic realities of the municipality, its potential to mitigate climate risks, support sustainable development, and promote equity.

The identification of adaptation options followed a participatory process, ensuring the inclusion of diverse stakeholder perspectives. Local government officials, community representatives, traditional authorities, and technical experts contributed to the assessment and ranking of these options. The collaborative approach ensured that the selected measures were practical, contextually relevant, and aligned with both municipal priorities and Ghana's National Adaptation Plan (NAP) framework.

To ensure effectiveness, each option was evaluated using a multi-criteria analysis (MCA) framework. This assessment considered factors such as technical feasibility, cost-effectiveness, environmental sustainability, and social acceptance. The adaptation options aim to enhance resilience, reduce vulnerabilities, and safeguard the livelihoods and ecosystems of the Kassena Nankana Municipality. The following sections present the detailed adaptation measures, their prioritization, and their alignment with the municipality's long-term development goals.

3.1 Agriculture

Agriculture is the backbone of livelihoods in the Kassena Nankana Municipality, with a significant proportion of households relying on farming for food and income. However, the sector is increasingly vulnerable to climate change, including erratic rainfall, prolonged dry spells, rising temperatures, and extreme weather events such as flooding. These challenges threaten agricultural productivity, food security, and the socio-economic stability of farming communities.

To address these vulnerabilities, on-farm adaptation actions have been identified as a critical component of the Kassena Nankana climate adaptation strategy. These actions aim to strengthen the resilience of agricultural systems by promoting sustainable farming practices, improving water resource management, and enhancing the adaptive capacity of farmers. The adaptation measures in Kassena Nankana have been categorized into four thematic areas.

Table 5. Ranking of adaptation options for the agricultural sector in the Kassena Nankana Municipality

Adaptation option	Final score	Rank
Expand extension services to provide training in agroforestry and conservation farming	48	1st
Promote agroforestry to reduce runoff and buffer floods	48	1st
Improve drainage systems and retention ponds to manage water flow	48	1st

Adaptation option	Final score	Rank
Provide incentives for the adoption of climate-resilient tools and crops	48	1st
Promote water-efficient irrigation technologies (e.g., drip irrigation, mulching)	46	2nd
Train farmers in water-saving methods (e.g., mulching, drip irrigation)	45	3rd
Distribute climate-resilient seeds through government programs, cooperatives, and non-governmental organizations (NGOs)	45	3rd
Develop solar-powered irrigation and community reservoirs	43	4th
Provide subsidies for adopting climate-smart technologies	44	4th
Run insurance awareness campaigns through farmer cooperatives	43	4th
Introduce affordable micro-insurance schemes tailored to smallholder risks	43	4th

Source: MPCU

3.1.1 Agroforestry and Soil Conservation

Agriculture in Kassena Nankana faces significant challenges due to soil degradation, erratic rainfall, and frequent flooding. These factors threaten productivity and livelihoods, particularly in communities where rain-fed agriculture dominates. Agroforestry and soil conservation have been identified as crucial strategies to address these challenges by enhancing soil health, controlling runoff, and promoting sustainable farming practices. Through participatory stakeholder consultations and an MCA, several adaptation options were evaluated and ranked.

Minimizing soil disturbance has been identified as an essential intervention to reduce erosion, conserve soil organisms, and improve soil structure. Conservation agriculture techniques such as reducing tillage and maintaining ground cover help farmers retain soil moisture and enhance crop yields. Community-based agroforestry initiatives have already begun in some areas, and further scaling of these interventions could significantly improve climate resilience in the municipality.

The improvement of drainage infrastructure, including retention ponds, has been ranked as a high-priority adaptation strategy to prevent waterlogging and soil erosion, both of which severely impact agricultural productivity. This structural intervention complements ecosystem-based solutions such as agroforestry, ensuring that flood-related damages are minimized.

3.1.2 Irrigation and Water Management

Water availability is a critical concern in Kassena Nankana, particularly for dry-season farming. Farmers in the municipality rely heavily on rain-fed agriculture, making them highly vulnerable to rainfall variability. Expanding access to irrigation and promoting efficient water-use techniques are key adaptation strategies to improve resilience to climate change.

Drip irrigation has been identified as a key adaptation measure to improve water-use efficiency in Kassena Nankana. This method delivers water directly to plant roots, minimizing evaporation and optimizing water conservation. Mulching is also widely promoted as an affordable and accessible technique to retain soil moisture. Training farmers in water conservation and irrigation techniques will enhance their ability to maintain productivity during dry periods.

The development of solar-powered irrigation and community reservoirs is another crucial adaptation strategy. Given the limited access to electricity in some rural communities, solar-powered solutions offer a sustainable alternative for improving irrigation capacity. This intervention, coupled with small-scale water storage systems, can help farmers maintain year-round crop production despite unpredictable rainfall patterns.

3.1.3 Climate-Resilient Crops and Input Accessibility

Ensuring access to climate-resilient seeds and improved farming inputs is essential for enhancing agricultural productivity in Kassena Nankana. The availability of drought-resistant crop varieties and the provision of targeted incentives for farmers to adopt climate-smart technologies were identified as priority adaptation strategies.

Drought-resistant seed varieties improve food security by ensuring consistent yields under extreme weather conditions. Distribution programs coordinated by government agencies, cooperatives, and NGOs will help ensure equitable access to these improved seed varieties. Financial support through subsidies can also accelerate the adoption of climate-smart technologies, reducing vulnerability among smallholder farmers.

3.1.4 Agricultural Insurance and Risk Management

Climate-induced risks such as droughts and floods significantly impact farming livelihoods in Kassena Nankana. Agricultural insurance schemes can provide financial protection for farmers, enabling them to recover more quickly from climate-related losses. However, many farmers lack awareness and access to suitable insurance products.

Increasing awareness of agricultural insurance options through farmer cooperatives can encourage wider participation in risk management schemes. Affordable micro-insurance products tailored to the needs of smallholder farmers will help cushion them from financial losses due to extreme weather events.

Table 6. Summary of adaptation options for agriculture

Objectives	**Indicators of success**	**Time frame**	**Resources** (finance, human, technology)	**Implementing partners**	**Estimated cost (GH₵)**
Adaptation action: Expand agroforestry extension services					
Train farmers in conservation farming and flood resilience	Increased adoption of sustainable practices, reduced erosion	Short term	Farmer training, agroforestry inputs	Local NGOs, agricultural extension services	50,000–80,000
Adaptation action: Improve drainage systems and retention ponds					
Control water runoff and mitigate flooding impacts on farmlands	Reduced farm losses due to flooding	Medium term	Infrastructure funding, engineering support	Kassena Nankana Assembly, environmental agencies	70,000–100,000
Adaptation action: Promote water-efficient irrigation technologies (e.g., drip irrigation, mulching)					
Enhance water-use efficiency for dry-season farming	Increased farm productivity during dry periods	Short term	Drip irrigation kits, training programs	Agricultural research institutions, farmer groups	60,000–90,000
Adaptation action: Distribute climate-resilient seeds (drought tolerant, flood resistant)					
Improve agricultural resilience to climate shocks	Higher crop yields in climate-stressed areas	Short term	Government seed programs, cooperative networks	Ministry of Food and Agriculture, cooperatives	40,000–70,000
Adaptation action: Introduce micro-insurance schemes for smallholder farmers					
Reduce financial risks from extreme weather	Reduce financial risks from extreme weather	Medium term	Insurance partnerships, cooperative outreach	Ghana Agricultural Insurance Program, local NGOs	50,000–80,000

Source: Authors

3.2 Water Resources and Sanitation

The Kassena Nankana Municipality faces significant challenges in water resources and sanitation due to shifting rainfall patterns, high-intensity storms, prolonged droughts, and rising temperatures. These climatic changes have exacerbated water scarcity, increased infrastructure failures, and heightened the risks of waterborne diseases. Additionally, limited access to CIS and inadequate maintenance of water infrastructure have contributed to frequent breakdowns of boreholes, dams, and irrigation systems.

Adaptation measures for water resources and sanitation focus on climate-resilient water management, infrastructure improvements, and community-led governance mechanisms to enhance water security. These actions were prioritized using the MCA framework, evaluating each adaptation option based on technical feasibility, cost-effectiveness, social acceptability, and long-term sustainability.

Table 7. Ranking of adaptation options for the water resources and sanitation sector

Adaptation option	Final score	Rank
Develop agroforestry systems to buffer against extreme weather impacts	51	1st
Expand access to small-scale irrigation systems and promote water conservation practices (e.g., alternate wetting and drying, efficient irrigation)	48	2nd
Train extension officers to act as CIS ambassadors	48	2nd
Introduce mobile weather advisories tailored to farming and water management needs	48	2nd
Implement community-led water resource management frameworks	48	2nd
Encourage public-private partnerships to fund water infrastructure upgrades	48	2nd
Repair and maintain existing water infrastructure (e.g., boreholes, dams)	46	3rd
Expand irrigation infrastructure (e.g., canals, tanks, boreholes)	43	4th
Install rainwater harvesting systems for households and farms	43	4th
Provide affordable smartphones and subsidized internet packages to improve access to water-related CIS	42	5th
Establish community internet hubs powered by solar energy	38	6th

Source: Authors

3.2.1 Climate-Resilient Water Management

Water security in Kassena Nankana is under increasing pressure due to unpredictable rainfall patterns, extreme weather events, and prolonged dry spells. To address this, agroforestry systems ranked highest among adaptation options, as they serve as a natural buffer against soil erosion and water shortages. By integrating tree planting with farming, these systems help regulate water flow, improve soil moisture retention, and reduce vulnerability to droughts and heavy rainfall events.

