SIGRA

Strengthening Investments in Gender-Responsive Climate Adaptation

Cowater Ghana

In partnership with Canada

Climate Change Risk and Vulnerability Assessment

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NANUMBA SOUTH DISTRICT

FREEDOM AND JUSTICE

epa

NATIONAL ADAPTATION PLAN GHANA

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ACRONYMS AND ABBREVIATIONS

AF	Adaptation Fund
CAMFED	Campaign for Female Education
CARE	Cooperative for Assistance and Relief Everywhere
CCAF	Community Climate Adaptation Fund
CCRP	Climate Change Resilience Project
CDD	Consecutive Dry Days
CHIRPS	Climate Hazards Group InfraRed Precipitation with Station Data
CHPS	Community-Based Health Planning and Services
CMIP6	Coupled Model Intercomparison Project - Phase 6
CRM	Climate Risk Management
CRVA	Climate Change Risk and Vulnerability Assessment
CSO	Civil Society Organization
CVCA	Climate Vulnerability and Capacity Analysis
CWD	Consecutive Wet Days
CWSA	Community Water and Sanitation Agency
EPA	Environmental Protection Agency
ETCCDI	Expert Team on Climate Change Detection and Indices
FAO	Food and Agriculture Organization
FBO	Farmer-Based Organization
FF	Far Future
FGD	Focus Group Discussion
FHH	Female-Headed Household
GAC	Global Affairs Canada
GCF	Green Climate Fund
GEA	Ghana Enterprises Agency
GHG	Greenhouse Gas
GIDA	Ghana Irrigation Development Authority
GIZ	*Deutsche Gesellschaft für Internationale Zusammenarbeit* (German Agency for International Cooperation)
GMet	Ghana Meteorological Agency
GoG	Government of Ghana
GSS	Ghana Statistical Service
ICT	Information and Communications Technology
IPCC	Intergovernmental Panel on Climate Change
KIIs	Key Informant Interviews
MbS	Nature-Based Solution
MDAs	Ministries, Departments, and Agencies
MESTI	Ministry of Environment, Science, Technology, and Innovation
MF	Mid Future
MHH	Men Households
MLGRD	Ministry of Local Government and Rural Development
MMDAs	Metropolitan, Municipal and District Assemblies
MoF	Matrix of Function

MoFA	Ministry of Food and Agriculture
MoFEP	Ministry of Finance and Economic Planning
MoGCSP	Ministry of Gender, Children and Social Protection
MoH	Ministry of Health
MoP	Ministry of Planning
MRH	Ministry of Roads and Highways
MSWR	Ministry of Sanitation and Water Resource
MTDPs	Mid-Term Development Plans
MWH	Ministry of Works and Housing
NADMO	National Disaster Management Organization
NAP	National Adaptation Plan
NbS	Nature-Based Solution
NCCE	National Commission for Civic Education
NCCP	National Climate Change Policy
NGO	Non-Governmental Organization
NSDA	Nanumba South District Assembly
PPPs	Public-Private Partnerships
PWD	Person with Disability
RCC	Regional Coordinating Council
RR	Rainfall Rate
SARI	Savanna Agricultural Research Institute
SDG	Sustainable Development Goal
SDII	Simple Daily Intensity Index
SGD	Sustainable Development Goals
SIGRA	Strengthening Investments in Gender-Responsive Climate Adaptation
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
VSLA	Village Savings and Loan Associations
WD	Wet Days
WHH	Women Headed-Households
WIAD	Women in Agriculture and Development

EXECUTIVE SUMMARY

Background

Climate change presents varied challenges to the socio-economic development agenda of Ghana at various levels. The changing climate has a wide range of implications for cities, local communities, indigenous businesses, industry and government at different levels. The government of Ghana, through the National Adaptation Planning (NAP) process, with technical and financial support from Global Affairs Canada (GAC), under the auspices of the "Strengthening Investments in Gender-Responsive Climate Adaptation" (SIGRA) project commissioned a Climate Change Risk and Vulnerability Assessment (CRVA) in the Nanumba South District of the Northern region of Ghana. The CRVA aims to support evidence-based decision-making and planning in climate change adaptation at the local level, this report presents the findings.

The economy and livelihoods of the people of the Nanumba South District are agrarian and highly vulnerable to the adverse impacts of climate change. The district experiences delayed rainfall and dry spells leading to prolonged drought, and rising temperatures that contribute significantly to land degradation and poor crop yields. The manifestations of these climate events coupled with inadequate infrastructure and institutional capacities constrain communities' adaptive strategies, leaving them with fewer tools to cope. To address these challenges, a gender-responsive and well-coordinated approach is essential. Such an approach ensures the inclusion of the diverse capacities, experiences, and perspectives of both men and women in climate adaptation initiatives, ultimately strengthening community resilience.

District Profile

The Nanumba South District is located in the northwestern part of Ghana's Northern Region. It is predominantly rural, with key population centers in Wulensi, Nakpayili, Gbungbaliga, and Lungni. The district faces significant challenges in infrastructure, economic development, health, and education. The district's landscape features a variety of water bodies, including two earthen dams and the Oti River, which flows through Kukuo. The district has a total population of 106,374, comprising 52,511 males and 53,863 females. It is predominantly rural, with 84,011 residents in rural areas and 22,363 in urban areas. The administrative and economic center is the capital, Wulensi. The district is largely agrarian, with over 85% of the population engaged in agriculture. Daily temperatures range from 29°C to 41°C, occasionally reaching 45°C. The district, like much of Ghana and West Africa, is affected by the wet southwest monsoon and the dry northeast trade winds. It experiences a single rainfall season (May–October), leaving the rest of the year completely dry.

Methodology

The study employed a mixed method approach that combines qualitative and quantitative analyses to assess climate risks, vulnerabilities, and adaptive capacities of the Nanumba South District. The methodology was designed to incorporate inclusivity and gender responsiveness, which ensures the active participation of diverse stakeholders, including women's, youth, and marginalized groups. The study started with a district-level workshop conducted in August 2024 with participants drawn from different institutions and organizations, and women's groups. Using the snowball sampling technique, the study conducted 12 key informant interviews (KIIs) with vital stakeholders strategically selected because of their long-standing experience in climate change issues and agricultural development in the Nanumba South District. Additionally, 9 focus group discussions (FGDs) were conducted with different socioeconomic groups, including men, women, the elderly, the youth, PWD, single parents, and migrant farmers. To further capture a comprehensive understanding of economic, physical, and social vulnerabilities across different socioeconomic groups, surveys involving 450 respondents were conducted within 10 communities across the district.

Key Findings

Climate Vulnerability

The historical analysis (1991-2020) on annual total precipitation shows historical patterns with significant interannual variability (1000 mm - 1680 mm). Three critical climate-related hazards –

droughts, floods, and bushfires – were identified in the Nanumba South District. These hazards exacerbate socio-economic challenges, disproportionately impacting marginalized groups such as women and smallholder farmers. Their effects deepen existing inequalities, hinder resilience, and slow development efforts.