Expanding access to small-scale irrigation and promoting water conservation practices ranked second. Climate-resilient techniques such as alternate wetting and drying and efficient irrigation can help

maximize limited water resources. These practices ensure that farmers can maintain productivity during dry seasons while minimizing water waste.

3.2.2 Climate Information Services and Early Warning Systems

Limited access to CIS affects the ability of farmers and communities to make informed decisions about water management. Training extension officers to act as CIS ambassadors, combined with the introduction of mobile weather advisories, ranked highly as key adaptation strategies. These interventions will enhance real-time decision making on when to irrigate, plant crops, or prepare for extreme weather events.

By using localized mobile-based CIS platforms, farmers and water users can receive timely updates on water availability, flood risks, and changing weather conditions. This approach has been successfully piloted in other regions and has shown great potential in improving climate adaptation at the community level.

3.2.3 Sustainable Water Infrastructure and Governance

The poor maintenance of existing water infrastructure, including boreholes, small dams, and irrigation systems, poses a significant challenge in Kassena Nankana. Encouraging public-private partnerships for infrastructure funding and implementing community-led water management frameworks were ranked as second-tier priority actions. These interventions ensure that water resources are efficiently managed, maintained, and equitably distributed.

Repairing and maintaining existing water infrastructure remains a critical need, as frequent breakdowns limit access to reliable water sources. Investments in irrigation expansion (e.g., canals, tanks, and boreholes) will also help mitigate water scarcity, particularly for dry season farming and domestic use.

3.2.4 Digital Solutions for Water Adaptation

Limited internet access in rural areas hinders the delivery of CIS and water management tools. Two lower-ranking adaptation options focus on improving digital access: providing affordable smartphones and subsidized internet packages and establishing community internet hubs powered by solar energy. These strategies, though ranked lower, can complement early warning systems and expand access to climate data for farmers and water users.

Table 8. Summary of adaptation options for water resources and sanitation

Objectives	**Indicators of success**	**Time frame**	**Resources** (finance, human, technology)	**Implementing partners**	**Estimated cost (GH₵)**
Adaptation action: Develop agroforestry systems to buffer against extreme weather impacts					
Improve water retention, control soil erosion, and enhance resilience to climate shocks	Increase agroforestry adoption, reduced erosion and runoff	Medium term	Tree seedlings, farmer training, extension services	Kassena Nankana Assembly, Forestry Commission, agricultural extension services	70,000–100,000
Adaptation action: Expand small-scale irrigation and promote water conservation practices					
Increase water-use efficiency in farming	Improve irrigation access, increased dry-season farming	Short term	Irrigation equipment, farmer training, technical expertise	Ministry of Food and Agriculture, Farmer-based organizations	60,000–90,000
Adaptation action: Train extension officers as CIS ambassadors					
Improve access to climate and water information	More farmers using CIS tools, increased preparedness for extreme weather	Short term	Training programs, CIS platforms, ICT tools	Ghana Meteorological Agency, agricultural extension services	50,000 –80,000
Adaptation action: Introduce mobile weather advisories for water management					
Improve farmer decision making on irrigation and water use	Increased adoption of CIS-based irrigation planning	Short term	Mobile app development, telecom partnerships, training programs	Telecommunications companies, local NGOs	40,000–70,000
Adaptation action: Encourage public-private partnerships for water infrastructure					
Improve investment in water infrastructure upgrades	More boreholes/dams maintained, increased funding from private sector	Medium term	Infrastructure funding, policy frameworks	Kassena Nankana Assembly, Water Resources Commission	80,000–120,000
Adaptation action: Repair and maintain existing water infrastructure					
Increase water availability for domestic and farming use	Reduced breakdowns of boreholes/dams, improved water access	Short term	Borehole repair kits, maintenance teams, engineering support	Ministry of Water and Sanitation, local water committees	50,000–80,000

Source: Authors

3.3 Gender and Livelihoods

Gender-based vulnerabilities in the Kassena Nankana Municipality are exacerbated by climate change, particularly in rural communities where women and marginalized groups face economic insecurity, limited access to resources, and exclusion from decision-making processes. Climate-related challenges such as reduced agricultural productivity, water scarcity, and migration disproportionately affect women, who often rely on smallholder farming and informal labour for their livelihoods.

The adaptation measures in this section focus on empowering women, promoting economic diversification, strengthening gender-responsive programs, and ensuring inclusive governance. Using the MCA framework, these options were assessed based on their feasibility, social impact, cost-effectiveness, and potential to improve resilience at the community level.

Table 9. Ranking of adaptation options for the gender and livelihoods sector

Adaptation option	Final score	Rank
Promote income diversification (alternative livelihoods for women and vulnerable groups)	48	1st
Strengthen women's participation in decision-making bodies	48	1st
Establish gender-inclusive leadership platforms to enhance women's roles in governance	45	2nd
Implement gender-responsive programs to address women's climate vulnerabilities	45	2nd
Provide training in climate-smart agricultural practices tailored for women	44	3rd
Support the formation of women-focused cooperatives to improve resource access	44	3rd

Source: Authors

3.3.1 Economic Empowerment and Livelihood Diversification

Women and vulnerable groups in Kassena Nankana are often dependent on climate-sensitive livelihoods, particularly rain-fed agriculture. To reduce their vulnerability, income diversification strategies ranked as the highest-priority adaptation measure. By promoting alternative livelihoods—such as agro-processing, handicrafts, eco-tourism, and small-scale enterprises—women and marginalized groups can develop more resilient sources of income.

Strengthening women's access to financial services, such as microloans and community savings schemes, is a key enabler of economic diversification. These financial resources allow women to invest in climate-resilient businesses and reduce their dependence on agriculture, which is increasingly at risk due to erratic weather patterns and land degradation.

3.3.2 Gender-Inclusive Governance and Leadership

Women's participation in decision making remains low in many parts of the Kassena Nankana Municipality. Strengthening women's representation in governance structures ranked equally as the highest-priority adaptation measure, alongside economic empowerment. Women's leadership in

climate adaptation planning and community governance is essential for ensuring that their specific needs and priorities are incorporated into policy and project implementation.

The establishment of gender-inclusive leadership platforms ranked second, as these platforms can provide training, mentorship, and advocacy opportunities for women seeking roles in climate governance, natural resource management, and policy formulation.

3.3.3 Capacity Building and Women-Focused Training

Women are often excluded from agricultural extension programs, limiting their access to climate-resilient farming knowledge and technologies. Providing training in climate-smart agricultural practices tailored for women was ranked as a third-tier priority, as it directly improves agricultural productivity and ensures food security. These trainings will cover:

- Water-efficient farming methods (e.g., mulching, drip irrigation)
- Soil conservation techniques (e.g., agroforestry, crop rotation)
- Post-harvest management and value addition

Women's engagement in climate-smart agriculture is expected to increase resilience, enhance household incomes, and promote food security, particularly in communities highly dependent on farming.

3.3.4 Women's Cooperatives and Resource Access

Limited access to land, credit, and market opportunities poses a major barrier to gender-equitable adaptation. Supporting women-focused cooperatives ranked third, as cooperatives provide a structured platform for collective action, knowledge sharing, and joint investment in climate-resilient enterprises. These cooperatives enhance women's access to markets, financing, and climate-resilient inputs, ensuring that they can effectively adapt to changing environmental conditions.

Table 10. Summary of adaptation options for gender and livelihoods

Objectives	**Indicators of success**	**Time frame**	**Resources** (finance, human, technology)	**Implementing partners**	**Estimated cost (GH₵)**
Adaptation action: Promote income diversification for women and vulnerable groups					
Reduce economic dependence on climate-sensitive activities	Increased participation in alternative livelihoods, improved household incomes	Medium term	Vocational training, financial support, small business development	NGOs, microfinance institutions, local government	50,000–80,000
Adaptation action: Strengthen women's participation in decision-making bodies					
Ensure gender-inclusive climate governance	Increased number of women in leadership roles, improved policy responsiveness	Medium term	Leadership training, advocacy programs, community engagement	Women's associations, local government	40,000–70,000
Adaptation action: Establish gender-inclusive leadership platforms					
Promote mentorship and leadership development for women in climate adaptation	Increased representation of women in governance and resource management	Medium term	Capacity-building workshops, leadership networks	NGOs, policy think tanks, women's groups	50,000–80,000
Adaptation action: Implement gender-responsive programs					
Address gender-specific climate vulnerabilities	Increased access to climate adaptation resources for women	Medium term	Awareness campaigns, tailored adaptation initiatives	NGOs, advocacy groups, local government	40,000–70,000
Adaptation action: Provide training in climate-smart agricultural practices					
Improve women's agricultural productivity and resilience	Higher adoption of climate-smart farming methods	Short term	Farmer extension services, demonstration farms	Ministry of Agriculture, local NGOs	30,000–50,000
Adaptation action: Support the formation of women-focused cooperatives					
Enhance access to markets, financing, and climate-resilient inputs	Increased participation of women in cooperatives, improved resource access	Medium term	Cooperative development funds, training on business management	Cooperatives, financial institutions, local government	50,000–90,000

Source: Authors

3.4 Health Adaptation Measures

Climate change is significantly affecting health outcomes in the Kassena Nankana Municipality, particularly through increased temperatures, flooding, waterborne diseases, and the rise of vector-borne infections such as malaria. The impacts of extreme weather events also place a burden on health infrastructure, leading to higher cases of malnutrition, respiratory illnesses, and mental health challenges associated with displacement and loss of livelihoods.

The adaptation strategies for health focus on strengthening health care infrastructure, improving disease prevention mechanisms, enhancing community awareness, and integrating climate-sensitive health planning into municipal policies. These adaptation options were assessed and ranked using the MCA framework, considering technical feasibility, cost-effectiveness, social benefits, and overall resilience impact.

Table 11. Ranking of adaptation options for the health sector

Adaptation option	Final score	Rank
Train health care workers in climate-sensitive disease prevention and response	48	1st
Strengthen public health outreach programs (targeting climate migrants and vulnerable groups)	48	1st
Expand vaccination and immunization services to cover climate-induced health risks	48	1st
Implement malaria and vector-borne disease control measures	48	1st
Improve early warning systems for climate-sensitive diseases	46	2nd
Upgrade and climate-proof health infrastructure (e.g., heat-resilient hospital designs)	45	3rd
Promote mental health support for climate-displaced persons	44	4th

Source: Authors

3.4.1 Capacity Building and Disease Prevention

Health professionals in Kassena Nankana must be equipped with climate-sensitive training to handle emerging health threats. Training health care workers in climate-sensitive disease prevention was ranked as the highest-priority adaptation measure, as it ensures hospitals, clinics, and community health centers are prepared for climate-related disease outbreaks.

Public health outreach programs, particularly targeting climate migrants and vulnerable populations, were also ranked as a top-priority adaptation action. Flooding, displacement, and changing weather patterns increase the spread of infectious diseases, making community-based awareness campaigns essential.

Vaccination and immunization services must be expanded to cover climate-induced health risks, such as the rise in waterborne and vector-borne diseases linked to floods and stagnant water.

3.4.2 Vector-Borne Disease Control

Vector-borne diseases such as malaria, dengue, and cholera are becoming more prevalent due to warmer temperatures, changing rainfall patterns, and increased mosquito breeding grounds. Implementing malaria and vector-borne disease control measures ranked as a high-priority adaptation measure, ensuring that communities receive mosquito nets, indoor residual spraying, and access to rapid malaria testing kits.

3.4.3 Climate-Sensitive Health Surveillance

Early warning systems for climate-sensitive diseases ranked as a second-tier adaptation measure, as real-time climate and disease data can help health authorities predict outbreaks and deploy rapid response mechanisms. These systems involve integrating health surveillance with meteorological forecasts, allowing for advanced planning to reduce disease burdens.

3.4.4 Strengthening Health Infrastructure

Health care facilities in Kassena Nankana require infrastructure upgrades to withstand extreme temperatures, floods, and disease outbreaks. Upgrading and climate-proofing health infrastructure, such as heat-resilient hospital designs and improved drainage around health centers, ranked third among adaptation measures.

Access to safe water, sanitation, and hygiene (WASH) facilities within hospitals and clinics is critical to preventing climate-related health impacts, particularly in times of flooding and drought.

3.4.5 Mental Health and Climate Resilience

Climate-induced stress, displacement, and loss of livelihoods have increased mental health challenges in affected communities. Promoting mental health support for climate-displaced persons ranked fourth among adaptation measures. By integrating psychosocial support services into community health care programs, vulnerable populations can receive assistance in managing climate-related stress and trauma.

Table 12. Summary of adaptation options for health

Objectives	**Indicators of success**	**Time frame**	**Resources** (finance, human, technology)	**Implementing partners**	**Estimated cost (GH₵)**
Adaptation action: Train health care workers in climate-sensitive disease prevention					
Strengthen the health care system's ability to manage climate-related diseases	Increased number of trained health care professionals, improved response times	Short term	Training programs, educational materials, medical resources	Ministry of Health, Ghana Health Service	60,000–90,000
Adaptation action: Strengthen public health outreach programs					
Improve community awareness of climate-induced health risks	Higher participation in health programs, reduced incidence of preventable diseases	Short term	Community health workers, radio programs, mobile clinics	NGOs, community health departments	40,000–70,000
Adaptation action: Expand vaccination and immunization services					
Reduce climate-induced disease outbreaks	Increased vaccine coverage, fewer reported cases of preventable diseases	Short term	Vaccine procurement, cold storage facilities, outreach teams	UNICEF, WHO, Ghana Health Service	70,000–100,000
Adaptation action: Implement malaria and vector-borne disease control					
Minimize the spread of mosquito-borne illnesses	Increased distribution of mosquito nets, lower malaria incidence	Short term	Insecticide-treated nets, community spraying campaigns, testing kits	National Malaria Control Program, local health units	50,000–80,000
Adaptation action: Improve early warning systems for climate-sensitive diseases					
Strengthen disease surveillance and emergency preparedness	Faster outbreak detection, improved coordination between health and climate agencies	Medium term	Digital health tracking systems, climate-disease data integration	Ghana Meteorological Agency, Ministry of Health	60,000–90,000
Adaptation action: Upgrade and climate-proof health infrastructure					
Enhance health care facility resilience to extreme weather conditions	Increased number of climate-proofed hospitals and clinics	Medium term	Construction materials, engineering expertise, financial investment	Ministry of Health, infrastructure development agencies	80,000–120,000

Objectives	**Indicators of success**	**Time frame**	**Resources** (finance, human, technology)	**Implementing partners**	**Estimated cost (GH₵)**
Adaptation action: Promote mental health support for climate-displaced persons					
Address psychological impacts of climate change	Increased access to mental health services, reduced climate-related stress cases	Medium term	Counselling services, community health integration	NGOs, mental health institutions	50,000–80,000

Source: Authors

3.5 Infrastructure and Human Settlements

Climate change is placing significant pressure on infrastructure and human settlements in the Kassena Nankana Municipality. The increasing frequency of floods, storms, and extreme temperatures is causing damage to roads, homes, drainage systems, and public buildings. Informal settlements and poorly planned urban expansion further exacerbate the municipality's vulnerability, leading to disruptions in transportation, housing, and essential services.

The adaptation measures in this section focus on climate-resilient construction, improving drainage infrastructure, and strengthening local capacity for disaster risk reduction. These actions were ranked using the MCA framework, considering technical feasibility, affordability, long-term sustainability, and social benefits.

Table 13. Ranking of adaptation options for the infrastructure and human settlements sector

Adaptation option	Final score	Rank
Train local communities on disaster-resilient construction techniques	48	1st
Establish local technician training programs for routine infrastructure maintenance	48	1st
Support the local production of affordable climate-resilient building materials	48	1st
Improve urban and rural drainage systems to reduce flood risk	46	2nd
Strengthen disaster preparedness and early warning systems for extreme weather events	45	3rd
Upgrade road networks to improve resilience to flooding and heavy rainfall	44	4th

Source: Authors

3.5.1 Climate-Resilient Building and Construction

Unregulated housing and weak infrastructure make Kassena Nankana's urban and rural settlements highly vulnerable to climate change. Training communities on disaster-resilient construction techniques ranked as a top adaptation measure, as it enhances the capacity of local builders, engineers, and residents to construct climate-proof housing.

The establishment of local technician training programs was equally prioritized, focusing on the routine inspection and maintenance of infrastructure. By equipping local workers with these skills, the municipality can reduce long-term repair costs and minimize infrastructure failures due to extreme weather events.

Supporting the local production of climate-resilient building materials ranked among the highest adaptation options. Locally sourced, affordable, and climate-adaptive materials (e.g., flood-resistant bricks, heat-resistant roofing, and reinforced concrete structures) will enable low-income households to build more durable homes while boosting local economies.

3.5.2 Drainage and Flood Control Infrastructure

Flooding is a recurring challenge in both urban and rural parts of Kassena Nankana. Improving urban and rural drainage systems ranked second, as poor drainage contributes to property damage, displacement, and transportation disruptions during heavy rainfall. The municipality requires investment in expanded drainage networks, retention basins, and flood diversion systems to mitigate these risks.

3.5.3 Disaster Preparedness and Early Warning Systems

With extreme weather events becoming more frequent, strengthening disaster preparedness and early warning systems ranked as a third-tier priority. The municipality needs a structured approach to disaster risk reduction, including:

- Real-time weather monitoring and community alerts
- Evacuation planning and emergency response coordination
- Public awareness campaigns on climate-induced disasters

3.5.4 Climate-Proofing Transportation Infrastructure

Climate variability affects road networks and transportation systems, particularly in flood-prone areas. Upgrading road networks to improve their resilience to flooding and heavy rainfall was ranked fourth. Strengthening road construction standards by incorporating elevated roadbeds, reinforced culverts, and improved drainage integration will reduce disruptions in movement and supply chains.