Economic Vulnerability

The lack of access to formal financial resources significantly limits women's ability to support their farming and economic activities. Economic vulnerability of the smallholder farmers stems from their inability to access credit facilities to implement climate change adaptation strategies. Most smallholder farmers in the district lack the financial resources to afford essential inputs such as fertilizers, improved seeds, and mechanized tools. This is particularly true for women farmers, who often face systemic barriers to accessing credit and financial support. Less access to credit, decreases their ability to cope with climate change and related disruptions. In comparison to an overwhelming 84% of men who are engaged in secondary economic activities in the district, only 16% of women engage in secondary economic activity, underpinning the economic disparity between genders. Access to farmlands is a major obstacle to achieving food and livelihood security in the Nanumba South District, especially in the face of climate change. Traditional land tenure systems, which are deeply rooted in patriarchal customs, often exclude women and marginalized groups, including migrants and youth, from land ownership and control. This creates significant challenges for these groups to adopt climate-resilient agricultural practices.

Physical Vulnerability

The Nanumba South District frequently experiences natural hazards such as floods, droughts, and windstorms, which significantly affect livelihoods. Droughts are particularly disruptive to farming, affecting food security. Prolonged dry spells reduce yields of staple crops like groundnut, maize, millet, and yam. Meanwhile, short but intense rainfall leads to flooding, which damages crops, displaces residents, and increases the spread of diseases. Windstorms destroy homes and community infrastructure, further exacerbating the economic hardships faced by the population.

Social Vulnerability

Results showed that sociocultural, economic, political, and religious norms often limit women's direct access to key roles in decision-making and leadership. Culturally, women’s voices are not well recognized in strategic decisions even though they play a significant role in the household economy. Gender roles are distinct and rigid, with women primarily responsible for domestic chores such as fetching water and firewood, childcare, and subsistence farming. Men, on the other hand, are more involved in commercial farming, livestock management, and community leadership roles. These disaggregated roles disproportionately place a burden on women’s economic activities and household sustenance. For instance, the extensive time women dedicate to such domestic chores limits their availability to participate in income-generating activities such as farming, trading, or artisanal work. This directly reduces the household's income and its ability to purchase essential goods and services, including food, especially during periods of climate-induced stress like droughts or floods, when agricultural yields may decline.

Projected Impacts of Increasing Temperatures and Erratic Rainfall on Access to Resources

Climate change manifestations, such as increasing temperatures, droughts and flooding are impacting infrastructure, health services, and access to water especially for marginalized groups in the Nanumba South District. The results of the assessment reveal that many of the communities within the district do not have access to reliable potable water, or water to facilitate dry season farming. As climate change impacts increase, women will struggle with water scarcity and increased household demands, while men will face challenges securing water for farming and livestock. Youth will encounter barriers to essential education and farming resources, and people with disabilities will face greater difficulties accessing water and health for their well-being and resilience. Flooding and soil erosion will further strain irrigation and agricultural tools, intensifying competition and leaving vulnerable groups struggling to meet basic needs if nothing is done based on the current climatic manifestation, and as indicated during focus group discussions in the various communities across the three zonal councils.

Recommendations

1. **Improved adaptive capacity through skill development:** The report recommends that the government, through its appropriate agencies such as the Ministry of Food and Agriculture and the Environmental Protection Agency provide skills development training for smallholder farmers, especially women, to improve their livelihood security.
2. **Increased support to small holder farmers:** Smallholder farmers should be supported to access farm inputs and mechanized tools to facilitate their farming activities. Efforts should also be made to construct earthed dams to facilitate dry season vegetable production to support household food and livelihood security.
3. **Improved investments and budgetary allocations for agricultural adaptations:** The Nanumba South District lacks the necessary financial resources to prioritize and fund climate-resilient agricultural interventions. Budget allocations for agricultural projects are often minimal and poorly coordinated, with funds allocated to other sectors such as infrastructure or education, leaving agriculture underfunded. There is the need for a conscious effort to budget funds for climate change adaptation interventions.
4. **The need for sex-disaggregated data:** Currently, most of the data collected at the district level is not disaggregated based on sex. This hampers the development of appropriate interventions aimed at building the resilience of smallholder female farmers in addressing climate change. Efforts should be made to empower the district assembly to collect sex-disaggregated data for effective decision-making and planning adaptation interventions.
5. **Improving decision-making capacity of marginalised socioeconomic groups:** Efforts should be made by the district assembly to provide leadership training to women and girls through education and mentorship programmes to boost their advocacy skills and confidence in decision-making roles.
6. **Improved policy framework for gender mainstreaming:** While climate change disproportionately affects women, particularly in rural areas, existing policies often fail to fully address the gender-specific needs and contributions in agriculture and climate resilience. Women, who make up a large portion of the agricultural workforce, are frequently excluded from decision-making processes related to climate change adaptations. This exclusion limits their access to critical resources, information, and support necessary to build resilience, further exacerbating food insecurity and vulnerability. There is therefore a need to develop a comprehensive gender-responsive policy framework that will address disparities and inequality against women, migrant farmers and the elderly.

Conclusions and Way Forward

Climate change manifestations coupled with inadequate infrastructure and institutional capacities compromise the ability of smallholder farming communities in the Nanumba South District to address climate change effects. These impacts disrupt food security, livelihoods, and essential services, deepening poverty and social inequalities. This is critical because most of the households in the district are directly dependent on rain-fed agro livelihoods. Effective adaptation in Nanumba South requires harnessing the potential of community-specific resources to develop sustainable and gender-responsive solutions. The report highlights the need for a gender-responsive, inclusive and well-coordinated approach to address gender inequality, economic, social and physical vulnerabilities in the Nanumba South District in the face of climate change.

1. Introduction

1.1 Project Background

In support of Ghana's National Adaptation Plan (NAP), the SIGRA Project (Strengthening Investments in Gender-Responsive Climate Adaptation) has commissioned Climate Change Risk and Vulnerability Assessments (CRVAs) for its five partner Districts. SIGRA (2023-2028) is a Global Affairs Canada funded project that seeks to advance climate action and inclusive governance in Ghana. Its ultimate outcome is to improve the resilience of Ghanaian citizens, particularly women, girls, and vulnerable groups through increased investments in inclusive and gender-responsive climate adaptation initiatives.

The project provides technical assistance to strengthen governance and national systems with key central Ministries, Departments and Agencies (MDAs) while providing direct grants to five MMDAs, funding local gender responsive climate adaptation projects. The project supports Regional Coordinating Councils (RCCs) in the Northern and Volta regions and strengthens the ability of targeted MMDAs to plan, implement, and report on climate adaptation initiatives. Additionally, SIGRA seeks to strengthen the participation, voice and influence of women led CSOs in government decision-making.

The project, which is currently being implemented by Cowater International, complements current national climate adaptation and resilience-building efforts in Ghana by recognizing the far-reaching consequences and implications of current and projected future climate change impacts on Ghana's sustainable development aspirations. As climate impacts become more pervasive, verifiable and pernicious in local communities across the country, the imperative for intentional interventions in the form of adaptation planning has also become an urgent policy concern, which has attracted several responses.

The National Adaptation Plan (NAP) as one such response is a flagship national program led by the Environmental Protection Agency (EPA) of Ghana and aims to identify climate impacts manifestations and associated risks and vulnerabilities across sectors and in local communities, and to put in place proactive adaptation interventions that build resilience. Ghana's NAP thus serves as an organizing avenue for subnational adaptation and resilience building through its use of place-based risk and vulnerability assessments, or what is described as district-specific adaptation planning. The primary objective, as outlined in Ghana's NAP Framework (Antwi-Agyei, 2018), is to reduce vulnerability to climate change impacts by enhancing adaptive capacity and resilience within local communities. Implicit in the district-focused approach is the recognition of the fact that climate change impacts are place-specific; that they are not homogeneous and require carefully considered adaptation measures that are also place-responsive.