Table 14. Summary of adaptation options for infrastructure and human settlements

Objectives	**Indicators of success**	**Time frame**	**Resources** (finance, human, technology)	**Implementing partners**	**Estimated cost (GH₵)**
Adaptation action: Train local communities on disaster-resilient construction					
Enhance local capacity for climate-adaptive housing	Increased adoption of resilient construction practices	Short term	Training programs, building materials, construction experts	NGOs, local government, construction training institutions	50,000–80,000
Adaptation action: Establish local technician training programs					
Build skilled labour for routine infrastructure maintenance	Higher number of trained technicians, improved infrastructure upkeep	Short term	Technical workshops, apprenticeship programs, equipment	Ministry of Works and Housing, local vocational schools	40,000–70,000
Adaptation action: Support local production of affordable climate-resilient building materials					
Improve access to durable and affordable housing materials	Increased use of flood-resistant bricks and heat-resistant roofing	Medium term	Small-scale manufacturing support, subsidies for climate-smart materials	Private sector, micro-enterprises, local entrepreneurs	50,000–90,000
Adaptation action: Improve urban and rural drainage systems					
Reduce flood risk in residential and commercial areas	Expansion of drainage networks, reduced flooding incidents	Medium term	Engineering expertise, drainage expansion funding, maintenance plans	Municipal engineers, Ministry of Infrastructure	70,000–100,000
Adaptation action: Strengthen disaster preparedness and early warning systems					
Enhance emergency response capacity for extreme weather events	Faster disaster response times, higher community preparedness	Medium term	Weather monitoring systems, community alert platforms	Ghana Meteorological Agency, local emergency services	60,000–90,000

Objectives	**Indicators of success**	**Time frame**	**Resources** (finance, human, technology)	**Implementing partners**	**Estimated cost (GH₵)**
Adaptation action: Upgrade road networks for climate resilience					
Reduce flood damage to transportation systems	Increased road durability in flood-prone areas	Long term	Road construction materials, drainage integration, engineering support	Ministry of Roads and Highways, municipal assembly	80,000–120,000

Source: Authors

4.0 Strategic Funding and Investment Framework

4.1 Introduction

The implementation of climate adaptation measures in the Kassena Nankana Municipality necessitates a tailored and strategic approach to funding that reflects the unique vulnerabilities and opportunities within the district. Situated in Ghana's Bono East Region, Kassena Nankana faces multifaceted climate challenges, including erratic rainfall, deforestation, water scarcity, and agricultural productivity losses, which demand targeted financial strategies.

This framework aims to achieve two primary objectives: to identify and mobilize diverse funding sources and to establish clear criteria for prioritizing resource allocation. These objectives are grounded in the municipality's commitment to addressing climate vulnerabilities while fostering economic growth, environmental sustainability, and social equity.

Kassena Nankana's funding strategy leverages a mix of local, national, and international financial streams. This includes mobilizing resources from government budgets, engaging with global climate funds, fostering public-private partnerships, and empowering local communities to contribute actively. Such an approach ensures financial resilience, especially in a context of fluctuating economic conditions and evolving climate risks.

Prioritization of funding will be guided by the municipality's development agenda, focusing on actions that address the most pressing climate risks, maximize community benefits, and ensure long-term sustainability. Special emphasis will be placed on gender-responsive programs, ecosystem-based solutions, and initiatives that enhance local capacity for climate resilience.

This framework serves as a roadmap to secure and manage the financial resources required for transforming Kassena Nankana's adaptation plan into actionable solutions, aligning global best practices with local realities for a sustainable and resilient future.

4.2 Potential Funding Sources for Kassena Nankana

The implementation of climate adaptation strategies in the Kassena Nankana Municipality hinges on securing diverse funding streams that align with its specific vulnerabilities and priorities. Kassena Nankana faces critical challenges, including deforestation, unreliable water supplies, agricultural stress due to erratic rainfall, and limited infrastructure resilience. The following funding sources are identified as key enablers for addressing these challenges.

4.2.1 Government Funding (National and Local)

Government funding remains a critical pillar in addressing the Kassena Nankana Municipality's climate adaptation needs, providing essential financial support for implementing projects that align with national development goals and the unique vulnerabilities of the district. Given the municipality's reliance on rain-fed agriculture, vulnerable ecosystems, and limited infrastructure, targeted government support is essential to mitigate climate risks, enhance resilience, and sustain livelihoods.

Kassena Nankana's adaptation priorities include improving water resource management, promoting sustainable agriculture, rehabilitating forests, and building disaster-resilient infrastructure. These priorities align with Ghana's broader climate strategies, including the National Climate Change Policy and the National Adaptation Plan, which emphasize resource mobilization at both national and local levels.

Key Government Funding Mechanisms

The **Ghana Climate Change Fund** (GCCF) provides targeted funding for climate adaptation and mitigation projects in vulnerable communities. This fund can address Kassena Nankana's adaptation needs by supporting:

- Water resource management: Funding rainwater harvesting and borehole development to improve water security for agriculture and households.
- Forestry rehabilitation: Financing reforestation programs to combat deforestation and restore degraded forest areas.
- Community resilience: Supporting disaster preparedness training and early warning systems to minimize the impact of extreme weather events.

The **Municipal Assemblies Common Fund** (DACF) is a critical resource for local-level projects. It allows assemblies like Kassena Nankana to design and implement grassroots adaptation measures, including:

- Small-scale irrigation systems: Providing farmers with affordable and efficient water systems to reduce reliance on rainfall.
- Training in climate-smart practices: Funding workshops and demonstrations to equip farmers with sustainable agricultural techniques, such as conservation agriculture.
- Rural infrastructure: Financing the construction of flood-resilient roads and drainage systems to reduce damage during heavy rains.

The **Ministry of Food and Agriculture** (MoFA) provides sector-specific funding to enhance food security and support farmers. It is particularly relevant for:

- Drought-resistant crops: Distributing improved crop varieties suitable for Kassena Nankana's changing climate.
- Farmer cooperatives: Establishing cooperatives to improve access to resources and markets.
- Agroforestry promotion: Encouraging the integration of trees into farming systems to reduce erosion and enhance soil fertility.

The **Ministry of Environment, Science, Technology, and Innovation** (MESTI) supports innovative and nature-based climate adaptation strategies. Funding opportunities include:

- Reforestation and biodiversity conservation: Supporting the establishment of community-managed forest reserves.

- Sustainable energy solutions: Introducing solar-powered irrigation and water systems to reduce energy costs and improve water access.
- Climate impact research: Funding localized studies to assess vulnerabilities and design evidence-based interventions.

The **Ghana Infrastructure Investment Fund** (GIIF) supports large-scale infrastructure projects that enhance resilience to climate impacts. For Kassena Nankana, this fund can finance:

- Flood-resilient roads and bridges: Upgrading transport networks to withstand extreme weather.
- Drainage systems: Developing urban and rural drainage to manage flood risks.
- Renewable energy infrastructure: Supporting the deployment of solar-powered systems in rural communities.

Funding from the **Forestry Commission** supports programs to combat deforestation and promote sustainable land use. In Kassena Nankana, this funding can be used for:

- Forest restoration projects: Planting native tree species to rehabilitate degraded lands.
- Community-based conservation: Engaging local communities in managing and protecting forest resources.
- Fuelwood alternatives: Promoting the adoption of biomass briquettes to reduce pressure on forest resources.

4.2.2 International Aid and Grants

International aid and grants play a critical role in bridging the resource gaps required for implementing climate adaptation measures in the Kassena Nankana Municipality. These funding sources provide both financial and technical support to address pressing climate vulnerabilities such as erratic rainfall, deforestation, declining agricultural productivity, and inadequate water resources. By tapping into international mechanisms, Kassena Nankana can accelerate its efforts to build resilience across sectors while ensuring sustainability.

The Green Climate Fund (GCF), established under the United Nations Framework Convention on Climate Change (UNFCCC), is one of the largest climate finance mechanisms available to developing countries. The GCF offers significant funding opportunities for both mitigation and adaptation projects. For Kassena Nankana, GCF resources could be directed toward agroforestry promotion and the restoration of degraded forests, addressing the district's urgent need to combat deforestation and enhance ecosystem services. Additionally, the fund could support the installation of solar-powered water systems to improve access to reliable water supplies for agriculture and household use, mitigating the impacts of erratic rainfall and prolonged droughts.

Similarly, the Adaptation Fund, also established under the UNFCCC, is well-suited for financing localized, community-driven adaptation projects in Kassena Nankana. This fund emphasizes initiatives that enhance the resilience of vulnerable populations. In Kassena Nankana, it could be used to develop

rainwater harvesting systems in underserved areas or to upgrade health facilities to address climate-induced health risks, such as heat-related illnesses and waterborne diseases. The Adaptation Fund's focus on direct community benefits aligns with Kassena Nankana's priority to empower local populations while building resilience.

The Global Environment Facility (GEF) is another critical source of international funding, offering grants for projects that address biodiversity conservation, land restoration, and sustainable land use. For Kassena Nankana, the GEF could support community-based reforestation programs aimed at restoring degraded lands and protecting watersheds. Such projects not only combat deforestation but also provide alternative livelihoods for forest-dependent communities, aligning with the district's goals of poverty alleviation and ecosystem restoration.

Bilateral partnerships with development agencies such as GIZ and the UK's Foreign, Commonwealth & Development Office (FCDO) present additional opportunities for Kassena Nankana. These organizations often fund projects that integrate climate resilience into local development. For example, GIZ could provide technical and financial support for training programs on climate-smart agriculture, equipping farmers with the skills to adopt sustainable practices like crop rotation and soil conservation. Similarly, USAID could finance small-scale irrigation projects, addressing the district's water scarcity challenges and enhancing agricultural productivity.

In addition to multilateral and bilateral aid, global philanthropic organizations such as the Gates Foundation and the Rockefeller Foundation have demonstrated a commitment to funding innovative solutions for climate adaptation. These foundations can provide grants for projects like mobile-based weather information systems, which would enable Kassena Nankana's farmers to make informed decisions about planting and harvesting. Philanthropic support could also fund educational campaigns to raise awareness about the benefits of adopting climate-smart practices.

Multilateral development banks (MDBs), including the World Bank and the African Development Bank (AfDB), offer concessional loans and grants for large-scale infrastructure projects. Kassena Nankana could leverage these resources to construct flood-resilient roads and drainage systems, which are critical for reducing the impacts of extreme weather events on livelihoods and infrastructure. These banks also support renewable energy installations, such as solar grids, which could be deployed in off-grid areas to enhance energy access.

Lastly, the Climate Investment Funds (CIF), through programs like the Pilot Program for Climate Resilience (PPCR), provide opportunities to integrate climate resilience into municipal planning. For Kassena Nankana, this could mean securing funding to align its adaptation strategies with national policies, such as Ghana's National Adaptation Plan, while focusing on vulnerable groups like women and youth.

4.2.3 Public-Private Partnerships

Public-private partnerships (PPPs) represent a transformative approach to addressing climate adaptation challenges in the Kassena Nankana Municipality. By leveraging the financial resources, technological expertise, and operational efficiency of private sector actors, PPPs can complement

public sector efforts to implement large-scale, high-impact projects that build resilience to climate change. In Kassena Nankana, where vulnerabilities include deforestation, inadequate water resources, and limited infrastructure, PPPs can be instrumental in bridging the resource and capacity gaps (Ogunsola et al., 2024).

One of the key areas where PPPs can create significant impact is renewable energy deployment, particularly for rural electrification and sustainable water systems. Solar-powered water systems, for instance, could be co-financed by private energy companies in partnership with the municipal assembly. These systems would address the challenges of water scarcity and unreliable electricity in remote areas, ensuring a steady supply of water for agricultural and domestic use (Yang & Yang, 2018). Private partners can bring the technical know-how for system installation and maintenance, while the municipality ensures community buy-in and alignment with local development priorities.

PPPs can also play a pivotal role in climate-resilient infrastructure development. The construction of flood-resistant roads and bridges is critical for minimizing disruptions caused by extreme weather events, such as heavy rainfall and flooding, which are common in Kassena Nankana. Through PPPs, the private sector could provide the capital and engineering expertise needed to implement such projects, while the public sector ensures that these developments align with national climate policies and local needs. These partnerships not only enhance infrastructure resilience but also create employment opportunities for local residents.

In the agricultural sector, PPPs can support the adoption of climate-smart technologies, such as precision farming tools and improved irrigation systems (de Jalón et al., 2018). Private agribusinesses and technology firms could collaborate with the municipality to introduce these innovations, reducing farmers' vulnerability to erratic rainfall and improving productivity. For example, drip irrigation systems—although costly for individual farmers—can become more accessible through co-financing arrangements between the public sector and private entities. This approach fosters inclusive growth by enabling smallholder farmers to adapt to climate challenges (Nanka-Bruce, 2008).

Another critical area for PPPs is forest conservation and ecosystem restoration. Deforestation is a significant issue in Kassena Nankana, threatening biodiversity and increasing the risk of soil erosion. Partnerships with private forestry companies and environmental organizations can facilitate large-scale reforestation efforts. These initiatives could involve tree planting campaigns, agroforestry projects, and the sustainable harvesting of timber and non-timber products (Mekonnen & Sarwat, 2017). Private sector involvement ensures the availability of financial resources and technical expertise, while the public sector provides regulatory oversight and facilitates community engagement.

Additionally, PPPs offer an avenue for implementing waste management solutions that promote both climate adaptation and mitigation. Waste-to-energy projects, for example, can transform agricultural and organic waste into renewable energy sources, reducing methane emissions while providing clean energy to communities (Amo-Asamoah et al., 2020). Private firms specializing in waste management can invest in the necessary infrastructure and technologies, supported by the municipality's regulatory framework and incentives.

To maximize the effectiveness of PPPs, the Kassena Nankana Municipality must establish a conducive environment for collaboration. This includes developing clear policies, offering incentives such as tax breaks for private investors, and ensuring transparency in project implementation. Regular stakeholder consultations are also essential to align private sector interests with public sector goals and community needs.

4.2.4 Community and Local Fundraising

Community and local fundraising are vital for mobilizing resources to address the Kassena Nankana Municipality's unique climate vulnerabilities, including erratic rainfall, deforestation, and agricultural productivity challenges. These approaches rely on the active participation of residents, traditional leaders, and local businesses to raise funds and contribute in-kind support for climate adaptation projects (Hlalele, 2023). Below are the key mechanisms tailored to Kassena Nankana's context.

Savings Groups and Cooperatives

Savings groups and cooperatives provide a platform for collective financial resource mobilization, particularly in agricultural communities. In Kassena Nankana, farmer cooperatives, women's groups, and youth associations can pool resources to support small-scale adaptation projects. For instance, cooperatives could fund community-led rainwater harvesting systems or invest in agroforestry programs that integrate trees into farmlands, improving soil fertility and reducing erosion. These groups are particularly effective in fostering inclusivity, as they enable even low-income households to contribute to and benefit from adaptation initiatives.

In-Kind Contributions

In-kind contributions, such as labour, materials, and equipment, reduce the financial burden of climate adaptation projects while fostering a sense of community ownership. In Kassena Nankana, residents can provide labour for reforestation campaigns, such as planting trees to restore degraded lands and stabilize watersheds. Similarly, community members can supply locally available materials, like sand and stones, for constructing small-scale flood defences. These contributions ensure that projects are implemented cost-effectively while engaging local populations in meaningful ways.

Local Fundraising Events

Local fundraising events integrated into cultural and social activities offer a creative way to raise resources. In Kassena Nankana, traditional festivals, such as yam or harvest festivals, could include fundraising activities like auctions, raffles, or community competitions. Proceeds from these events could be directed toward projects like borehole construction or training sessions on climate-smart agriculture. Tying fundraising efforts to cultural events, the municipality can enhance community participation and align initiatives with local traditions.

Partnerships With Local Businesses

Local businesses, including agro-processors, timber companies, and traders, are critical stakeholders in climate adaptation. These businesses can sponsor specific projects that align with their operations

and benefit the wider community. For example, timber companies could co-finance reforestation programs to ensure sustainable wood supply while contributing to ecosystem restoration. Similarly, agro-processors could sponsor solar-powered irrigation systems, ensuring consistent agricultural output and reducing water stress during dry seasons. Such partnerships create a win-win situation, where businesses enhance their reputations while supporting local development.

Voluntary Contributions and Micro-Donations

Voluntary contributions from individuals and households can collectively fund impactful projects. In Kassena Nankana, households could contribute small amounts to a community fund dedicated to projects like improving rural drainage systems or purchasing drought-resistant seeds. Leveraging mobile money platforms can further simplify micro-donations, allowing residents to contribute conveniently. This approach ensures that everyone, regardless of income level, can participate in building resilience within their communities.

Engaging Religious and Traditional Leaders

Religious and traditional leaders in Kassena Nankana are influential figures who can rally communities to support climate adaptation initiatives. Chiefs, elders, pastors, and imams can advocate for fundraising efforts during community meetings, religious gatherings, and cultural events. For example, churches and mosques could host environmental stewardship campaigns, encouraging congregants to donate toward reforestation or water management projects. Traditional leaders could use their platforms to promote voluntary labour contributions for community infrastructure upgrades, such as building flood-resilient roads.

Leveraging Local Knowledge and Expertise

Local knowledge and expertise are invaluable assets in designing and implementing adaptation projects. Farmers in Kassena Nankana possess indigenous knowledge on water conservation techniques and soil management practices that can inform sustainable agriculture initiatives. Similarly, local artisans and craftsmen can contribute to constructing climate-resilient infrastructure, such as culverts and retaining walls. Integrating local expertise into adaptation efforts, the municipality ensures that projects are practical, cost-effective, and culturally appropriate.

4.2.5 Innovative Financing Mechanisms

Innovative financing mechanisms present an opportunity for the Kassena Nankana Municipality to secure sustainable resources for implementing climate adaptation projects. These mechanisms go beyond conventional funding approaches by combining market-based tools, incentives, and partnerships to address critical challenges such as water scarcity, deforestation, and the need for climate-resilient agriculture. They are designed to create financial pathways that not only address Kassena Nankana's immediate vulnerabilities but also promote long-term environmental sustainability and economic growth.

Green bonds are financial tools issued to fund environmentally sustainable projects, providing a viable solution for Kassena Nankana's infrastructure and energy needs. In Kassena Nankana, green bonds

could be used to finance the construction of flood-resilient infrastructure in flood-prone areas, such as upgraded drainage systems and weather-resistant roads. Additionally, these bonds could support solar-powered irrigation schemes that would address water scarcity and increase agricultural productivity. Kassena Nankana's commitment to climate-smart projects would attract both national and international investors interested in contributing to sustainable development.

Payments for ecosystem services (PES) are financing arrangements where beneficiaries of ecosystem services—such as clean water, biodiversity, and carbon storage—pay those who manage or restore these ecosystems. In Kassena Nankana, PES schemes could incentivize communities to participate in forest conservation and sustainable land use practices. For instance, industries downstream that rely on stable water supplies could provide payments to upstream communities for maintaining forest cover, which stabilizes water flows and reduces erosion (Hack, 2018).