The SIGRA Project complements Ghana's NAP processes by helping to address the growing impacts of climate change especially in local communities. The gendered focus of the project is particularly instructive as it highlights differential experiences of climate change impacts and how that also demonstrates differences in adaptive capacity levels, especially as they relate to women, young people, migrants and Persons with Disability (PWDs). While the project aims generally at improving the lives, livelihoods and well-being of people living in different places and facing climate change risks and vulnerabilities, the intentional focus on marginalization and differential adaptive capacity provides deeper insights that will inform adaptation planning (Antwi-Agyei et al., 2015). Such an approach not only enhances understandings around gender-responsive adaptation planning, but also, and perhaps more importantly, it facilitates the development of place-specific knowledge that may guide the direction of future investments in the implementation of adaptation options.

It becomes imperative, therefore, that Ghana's adaptation planning processes foster knowledge building, learning and capacity building (GIZ et al., 2022). The SIGRA project with its emphasis on specific vulnerabilities, rather than generalized vulnerabilities, affirms the fact that climate adaptation is both a learned and a learning process, which requires intentional processes that create the enabling environment for people to learn to adapt. Adaptation only happens when people have learned to live differently or made the necessary adjustments to their lives to become resilient. The logical process is that this work—CRVA—as has been completed for the Nanumba South District, will serve as the

premise from which a costed adaptation plan and associated intervention projects will be developed. A district-specific adaptation plan will ultimately serve as a major tool in the hands of the Assembly to develop innovative and bankable projects as they source funds (climate finance) for implementation.

1.2 Defining Climate Change Risks and Vulnerability

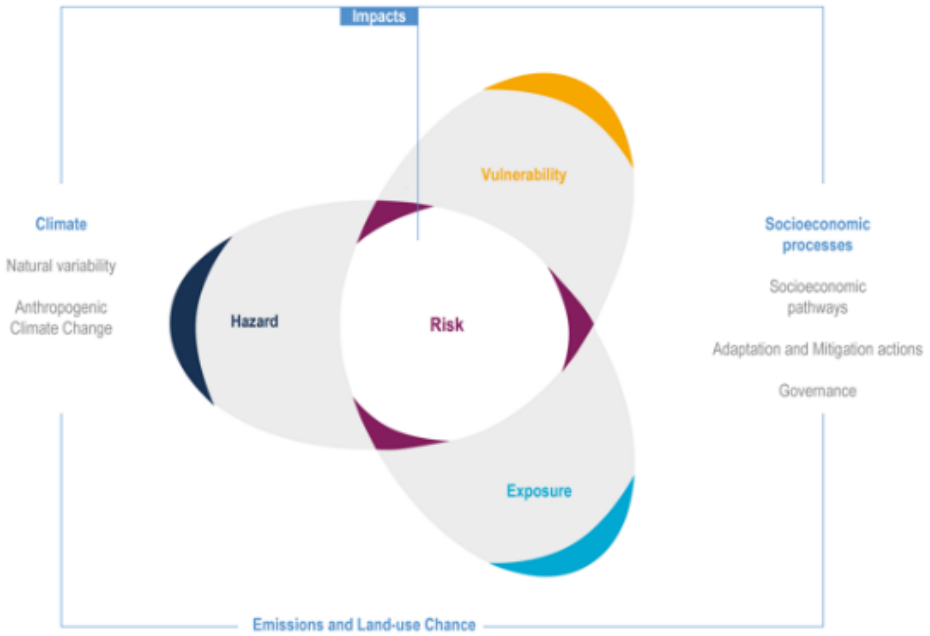
Climate change risk and vulnerability are foundational concepts for assessing the impacts of climate change on human and natural systems. These concepts have been refined and operationalized through frameworks developed by the IPCC, and CARE International each offering unique insights and methodologies. The IPCC provides a theoretical structure for understanding risk, while CARE extends this framework by incorporating practical tools and participatory approaches, which are highly relevant for addressing the complex socio-economic and gendered vulnerabilities across sectors and in all communities in Ghana. Ghana's NAP process, as led by the EPA, is guided by these internationally recognized conventions.

1.2.1 IPCC Risk and Vulnerability Framework

The Intergovernmental Panel on Climate Change (IPCC) defines climate risk as the interaction of three core components: hazards, exposure, and vulnerability (**Figure 1**). Hazards refer to climate-related events or conditions (*e.g.*, droughts, floods), while exposure reflects the presence of people, ecosystems, and assets in areas at risk. Vulnerability encompasses the susceptibility to harm and the capacity to adapt, shaped by socio-economic, cultural, and environmental factors (IPCC, 2022). The IPCC framework emphasizes that climate risk is not only determined by the magnitude of hazards but also by the socio-economic processes influencing exposure and vulnerability. For instance, in the Nanumba South District, cultural barriers restrict women's involvement in economic activities, which limits their adaptive capacity, further compounding their overall vulnerability to droughts and floods.

Additionally, the IPCC also highlights the concept of compound and cascading risks, where multiple hazards interact to amplify vulnerabilities. For example, in Nanumba South District, climate change related floods can lead to the destruction of food crops and livestock, with severe consequences for food security and well-being, which disproportionately affects women, children and the elderly. This interconnectedness underscores the need for integrated and inclusive adaptation strategies. The IPCC framework (**Figure 1**) provides a theoretical backbone for understanding climate risks, offering a basis for assessing hazards, exposure, and vulnerability.

Figure 1: The IPCC risk and vulnerability framework



1.2.2 CARE International's Climate Vulnerability and Capacity Analysis

CARE International's Climate Vulnerability and Capacity Analysis (CVCA) framework builds on the IPCC's principles of climate risk, emphasizing the interplay between climate impacts and socio-economic and gender factors (CARE, 2009). It acknowledges that vulnerabilities are not uniform and are shaped by variables such as gender, age, and social roles, which influence how different groups experience and respond to climate challenges.

The CVCA framework is inherently participatory, employing tools such as community mapping, focus group discussions (FGDs), and household surveys to identify specific vulnerabilities and resilience strategies at the local level. In the Nanumba South District, this could involve promoting women-led initiatives aimed at addressing food insecurity and water shortages resulting from climate change. The CVCA framework operationalizes the IPCC's concepts of vulnerability and adaptation in a way that is tailored to local realities by integrating local knowledge with scientific data.

A core focus of the CVCA approach is enhancing adaptive capacity through community-driven solutions. This might involve forming women-led cooperatives to promote climate-resilient agricultural practices or establishing community-managed water conservation systems to address water scarcity. By integrating local knowledge with scientific evidence, the CVCA framework operationalizes the IPCC's theoretical concepts into actionable, context-specific strategies. This approach not only addresses immediate climate challenges but also tackles systemic inequalities, fostering long-term resilience in vulnerable communities.