Carbon markets offer a platform for Kassena Nankana to generate revenue by reducing greenhouse gas emissions through reforestation, afforestation, and sustainable energy projects. Communities engaging in tree planting or adopting biomass briquettes to reduce reliance on traditional fuelwood could generate carbon credits. These credits could then be sold to industries or organizations seeking to offset their emissions. For example, implementing large-scale reforestation programs in Kassena Nankana's degraded forest areas could not only restore biodiversity but also create a steady revenue stream. Carbon market participation would require capacity building for local stakeholders to manage and report emissions reductions effectively.

Blended finance combines public and private sector resources to de-risk investments in large-scale adaptation projects. For Kassena Nankana, this mechanism could attract private sector funding for renewable energy installations, such as community solar grids, by supplementing the investment with public grants or concessional loans. Similarly, blended finance could support the construction of flood-resilient housing in vulnerable areas, with public funds used to lower financial risks for private investors.

This approach ensures that transformative projects—such as large-scale irrigation systems or renewable energy hubs—are financially feasible, while aligning public and private interests for mutual benefit.

Impact investments are financial commitments made with the intention of generating measurable social and environmental benefits alongside financial returns. Kassena Nankana could attract impact investors for projects like community-based renewable energy initiatives or eco-tourism development. For instance, establishing sustainable agro-processing facilities could reduce post-harvest losses, improve farmer incomes, and support food security—all while offering economic returns to investors. Impact investment projects in Kassena Nankana should highlight clear benefits, such as reduced vulnerability to climate change, improved livelihoods, and alignment with global sustainability goals.

4.3 Criteria for Allocation and Prioritization of Funds

Efficient allocation and prioritization of funds are essential for ensuring that the Kassena Nankana Municipality effectively addresses its climate adaptation challenges, including erratic rainfall, deforestation, agricultural vulnerabilities, and water scarcity. A well-defined set of criteria ensures that resources are directed toward impactful, equitable, and sustainable projects. The following sections provide an in-depth expansion of each criterion, demonstrating their relevance to Kassena Nankana's unique context.

1. Alignment with Kassena Nankana's adaptation priorities

Adaptation projects must address the most critical vulnerabilities identified in Kassena Nankana's climate action framework. These priorities include water resource management, sustainable agriculture, reforestation, and infrastructure resilience. Projects that directly support these goals will be prioritized to ensure coherence with the municipality's broader development strategy. For example, funding for agroforestry initiatives aligns with Kassena Nankana's need to combat deforestation and soil degradation while enhancing livelihoods. Similarly, water resource projects such as boreholes and rainwater harvesting systems address the pressing challenge of water scarcity, particularly in underserved rural areas. Alignment ensures that resources are used strategically to achieve meaningful and measurable progress.

2. Scale and breadth of impact

The scale and breadth of a project's impact are crucial factors in prioritization. Projects that benefit large segments of the population or address widespread vulnerabilities are prioritized to maximize the value of limited resources. For instance, constructing flood-resilient roads and drainage systems would have far-reaching benefits by safeguarding both infrastructure and livelihoods during extreme weather events. In Kassena Nankana, reforestation programs covering degraded forest areas would impact the broader ecosystem while providing tangible benefits to farmers and downstream water users. Projects with multi-sectoral impacts, such as agroforestry systems that improve soil health, increase agricultural productivity, and sequester carbon, are particularly valued.

3. Inclusivity and equity

Equity is a cornerstone of fund allocation, ensuring that vulnerable and marginalized groups—such as women, youth, and low-income households—are not left behind. In Kassena Nankana, women and youth play critical roles in agriculture and natural resource management but often face barriers to accessing resources and training. Adaptation initiatives that address these disparities, such as gender-responsive programs or youth-focused agricultural training, will receive priority funding. For example, a program offering women-led cooperatives access to drought-resistant seeds and training on climate-smart farming techniques not only promotes inclusivity but also strengthens food security and household resilience. Equity-focused projects ensure that benefits are distributed fairly and foster broader community support for adaptation efforts.

4. Urgency of need

Given the immediate threats posed by climate change, projects addressing critical and time-sensitive vulnerabilities will be prioritized. For instance, communities in flood-prone areas require urgent investments in drainage systems, flood defences, and resilient housing to minimize losses during extreme weather events. Similarly, areas experiencing prolonged dry spells would benefit from fast-tracked funding for boreholes and small-scale irrigation systems to stabilize water supply.

Prioritizing urgent needs ensures that funding is directed to areas where it will have the most immediate and life-saving impact. This approach helps avert crises while laying the foundation for long-term adaptation.

5. Cost effectiveness

Cost effectiveness is essential to maximize the impact of limited funds. Projects must demonstrate efficient use of resources by achieving significant outcomes relative to their costs. For instance, community-led reforestation programs—relying on local labour and in-kind contributions—are cost-effective compared to mechanized restoration projects. Similarly, training farmers on low-cost climate-smart practices, such as crop rotation and composting, yields high returns in terms of productivity and sustainability.

Cost-effective projects allow Kassena Nankana to stretch its resources further while delivering tangible benefits to communities. This criterion also ensures accountability by prioritizing initiatives that make prudent use of public and donor funds.

6. Feasibility and readiness

Feasibility assesses whether a project can be successfully implemented given existing technical, institutional, and operational capacities. Projects with well-defined implementation plans, clear timelines, and reliable technical support are more likely to succeed and, therefore, receive priority funding. For example, a reforestation program with established nursery sites, community buy-in, and trained facilitators demonstrates readiness for execution.

Feasibility also includes institutional backing, such as support from local government departments or NGOs. Ensuring that projects are realistic and achievable minimizes delays and enhances the likelihood of successful outcomes.

7. Environmental co-benefits

Adaptation projects that deliver additional environmental benefits are highly valued. For instance, agroforestry programs in Kassena Nankana not only improve soil fertility and support agriculture but also enhance biodiversity, sequester carbon, and stabilize water cycles. Similarly, conservation agriculture practices reduce erosion, improve water retention, and enhance ecosystem services.

Projects with multiple environmental co-benefits help address interconnected challenges, making them more impactful and sustainable. These initiatives also align with global goals, such as reducing greenhouse gas emissions and promoting biodiversity conservation.

8. Long-term sustainability and scalability

Sustainability ensures that funded projects continue to deliver benefits long after their initial implementation phase. In Kassena Nankana, community-managed water systems or cooperatively run agroforestry projects are examples of sustainable initiatives that empower local populations to maintain and scale their benefits.

Scalability is another critical factor—projects that can be expanded to other areas of Kassena Nankana or replicated in similar contexts are prioritized. For instance, piloting a successful rainwater harvesting system in one community could inform broader rollouts across the municipality.

9. Community participation and ownership

Projects that actively involve local communities in planning, implementation, and management foster ownership, accountability, and long-term success. In Kassena Nankana, community-driven initiatives, such as village-led reforestation efforts or participatory water resource management, ensure that projects are culturally appropriate and meet local needs.

Engaging communities in adaptation projects not only builds trust but also enhances their capacity to sustain these efforts over time. When communities feel ownership of projects, they are more likely to protect and maintain the investments.

10. Potential for leveraging additional funding

Projects that attract co-funding from external sources, such as international donors, government programs, or private sector partners, will be prioritized. For example, a solar-powered irrigation project co-funded by international aid organizations and local businesses leverages additional resources while reducing the financial burden on the municipality.

Leveraging external funding also enhances the municipality's credibility, demonstrating its ability to manage resources effectively and deliver impactful projects. This criterion ensures that Kassena Nankana maximizes its financial resources by building strategic partnerships.

Implementation Process

1. **Scoring and ranking**: Each project will be evaluated against the criteria and scored based on its alignment with priorities, feasibility, and potential impact. High-scoring projects will be prioritized.

2. **Stakeholder consultations**: Regular consultations with local communities, NGOs, government agencies, and private sector stakeholders ensure that prioritization reflects diverse perspectives and needs.

3. **Monitoring and evaluation**: A robust monitoring framework will track the progress and outcomes of funded projects, ensuring accountability and providing insights for future adaptation efforts.

5.0 Framework for Adaptation Monitoring, Evaluation, and Learning

5.1 Introduction

The Framework for Monitoring, Evaluation, and Learning (MEL) is an essential component of the Kassena Nankana Municipality's Climate Adaptation Plan. It ensures that adaptation measures are effectively implemented, progress is continuously tracked, and lessons learned are integrated into future planning. This framework is particularly critical given Kassena Nankana's vulnerabilities to erratic rainfall, deforestation, agricultural challenges, and water scarcity, which require adaptive and evidence-based approaches to address effectively.

The MEL framework is designed to provide a systematic approach to evaluating the success of adaptation initiatives, measuring their impact on vulnerable communities, and identifying opportunities for improvement. It goes beyond traditional monitoring and evaluation by incorporating a learning component that captures best practices, promotes innovation, and enhances resilience at both community and municipal levels (Hlalele, 2023).

Aligned with Ghana's NAP, the framework ensures accountability and transparency by engaging stakeholders, including local communities, municipal authorities, NGOs, and funding partners. The participatory nature of the MEL framework fosters inclusivity and ensures that the voices of women, youth, and marginalized groups are integrated into the adaptation process. It also emphasizes the importance of data-driven decision making, using measurable indicators to assess project outcomes and inform future interventions.

Objectives of the MEL Framework

The objectives of the MEL framework for the Kassena Nankana Municipality are centered on ensuring that adaptation initiatives are effective, equitable, and sustainable. By clearly defining goals and establishing measurable outcomes, the framework enhances the ability of stakeholders to assess progress, address challenges, and improve future interventions. The key objectives are as follows:

- **Track progress and performance**: to monitor the implementation of adaptation projects and evaluate their progress against predefined targets. This ensures that interventions remain on schedule and within budget, while delivering expected results.
- **Assess effectiveness and impact**: to evaluate the effectiveness of adaptation measures in reducing vulnerabilities, enhancing resilience, and achieving long-term sustainability. This involves assessing whether projects are meeting their intended objectives and identifying areas for improvement.
- **Promote accountability and transparency**: to establish clear mechanisms for accountability by providing stakeholders, including government agencies, donors, and local communities, with evidence-based insights into how resources are being used and the outcomes achieved.

- **Foster learning and knowledge sharing**: to capture lessons learned, best practices, and innovations from adaptation efforts and disseminate them across sectors and communities. This promotes continuous improvement and informs the design of future projects.
- **Support adaptive management**: to enable real-time adjustments to projects and policies based on monitoring and evaluation findings. This ensures that adaptation efforts remain flexible and responsive to changing conditions and emerging challenges.
- **Strengthen institutional and community capacity**: to enhance the capacity of municipal authorities, local communities, and other stakeholders to implement, monitor, and evaluate adaptation measures effectively. This includes training, technical assistance, and the provision of tools and resources for data collection and analysis.
- **Align with national and global goals**: to ensure that Kassena Nankana's adaptation efforts align with Ghana's NAP, the Sustainable Development Goals (SDGs), and other international climate frameworks.

5.2. MEL Design for the Kassena Nankana Municipal Assembly

The MEL framework for the Kassena Nankana Municipal Assembly is tailored to address the unique vulnerabilities and priorities of the region. Climate risks such as erratic rainfall, deforestation, and declining agricultural productivity require a robust system for tracking progress, evaluating results, and integrating lessons learned. This framework emphasizes a participatory approach, inclusivity, and adaptive management to ensure that adaptation initiatives are impactful, sustainable, and aligned with the needs of Kassena Nankana's residents (Antwi-Agyei et al., 2013).

5.2.1 Monitoring Framework

Monitoring is the cornerstone of the MEL framework, serving as a continuous process to track the implementation of adaptation projects and their alignment with intended goals. For Kassena Nankana, monitoring not only ensures timely project delivery but also identifies challenges early, allowing for corrective actions to be implemented. This proactive approach is particularly crucial given the dynamic and unpredictable nature of climate impacts in the municipality.

Monitoring in Kassena Nankana will focus on both quantitative and qualitative data to provide a holistic view of project progress. It will involve real-time tracking of infrastructure projects like boreholes and flood defences, as well as ongoing assessments of community-led initiatives such as agroforestry and conservation agriculture. By integrating modern technologies with traditional knowledge systems, the monitoring framework will ensure that adaptation measures remain relevant and effective.

5.2.2. Objectives of the Monitoring Framework

1. **Track progress of key adaptation measures**: The monitoring framework ensures that projects such as irrigation systems, rainwater harvesting, and reforestation efforts are implemented according to schedule and meet their intended objectives. Progress tracking allows stakeholders to assess whether resources are being utilized effectively and whether timelines are being met.

2. **Identify challenges and enable timely corrections**: One of the key objectives is to detect potential delays, resource shortages, or operational challenges during project implementation. Early identification allows for swift corrective measures, ensuring that projects remain on track.

3. **Ensure accountability and transparency**: The monitoring framework provides a mechanism for reporting progress to all stakeholders, including local communities, municipal authorities, NGOs, and donors. Transparent reporting builds trust and ensures that resources are used responsibly.

4. **Enable data-driven decision making**: Reliable data collected through monitoring informs evidence-based decisions, allowing for the optimization of project designs and resource allocation. This ensures that adaptation measures are effective and responsive to changing conditions.

5. **Evaluate long-term impacts**: Monitoring goes beyond immediate results by assessing the long-term sustainability of adaptation measures. This includes evaluating whether projects have achieved their goals of reducing vulnerabilities and building resilience.

5.2.3 Key Indicators and Metrics

To ensure the success of adaptation initiatives, a set of tailored indicators and metrics will be used to track progress and assess impacts. These indicators are aligned with Kassena Nankana's specific climate challenges and socio-economic priorities.

Key Indicators and Metrics

1. **Reduction in climate vulnerabilities**: Indicators will measure the extent to which adaptation initiatives have reduced the risks posed by climate hazards, such as droughts, floods, and deforestation.

Example: Monitoring the decrease in flood-related damages to homes and infrastructure after the construction of drainage systems.

2. **Community participation rates**: Indicators will track the engagement of local communities in adaptation projects, with a focus on inclusivity and equity.

Example: Assessing the participation of women and youth in tree-planting campaigns or training programs on climate-smart agriculture.

3. **Environmental recovery metrics**: Metrics will evaluate the restoration of ecosystems, such as forest cover, water resources, and biodiversity.

Example: Measuring improvements in vegetation cover in areas undergoing reforestation.

4. **Agricultural productivity**: Indicators will assess the effectiveness of climate-smart farming practices in improving yields and reducing losses due to climate variability.

Example: Tracking the adoption of drought-resistant crops and the corresponding increase in yields.

5. **Infrastructure sustainability**: Metrics will evaluate the durability and performance of infrastructure projects, such as boreholes, flood barriers, and irrigation systems.

Example: Monitoring the long-term functionality of water supply systems in rural areas.

5.2.4 Data Collection Methods

The MEL framework employs a combination of innovative and traditional methods to gather reliable and inclusive data. These methods are designed to reflect Kassena Nankana's socio-economic and environmental context.

1. **Community-based reporting**: Local communities will be empowered to collect and report data using mobile technology and participatory tools. This approach fosters ownership and ensures that data reflects on-the-ground realities.

2. **Remote sensing and geographic information systems (GIS) technology**: Satellite imagery and GIS mapping will track changes in land use, forest cover, and water resources. This method provides precise spatial data to inform decision making.

3. **Household surveys and focus groups**: Surveys and focus groups will capture qualitative and quantitative insights from project beneficiaries, ensuring that their perspectives are integrated into the evaluation process.

4. **Environmental sensors**: Sensors will be deployed to measure critical environmental parameters, such as rainfall, soil moisture, and water quality.

5. **Integration of traditional knowledge**: Local knowledge systems will complement scientific data, providing context-specific insights into climate patterns and adaptation practices.

5.2.5 Roles and Responsibilities

To ensure the effective implementation of the MEL framework, clear roles and responsibilities will be assigned to various stakeholders:

1. **Kassena Nankana Municipal Assembly**: The assembly will oversee MEL activities, ensuring alignment with district development plans and national policies.

2. **Community members and groups**: Local groups, including women's associations and youth clubs, will actively participate in monitoring and data collection.

3. **Traditional leaders**: Chiefs and elders will mobilize community participation and contextualize findings based on local knowledge.

4. **NGOs and academic partners**: These stakeholders will provide technical expertise, conduct independent evaluations, and build capacity for data collection and analysis.

5. **Project implementation teams**: Teams responsible for executing projects will collect and manage data, ensuring compliance with MEL requirements.

5.2.6 Learning and Adaptive Management

The learning component ensures that insights from MEL activities are used to refine future projects and improve adaptation strategies.

1. **Feedback loops**: Regular feedback from stakeholders is integrated into project planning and implementation.

2. **Knowledge sharing**: Lessons learned are disseminated across sectors and communities to promote innovation and scalability.

3. **Capacity building**: Training programs will enhance the skills of municipal staff, community members, and partners in MEL implementation.

5.3 Steps in Implementing the MEL Framework

The implementation of the MEL framework in the Kassena Nankana Municipal Assembly requires a structured and phased approach to ensure efficiency, inclusivity, and alignment with the municipality's climate adaptation goals. The steps outlined below are designed to integrate data collection, stakeholder involvement, and adaptive management seamlessly.

1. **Establish baselines and targets**: define the starting point for monitoring and the specific goals for each adaptation project. This step ensures that progress can be measured accurately over time.

2. **Develop monitoring and evaluation plans**: create detailed plans outlining key performance indicators (KPIs), data collection methods, timelines, and roles and responsibilities.

3. **Build capacity for implementation**: train stakeholders, including municipal staff, community members, and project teams, on data collection tools, reporting methods, and adaptive management techniques.

4. **Conduct participatory data collection**: engage stakeholders in gathering quantitative and qualitative data to ensure inclusivity and accuracy.

5. **Analyze and validate data**: compile and analyze data to assess project performance and identify trends or challenges. Validation ensures data accuracy and stakeholder confidence.

6. **Generate reports and share findings**: produce clear and accessible reports to inform stakeholders about project progress, challenges, and successes.

7. **Facilitate stakeholder feedback**: organize regular meetings and workshops to gather input from stakeholders and incorporate their perspectives into the evaluation process.

8. **Apply learning to improve adaptation strategies**: use insights from monitoring and evaluation to refine current projects and inform the design of future initiatives.

9. **Establish feedback loops for continuous improvement**: create mechanisms for ongoing learning and adaptation, ensuring that MEL results are integrated into municipal planning processes.

5.4. Sustainability of the MEL Framework

Ensuring the sustainability of the MEL framework in Kassena Nankana requires a long-term vision and commitment from all stakeholders. The following strategies will ensure that the MEL framework remains operational, impactful, and adaptive to changing conditions:

1. **Institutionalization of the MEL framework**: embed the MEL framework into the core operations of the Kassena Nankana Municipal Assembly. This involves integrating MEL processes into municipal plans and budgets.