1.2.3 Adoption of Other Risk and Vulnerability Assessment

Integrating gender-responsive approaches into climate risk and vulnerability assessments enhances their effectiveness by capturing the socio-economic dimensions of climate impacts. By adopting broader risk assessment frameworks, these evaluations can provide deeper insights into climate risks, adaptation investments, and the differentiated vulnerabilities of women, youth, and marginalized groups. This approach and framework ensure that climate adaptation strategies are both equitable and economically sustainable, strengthening resilience at local and national levels as done in other assessments such as the Livelihood Vulnerability Index, UNDP's Climate Risk and Vulnerability Assessment Framework, the Economics of Climate Adaptation Framework by Global Environment Facility, GIZ's Risk and Vulnerability Framework and the World Bank's Climate Change Risk Framework. This assessment adopts a more comprehensive and integrated approach as done in other frameworks by considering socio-economic evaluations and gender-responsive approaches into its assessments with emphasis on gender-inclusive adaptation measures, promoting equitable access to resources and actively involving women in climate governance. The Climate Risk Management (CRM) methodology combines advanced tools, such as climate modelling and hazard mapping, with participatory techniques to ensure adaptation strategies are tailored to local needs and realities.

Aligned with objectives of the Strengthening Investments in Gender-Responsive Climate Adaptation (SIGRA) initiative, this Climate Change Risk and Vulnerability Assessment (CRVA) emphasizes a localized understanding of vulnerabilities, risks, and adaptive capacities at the district level while embedding strong gender considerations. The assessment incorporates the unique needs, perspectives, and contributions of women and marginalized groups to ensure that adaptation strategies are both inclusive and equitable. This approach strengthens the foundation for designing targeted, evidence-based adaptation strategies that are not only effective in addressing localized climate risks but also socially just.

1.3 Study Aims and Objectives

1.3.1 Study Aim

This assessment focuses on the gendered dimensions of climate vulnerability in the Nanumba South District. The goal is to provide actionable strategies for building resilience in vulnerable communities while ensuring equity and inclusiveness in climate adaptation efforts. The assessment integrates local insights with global adaptation priorities to address the unique challenges faced by the district.

1.3.2 Study Specific Objectives

1) ***Examine Climate Vulnerabilities*:** Assess the vulnerabilities specific to groups such as men, women, and the marginalized in the Nanumba South District. This objective examines the gender intersection of socioeconomic and environmental factors to shape exposure and sensitivity to climate impacts.
2) ***Identify Gender Gaps*:** Identify gender disparities that hinder equitable participation in climate adaptation efforts in Nanumba South District. Women, heavily involved in agriculture and natural resource management often face systemic barriers in accessing critical resources, climate information, and decision-making processes.
3) **Develop Actionable Solutions:** Propose adaptation policies and interventions that are gender-responsive and improve resilience, promote social equity, and address the specific climate adaptation needs of Nanumba South District.

The study aligns with the National Adaptation Plan (NAP), key national climate change and gender policy and international frameworks that emphasize the importance of gender equity and resilience in addressing climate change. Both the National Adaptation Plan Framework (2018) and the National Climate Change Policy (2013) emphasize the need for a gender-responsive approach to climate change adaptation in Ghana.

Sustainable Development Goal (SDG) 5 on Gender Equality highlights the need to address gender disparities in adaptation efforts and to empower women as key leaders in building climate resilience. Similarly, SDG 13 (Climate Action) underscores the urgency of strengthening adaptation strategies to enhance the resilience of communities that are most vulnerable to the adverse impacts of climate change. Together, these goals provide a foundation for integrating gender-responsive and inclusive approaches into climate adaptation planning in the Nanumba South District.

1.4 Document Purpose and Intended Users

The Climate Change Risk and Vulnerability Assessment (CRVA) for Nanumba South District is designed to identify, analyze, and prioritize the gendered perspective of climate vulnerability within the Nanumba South District in line with the NAP framework. The climate risk and vulnerability assessments were disaggregated by sectors and gender dynamics, based on local and national information.

The AR5 framework, developed by the IPCC in AR5, conceptualizes climate risk as a function of three interlinked components: hazard, exposure, and vulnerability. Hazard refers to the potential occurrence of climate-related physical events such as floods, droughts, or storms. Exposure involves the presence of people, infrastructure, ecosystems, or economic assets in areas that could be adversely affected by these hazards. Vulnerability encompasses the susceptibility of these exposed elements to harm, including their capacity to cope with and adapt to climate impacts. By integrating these components, the AR5 framework offers a comprehensive understanding of climate risk, highlighting the importance of both environmental and socio-economic dimensions. This approach supports the incorporation of local knowledge and context-specific realities in assessing climate change impacts at the district level.

Specifically, the document through this assessment aims to:

1. **Provide a Comprehensive Overview of Climate Risks:** To capture a detailed picture of the climate hazards specific to Nanumba South District, including the gendered dimensions of their current and potential future impacts on people, livelihoods, and ecosystems. This entails a rapid but thorough collection of information that informs adaptation planning and decision-making processes.
2. **Enhance Understanding of Vulnerabilities:** To deepen the understanding of the district's vulnerabilities, considering gender considerations and the multifaceted nature of climate risks that affect social, economic, and environmental dimensions.
3. **Support Adaptation Planning**: To offer a foundational basis for developing targeted and effective adaptation strategies and measures that address the prioritized risks, thereby strengthening the resilience of the Nanumba South District to climate change.

4. **Promote Stakeholder Engagement and Collaboration:** To facilitate an inclusive process that engages a wide range of stakeholders, including government agencies, local communities, NGOs, and private sector actors, ensuring that the CRVA process is grounded in local realities and benefits from diverse perspectives and expertise.
5. **Align with National and Regional Climate Change Frameworks:** To ensure that the findings and recommendations of the CRVA for Nanumba South District are consistent with national climate change strategies and action plans, contributing to the broader efforts to mitigate and adapt to climate change in Ghana.
6. **Build Institutional Capacity:** To strengthen the capacities of Assembly staff and relevant stakeholders. This will equip them with the knowledge and skills needed to effectively govern adaptation efforts, including conducting future climate risk and vulnerability assessments and developing comprehensive adaptation plans.

2. Profile of Nunumba South District

2.1 Geography and Climate-Related Profiles

2.1.1 Location and Size

The total land area of Naumba South is 1,789.2 km^2 and is accessible via road networks that connect to major towns in the Northern Region and beyond (GSS, 2021). This extensive area of land serves multiple purposes, primarily agriculture, the backbone of the district's economy as well as settlements and natural reserves. The district lies between latitudes 8.5^{o}N and 9.0^{o}N and longitudes 0.5^{o}E and 0.5^{o}W.

The district is bordered by the Nanumba North District to the north, which was part of the historical Nanumba traditional area, bound to the eastern corridor with Krachi West District and to the south, it is bordered by the Nkwanta North District, which is also part of the Oti Region. The southern boundary significantly impacts the district's socioeconomic activities and demographic patterns, shaping interactions and development within the region. Kpandai District forms a boundary with Nanumba South District at the western point.

The district capital, Wulensi acts as the central point for economic activities, fostering connectivity with neighbouring districts and facilitating the role as an emerging centre for socioeconomic development in the region (GSS, 2021).

2.1.2 Physical and Environmental Features

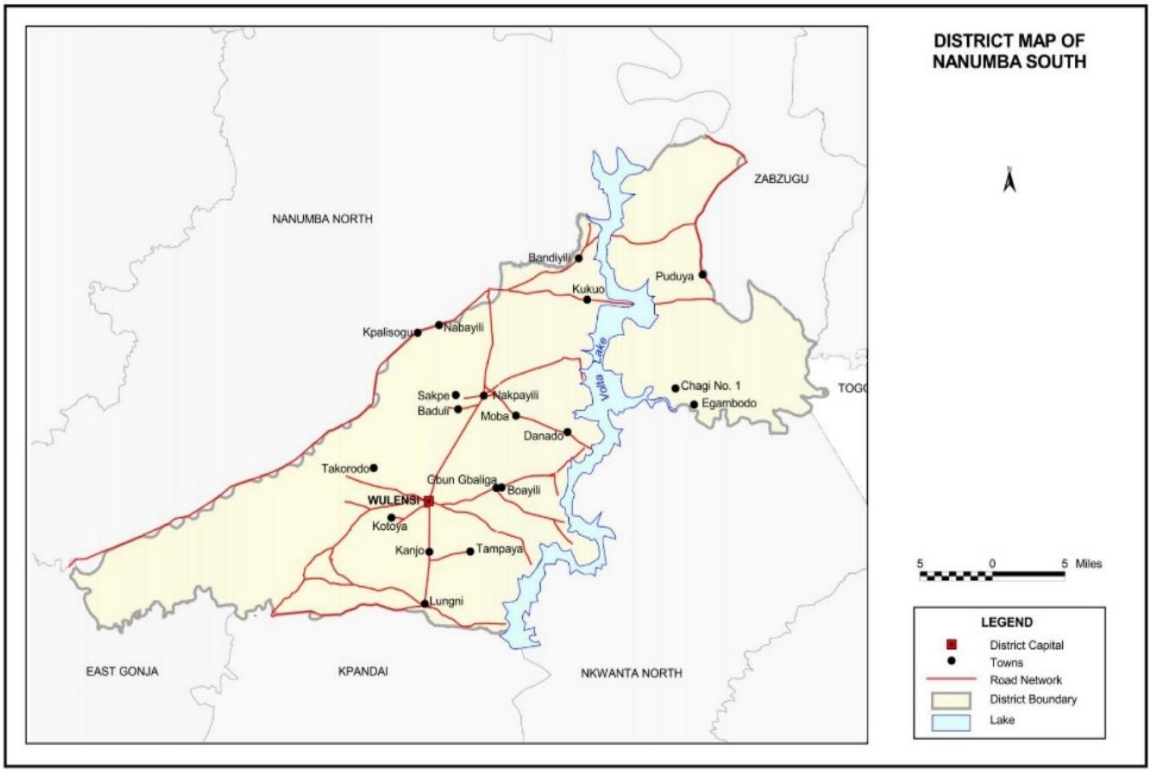
The Nanumba South District is located in the northwestern part of Ghana's Northern Region. It is predominantly rural, with key population centers in Wulensi, Nakpayili, Gbungbaliga, and Lungni (**Figure 2**). The district faces significant challenges in infrastructure, economic development, health, and education. Wulensi, the district capital, is connected by a first-class road linking the district to Nanumba North, Kpandai, and the Oti Region. The district's landscape features a variety of water bodies, including two earthen dams and the Oti River, which flows through Kukuo.

The district's soils are predominantly heavy and dark-colored, classified into savannah ochrosols, savannah glysols, and groundwater laterite. Savannah glysols, which originate from alluvial-colluvial deposits, are found along major rivers and are well-suited for agriculture (NSDA, 2022).

Geologically, the district lies within the acidic gneiss belt, with soil types ranging from well-drained sandy loams to poorly drained clays. These soils support diverse land uses, including arable farming and livestock grazing.

Demographically, the district has an annual growth rate of 1.1%, which is below the national average of 2.4%. Most settlements remain rural, relying heavily on natural resources for livelihoods (GSS, 2021). However, human activities particularly annual bushfires are depleting the once lush Guinea-Savannah vegetation, gradually transforming it into treeless grasslands on fragile soils. These physical and environmental features significantly influence the district's agriculture, water resources, and overall ecological balance.

Figure 2: Physical and environmental features of Nanumba South District



2.1.3 Topography and Climate

The Nanumba South District has a relatively flat terrain with a gently undulating landscape, characteristic of the Guinea Savannah ecological zone. The area is dominated by vast savannah grasslands with scattered drought-resistant trees (GSS, 2021). This landscape supports both rain-fed agriculture and livestock rearing, which are the primary livelihoods of the district's inhabitants.

Several rivers and streams flow through the district, with the most notable being the Oti River (Mid-Term Development Plan [MTDP], Nanumba South District Assembly, 2020). These water bodies, when properly managed, play a crucial role in dry-season farming, fishing, and providing water for domestic use and livestock (**Photo 1**). They also offer potential for small-scale irrigation projects and other water-based economic activities (MTDP, 2020).

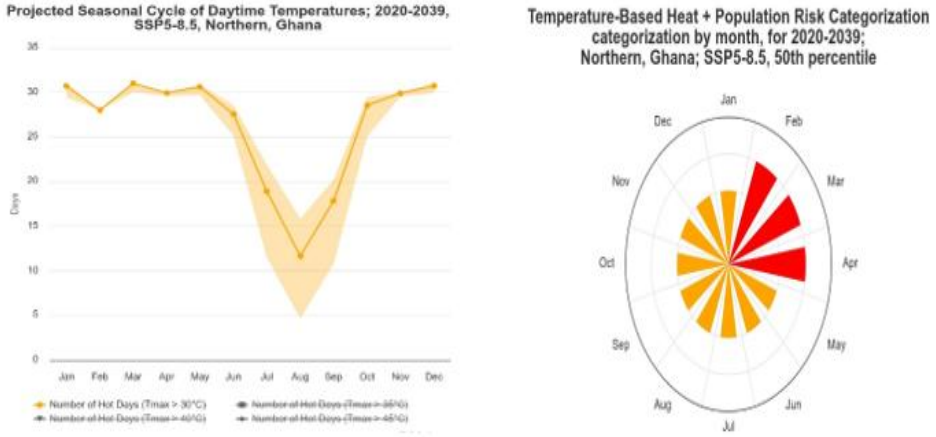
Photo 1: Canoes for fishing in the River Oti

The Nanumba South District falls within Ghana's tropical savannah climate zone, typical of semi-arid regions. It has distinct wet and dry seasons, which directly influence crop production cycles. Rainfall is unpredictable and lasts for less than four months (June–September), followed by a prolonged dry spell, seven months (MTDP, 2020). During this period, high evapotranspiration causes grasses to dry out, increasing the risk of bushfires and water shortages.

Daily temperatures range from 29°C to 41°C, occasionally reaching 45°C. The district, like much of West Africa, is affected by the wet southwest monsoon and the dry northeast trade winds. It experiences a single peak rainfall season (May–October), leaving the rest of the year completely dry. The prolonged dry conditions hinder livestock production and other key economic activities (GSS, 2021). December and January mark the Harmattan season, characterized by dry, dusty winds from the Sahara, which can lower temperatures to around 27°C (MTDP, 2020).

Maximum rainfall is recorded in September with its accompanied windstorms. During this period streams and rivers overflow their banks and surface run-off (GSS, 2021). As a result of this rainfall pattern, there is only one cropping season, as most farmers in the district rely on rain-fed agriculture. **Figure 3** illustrates the projected seasonal temperature changes for the Northern Region, offering valuable insight into the timing and severity of drought events in the Nanumba South District (MTDP, 2020). These projections indicate a continuous surge in temperatures, particularly during the dry season, which could lead to more frequent and prolonged droughts.