2. **Capacity building for long-term implementation**: continuously train municipal staff, community members, and project teams to sustain the MEL framework. Capacity building ensures that local stakeholders have the skills to manage monitoring and evaluation independently.

3. **Leveraging partnerships for technical and financial support**: build and maintain partnerships with NGOs, academic institutions, and international agencies to provide technical expertise and funding for MEL activities.

4. **Promoting community ownership**: foster local ownership of the MEL framework by actively involving community members in monitoring and decision-making processes. This ensures buy-in and sustained participation.

5. **Ensuring financial sustainability**: develop diverse funding streams to support MEL activities, including government allocations, donor contributions, and community fundraising.

6. **Adapting to evolving climate risks**: ensure the MEL framework remains flexible and responsive to new challenges and opportunities. This involves regular reviews and updates to the framework.

7. **Knowledge management and dissemination**: create a centralized system for storing and sharing MEL data, ensuring that lessons learned are accessible to all stakeholders.

8. **Strengthening feedback mechanisms**: develop systems for regular feedback between stakeholders to ensure that MEL results inform planning and implementation at all levels.

6.0 Conclusion and Recommendations

6.1 Introduction

The Kassena Nankana Municipality is already experiencing the effects of climate change, including erratic rainfall patterns, prolonged dry spells, and an increasing frequency of extreme weather events such as floods and high temperatures. These climatic changes threaten key sectors, including agriculture, water resources, health, and infrastructure, posing significant risks to livelihoods, food security, and overall socio-economic stability. Without proactive measures, climate change will continue to exacerbate vulnerabilities, disrupt economic activities, and threaten the well-being of residents.

The adaptation action plan outlined in this document represents a strategic response to these escalating climate risks. The proposed interventions aim to safeguard critical sectors, enhance climate resilience, and ensure sustainable development in the municipality. By integrating climate adaptation into municipal planning, infrastructure development, and governance frameworks, Kassena Nankana is taking important steps toward securing a climate-resilient future. The plan is designed with a strong emphasis on participatory governance for ensuring that local communities, technical experts, and policy-makers collaborate to develop and implement effective adaptation measures.

A robust MEL framework underpins this adaptation plan, enabling continuous tracking of progress, assessing the effectiveness of interventions, and refining strategies over time. This framework aligns local adaptation actions with national and international climate strategies, reinforcing the municipality's commitment to addressing both immediate climate-related challenges and long-term sustainability goals. Achieving these objectives will require sustained commitment from all stakeholders, including government agencies, civil society organizations, private sector actors, and community members. The following recommendations outline the key actions necessary to advance climate adaptation efforts in the Kassena Nankana Municipality.

6.2 Recommendations

Institutional capacity strengthening: Enhance the capacity of municipal assembly officials, technical staff, and community leaders through regular training in climate adaptation planning, project management, and stakeholder engagement. Establishing a dedicated climate adaptation unit within the municipal assembly is essential for coordinating climate-related initiatives, integrating adaptation insights into the Medium-Term Development Plan (MTDP), and mobilizing resources. Strengthening the role of local government agencies and traditional leaders in climate governance will further enhance the effectiveness and sustainability of adaptation efforts.

Community engagement: Actively involve local communities in designing and implementing adaptation measures to ensure contextual relevance, inclusivity, and long-term sustainability. Special attention should be given to the participation of vulnerable groups, including women, youth, and persons with disabilities, in adaptation planning. Strengthening women's cooperatives in climate-smart agriculture and supporting youth-led initiatives in reforestation and environmental monitoring

will enhance local ownership and sustainability. Public awareness campaigns on climate adaptation, early warning systems, and disaster preparedness should be expanded to improve community resilience.

Financial sustainability: Mobilize diverse funding streams by leveraging innovative financing mechanisms such as green bonds, PES, and PPPs. Developing strong funding proposals will enhance the municipality's ability to access international climate finance from sources such as the Green Climate Fund (GCF) and the Adaptation Fund. Complementing external funding with local fundraising initiatives, including community savings groups and cooperative financing, will promote collective responsibility and shared success. Integrating climate adaptation into municipal budgets will ensure consistent financial support for adaptation actions.

Inclusivity and gender-responsive adaptation: Ensure that adaptation measures address social inequalities and promote equitable access to resources. Implement gender-responsive policies by ensuring women have equal access to climate-smart technologies, financial services, and leadership opportunities. Supporting the formation and strengthening of women-led cooperatives, agribusinesses, and community resilience projects will enhance economic empowerment and social resilience. Monitoring frameworks should incorporate gender-disaggregated indicators to assess progress in integrating women's voices and contributions into climate adaptation decision making.

Technological innovation for climate adaptation: Utilize GIS, environmental sensors, and mobile applications to enhance data collection, real-time monitoring, and informed decision making. Expanding digital platforms for climate information services will improve the dissemination of weather forecasts, early warning alerts, and best practices for sustainable agriculture. Training municipal staff and community leaders in these technologies will ensure that climate adaptation planning is data-driven and responsive to emerging climate challenges.

Knowledge sharing and continuous learning: Establish platforms for exchanging best practices and fostering collaboration among government institutions, researchers, NGOs, and community groups. Organizing regular stakeholder workshops, developing online knowledge repositories, and strengthening partnerships with universities and research institutions will ensure that climate adaptation efforts remain dynamic, evidence-based, and continuously refined. Documenting and sharing lessons learned from adaptation projects will further improve decision making and support the scaling up of successful strategies.

6.3 Conclusion

The climate adaptation plan for the Kassena Nankana Municipality provides a comprehensive strategy for addressing the current and future impacts of climate change. By prioritizing institutional capacity strengthening, fostering community engagement, ensuring financial sustainability, promoting inclusivity, leveraging technological advancements, and facilitating knowledge sharing, the municipality can enhance resilience, protect livelihoods, and support sustainable development. These adaptation measures are designed to provide long-term benefits, reducing vulnerabilities across key sectors while promoting equitable and inclusive climate action.

Sustained commitment from all stakeholders will be essential in ensuring the successful implementation of these adaptation measures. The municipality must continue to integrate climate considerations into its development planning processes, ensuring that adaptation remains a core priority. Collaborative efforts between government agencies, development partners, private sector actors, and local communities will be key in scaling up adaptation efforts and securing the necessary resources.

Through continuous learning, adaptive management, and sustained stakeholder engagement, the Kassena Nankana Municipality has the potential to serve as a model for local climate adaptation in Ghana and beyond. By strengthening resilience at all levels—community, institutional, and policy—the municipality can safeguard its people, economy, and environment from the growing threats of climate change, ensuring a sustainable and climate-secure future for generations to come.

References

Acheampong, E. N., Ozor, N., & Owusu, E. S. (2014). Vulnerability assessment of Northern Ghana to climate variability. *Climatic Change*, 126, 31–44.

Amo-Asamoah, E., Owusu-Manu, D.-G., Asumadu, G., Ghansah, F. A., & Edwards, D. J. (2020). Potential for waste to energy generation of municipal solid waste (MSW) in the Kumasi metropolis of Ghana. *International Journal of Energy Sector Management*, 14(6), 1315–1331.

Antwi-Agyei, P., Dougill, A. J., & Stringer, L. C. (2013). Barriers to climate change adaptation in sub-Saharan Africa: Evidence from northeast Ghana and systematic literature review. *Centre for Climate Change Economics and Policy Working Paper, 154.*

Atanga, R. A., & Tankpa, V. (2021). Climate change, flood disaster risk and food security nexus in Northern Ghana. *Frontiers in Sustainable Food Systems, 5*, 706721.

de Jalón, S. G., Iglesias, A., & Neumann, M. B. (2018). Responses of sub-Saharan smallholders to climate change: Strategies and drivers of adaptation. *Environmental Science & Policy, 90*, 38–45.

Hack, J. (2018). Application of payments for hydrological ecosystem services to solve problems of fit and interplay in integrated water resources management. In *Sustainability in the Water Energy Food Nexus* (pp. 217–236). Routledge.

Hlalele, B. M. (2023). *Examining the Impact of Climate Change on Community Disaster Risk and Identifying Strategies for Adaptation: A Systematic Review for Sub-Saharan Africa.*

IPCC. (2022). Climate change 2022: Impacts, adaptation and vulnerability. *Cambridge University Press. Cambridge University Press, Cambridge, UK and New York, NY, USA, Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)], 3056.* https://doi.org/doi:10.1017/9781009325844

Mekonnen, Y., & Sarwat, A. I. (2017). *Renewable energy supported microgrid in rural electrification of Sub-Saharan Africa*. 595–599.

Nanka-Bruce, O. (2008). The socioeconomic drivers of rural electrification in sub-Saharan Africa. *The Journal of Energy and Development, 33*(2), 215–247.

Ogunsola, O. Y., Adebayo, Y. A., Dienagha, I. N., Ninduwezuor-Ehiobu, N., & Nwokediegwu, Z. S. (2024). Public-private partnership models for financing renewable energy and infrastructure development in Sub-Saharan Africa. *Gulf Journal of Advance Business Research, 2*(6), 483–492.

Yang, F., & Yang, M. (2018). Rural electrification in sub-Saharan Africa with innovative energy policy and new financing models. *Mitigation and Adaptation Strategies for Global Change*, 23, 933–952.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