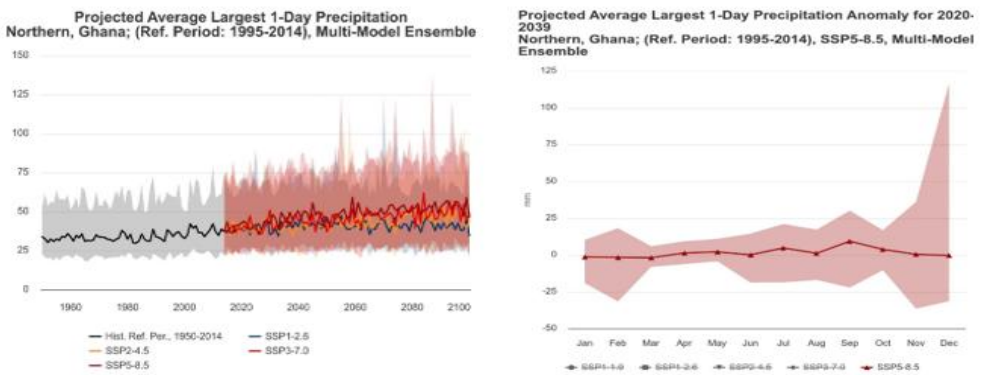
Figure 3: Projected seasonal daytime temperatures for the Northern Region of Ghana



Source: Climate Change Knowledge Portal

Figure 4 illustrates the weather patterns in Nanumba South District, showing a distinct dry season from November to April, characterized by predominantly sunny days. The rainy season spans from May to October, with peak rainfall and overcast conditions in August and September. Transition periods feature more frequent partly cloudy days, while precipitation drops sharply after October, marking the return of dry conditions typical of the savanna climate (GSS, 2021). The graph presents the monthly distribution of sunny, partly cloudy, overcast, and rainy days.

Figure 4: Expected change in the maximum daily rainfall for the Northern Region of Ghana



Source: Climate Change Knowledge Portal

2.1.4 Relief and Vegetation

The Nanumba South District's landscape reflects the Guinea Savanna ecological zone (GSS, 2021). It features undulating terrain with scattered depressions and high elevations, which contribute to soil erosion and poor water retention during the rainy season. While this topography presents challenges, it also offers opportunities for agriculture, settlement, and conservation, requiring careful planning to maximize its potential (**Photo 2**).

The River Oti is the district's main water body, with several smaller rivers and streams forming a dendritic drainage pattern. These tributaries dry up in the dry season, limiting water availability for farming, fishing, and household use. During peak rainfall (August–September), the rivers swell, sometimes causing floods, yet water retention remains low in the dry season. These water bodies serve about 26% of households in the district (MTDP, 2020).

The district falls within the Guinea Savanna vegetation zone, characterized by grasslands, shrubs, and scattered trees. This environment supports crops such as maize, millet, sorghum, yam, and groundnut. Cash crops like shea (*Vitellaria paradoxa*) and dawadawa (*Parkia biglobosa*) are also grown, along with a few mango trees.

Photo 2: Shea trees intercropped with maize in the Nanumba South District

Source: Mid-Term Development Plan (2020)

The district's staple crops and cash trees are vital to both the local ecology and economy (MTDP, 2020). They provide shade, have medicinal properties, help prevent soil erosion, and support the livelihoods of women and youth through shea butter and dawadawa processing.

Although the soils in Nanumba South District are generally suitable for agriculture, proper management is needed to maximize productivity (GSS, 2021). The landscape is prone to erosion, which washes away topsoil and depletes organic matter, reducing soil fertility and hindering crop growth (MTDP, 2020).

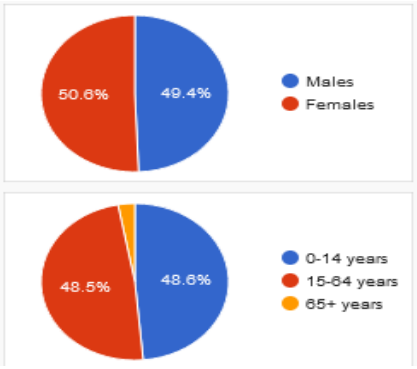
2.2 Key Demographic Characteristics of the Nanumba South District

According to the 2021 Population and Housing Census by the Ghana Statistical Service (GSS, 2021), the Nanumba South District has a total population of 106,374, comprising 52,511 males and 53,863 females. The district is predominantly rural, with 84,011 residents in rural areas and 22,363 in urban areas. The administrative and economic center is located in the capital, Wulensi.

Nanumba South is largely agrarian, with over 85% of the population engaged in agriculture. Additionally, 6.5% work in sales, while 5.4% are involved in service and trade-related activities, primarily in urban areas (GSS, 2021). The district has a youthful population, with a significant proportion under the age of 15, with 45% aged 0–14 years, 50% between 15-64 years, and only 5% aged 65 and above. This age

structure creates significant demand for education, healthcare, and employment opportunities, shaping the district's socioeconomic priorities (**Figure 5**).

Figure 5: Population of Nanumba South District, stratified by gender and age distribution



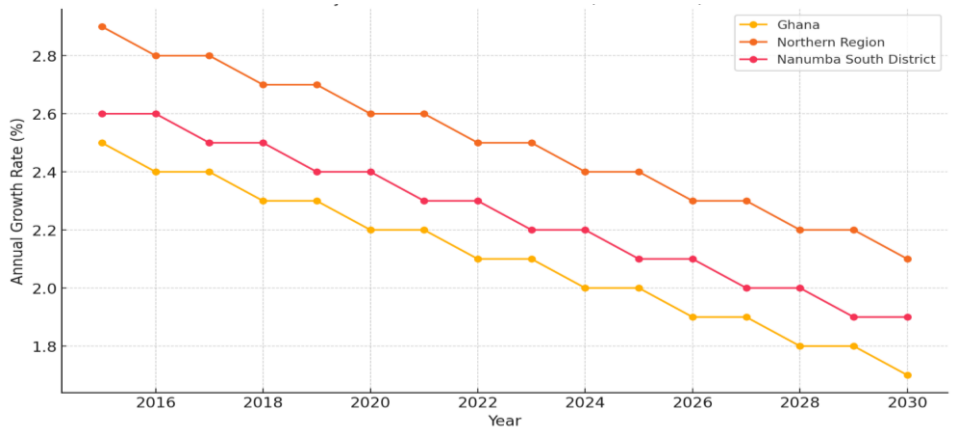
Gender (C 2021)	
Males	52,511
Females	53,863

Age Groups (C 2021)	
0-14 years	51,677
15-64 years	51,631
65+ years	3,066

Source: Ghana Statistical Service, 2021

Figure 6 shows the projected annual growth rates for Ghana, the Northern Region, and Nanumba South District from 2015 to 2030. The data reveals a gradual decline in growth rates across all three areas, reflecting demographic transitions and economic trends.

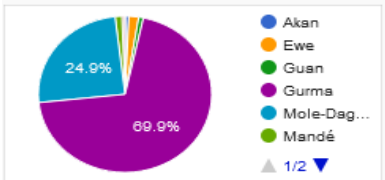
Figure 6: Projected annual growth rate (2015-2030)



Source: United Nations Department of Economic and Social Affairs (UNDESA, 2019), World Population Prospects

The indigenous people of Nanumba South are primarily Gurma, with Gonja, Mole-Dagbani, Ewe, and Guan ethnic groups also present, especially along the White Volta River (**Figure 7**), where fishing is common (GSS, 2021). The district predominantly follows an extended family system, reflecting its rural and traditional social structure.

Figure 7: Ethnic groups across the Nanumba South District

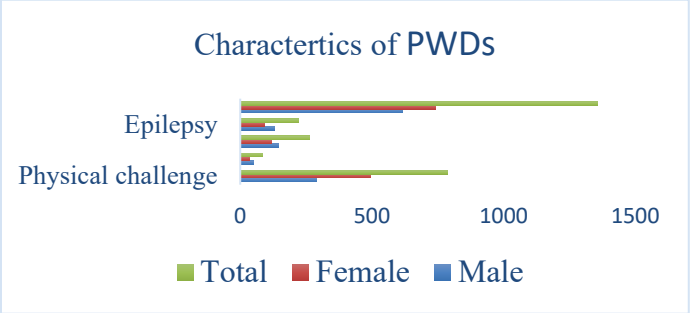


Ethnic Group (C 2021)	
Akan	737
Ga-Dangme	39
Ewe	1,945
Guan	921
Gurma	73,915
Mole-Dagbani	26,294
Grusi	72
Mandé	1,336
Other Ethnic Group	504

Source: GSS (2021)

The Nanumba South District has a total number of one thousand three hundred and sixty-two (1,362) people with disabilities disaggregated as 580 males and 782 females (**Figure 8**).

Figure 8: Data on people with disabilities in the Nanumba South District



Source: GSS (2021)

2.3 Key Economic Activities in the Nanumba South District

Agriculture is the backbone of the Nanumba South District's economy, employing over 80% of the population (**Photo 3**). The sector is predominantly rain-fed and operates for about four months, leaving rural households, especially women, to rely on alternative livelihoods for the remaining seven months. Women often engage in shea butter processing, dawadawa production, petty trading, and handicrafts, while men supplement their income through fishing, charcoal burning, and small-scale trading. The district has only two earth dams, located in Wulensi and Nakpayili, which provide limited support for dry-season farming. This insufficient water infrastructure restricts irrigation farming, affecting food security and income generation for rural communities (Mid-Term Development Plan, Nanumba South District Assembly, 2020).

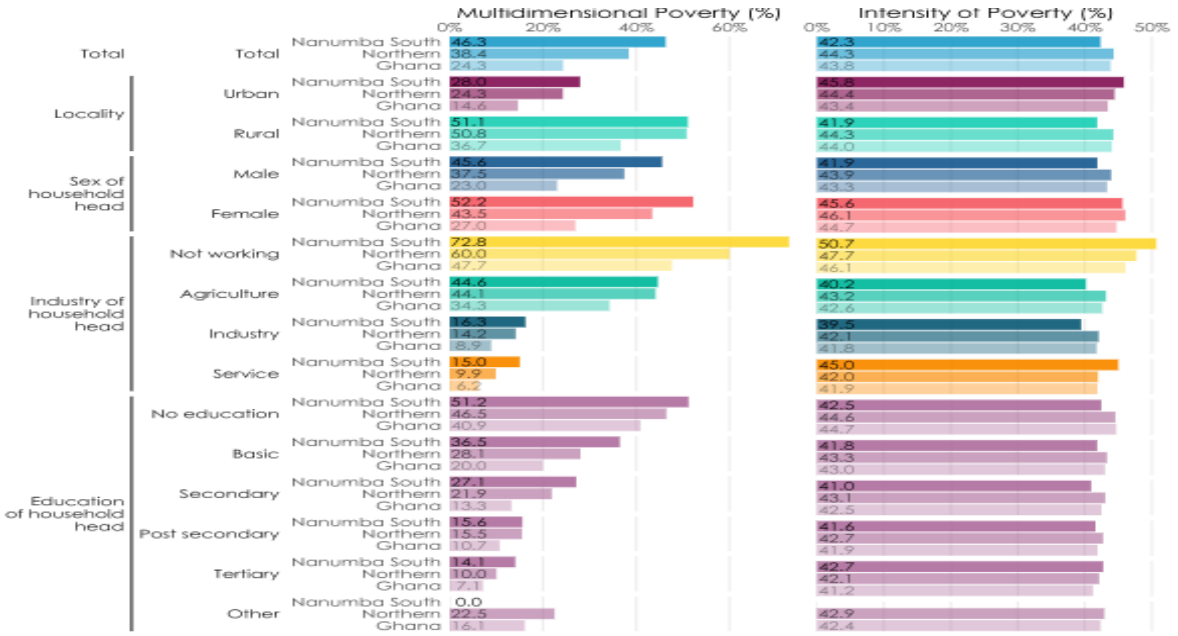
Photo 3: Women and men in Bandayili engaged in shea processing and farming

The two earth dams constructed under the New Patriotic Party's "One Village, One Dam" initiative are intended to support the cultivation of vegetables like okra, pepper, tomatoes and onion to improve households' economic and livelihood activities (**Photo 4**). These two dams are insufficient, to ensure the year-round supply of water for farming activities to support the people's economic activities, and this reflects a broader challenge across the Northern Region, where many districts lack adequate irrigation dam infrastructure.

Photo 4: Irrigation facility within Nakpayili community in Nanumba South District

The standard of living in Nanumba South is lower than the national average, as reflected in the district's poverty mapping (GSS, 2021). According to Ghana Statistical Service (2021), 46.3% of the population experiences multidimensional poverty, characterized by limited access to basic necessities such as quality healthcare, education, clean water, and improved sanitation (**Figure 9**).

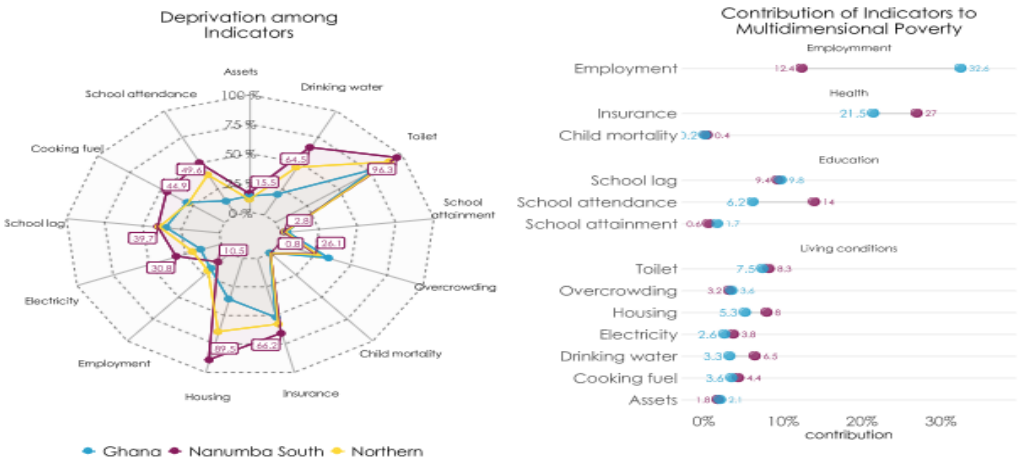
Figure 9: Multidimensional poverty and its intensity in Nanumba South



Source: Ghana Statistical Service (GSS, 2021)

Figure 10 indicates that the poverty profile in Nanumba South District is most severe in rural areas, non-working households, and female-headed households. The district has a high deprivation rate of 41.6%, indicating widespread socioeconomic challenges.

Figure 10: Deprivation indicators and contribution to multidimensional poverty in the Nanumba South District

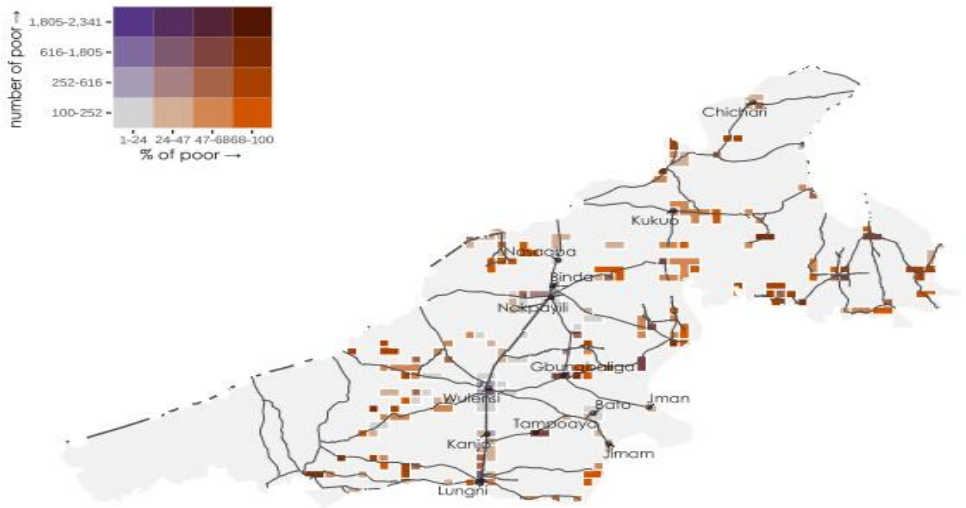


Source: GSS (2021)

The multidimensional poverty hotspot in the district highlights substantial levels of deprivation and identifies the lack of employment as the largest contributor to poverty (32.6%), followed by healthcare (21.5%) and education (9.8%), with issues related to school delays and attendance being key concerns (GSS, 2021). Poor living conditions, including overcrowding, inadequate housing, lack of fuel for cooking, and limited access to electricity, further exacerbate poverty levels (MTDP, 2020). **Figure 11** highlights multidimensional poverty hotspots across the Nanumba South District, with variations in the

density and proportion of poor individuals. Gbungbaliga and similar communities show higher concentrations of poverty, as indicated by darker spots on the map. The distribution reflects significant disparities in poverty levels within the district, with some locations experiencing extreme deprivation.

Figure 11: Multidimensional poverty hotspots across the Nanumba South District



Source: GSS (2021)

Fishing is an important livelihood activity for some of the communities along the River Oti in the Nanumba South District, as is the transportation of goods and services into and out of the district (**Photo 5**). This is particularly true for settlers in communities with a noticeable Ewe origin who migrated and have a strong fishing tradition. The scarcity of sufficient water bodies places significant pressure on fishing, leading to dwindling fish populations and reduced catches in the remaining water sources.

Livestock production and poultry rearing are prominent across a few of the urban communities in the district (GSS, 2021). These economic activities support both household income and community development. Smock weaving in Wulensi indicates the rich cultural heritage of the people in the district. Carpentry, beauty care, welding, and auto mechanics are more localized, centred in larger settlements with higher demand for such services (MTDP, 2020).

Photo 5: Transportation and fishing canoes on the River Oti along Kukuo Community

Source: Nanumba South District Assembly, 2020

2.4 Observed Gender Gaps in the Nanumba South District

Gender disparity in Nanumba South District mirrors broader trends in rural Ghana, and is evident in agriculture, education, economic involvement. According to the African Development Bank's Africa Gender Index Report (2023), women in the district face limited opportunities for personal and economic development and are often excluded from decision-making processes. Economic inequality disproportionately affects women, as they have restricted access to land, credit, and agricultural inputs, reducing their productivity. Their economic activities are largely informal and undervalued, with sociocultural norms restricting women's decision-making power and mobility. During environmental and

economic shocks, men often migrate in search of opportunities, leaving women with increased caregiving responsibilities, reduced access to essential resources like food and water. These inequalities hinder women's ability to adapt to climate change and improve their livelihoods.

2.4.1 Education

Enrolment and Retention: Programmes like the Ghana School Feeding Programme and support from organizations such as Campaign for Female Education (CAMFED) have boosted school enrollment by addressing barriers that hinder retention in school. Many children, especially girls, drop out of school due to financial hardships and household responsibilities, deepening education disparities. Likewise, CAMFED offers mentorship and life skills training through its peer support network, empowering girls to stay in school and complete their education. The organization also works with communities to challenge cultural norms that limit girls' education, advocating for policies that promote gender equality in schools. These efforts have contributed to higher retention rates and better educational outcomes for girls in the district.

Cultural practices: Deep-rooted societal norms such as early marriage and traditional domestic expectations limit girls' education and their economic opportunities. This not only restricts their future opportunities but also reinforces poverty and economic dependence in the community. Also, social and cultural norms discourage women from participating in decision-making, restricting their economic empowerment. These cultural barriers contribute to gender inequality and hinder girls' long-term development in the district.

2.4.2 Health

The 2023 Ghana Health Service report revealed that the district is served by one district hospital, thirteen health centers, and twenty-five Community-based Health Planning and Services (CHPS) compounds, catering to a population of approximately 120,000 people (Ghana Health Service, 2023). Women with disabilities in the Nanumba South District face increased vulnerabilities and have fewer opportunities for employment and social integration compared to men. For example, women with disabilities were often overlooked in favor of men with disabilities for support aimed at improving economic well-being (MTDP, 2020).

2.4.3 Water and Sanitation

Clean water access is a major challenge in Nanumba South District (MTDP, 2022). Many residents depend on rainwater harvesting, which is often insufficient, or travel long distances to reach dams. These dams are frequently overgrown with plants and silt, reducing clean water availability for households, crops, and livestock. Women and girls are most affected, as water collection demands significant time and effort. The lack of reliable water sources also hampers sanitation and increases waterborne diseases such as cholera and bilharzia.

2.4.4 Agriculture and Economic Participation

Poor Infrastructure and Limited Access to Finance: Inadequate infrastructure, such as poorly maintained roads, limited storage facilities, and lack of irrigation systems, hampers productivity and market access for many communities. Additionally, limited access to financial services, such as loans and credit, restricts opportunities for investment in modern farming techniques, equipment, and other income-generating activities. This combination of poor infrastructure and financial constraints perpetuates cycles of poverty and reduces economic resilience, particularly for marginalized groups like smallholder farmers and women (GSS, 2021).

Economic Marginalization: Women are predominantly engaged in lower-income activities such as food processing and petty trading, further widening the income gap. They mostly face limited access to resources such as land, credit, and extension services due to sociocultural barriers (GSS, 2021).

Community Participation and Decision-Making: In the Nanumba South Distrit, women face obstacles in the decision-making process within many community-based organizations. Sociocultural, economic, political, and religious norms frequently restrict women's ability to assume key decision-making and leadership roles. Instead, women are often assigned activity-specific tasks such as caregiving, fetching of water and firewood by male leaders, limiting their influence and contributions. Additionally, many women lack the confidence to voice their concerns, leaving them suppressed and

compelled to accept decisions made by men, even when such decisions negatively impact their well-being. Building the capacity of women in the Nanumba South District is essential, as it empowers them to participate in community decision-making processes.

2.4.5 Sociocultural Norms

Patriarchal Structures: Like all other districts in the northern region of Ghana, the Nanumba South District's patriarchal culture reinforces gender roles that marginalize women. Men dominate in access to natural resources, and decision-making at household and community levels, leaving women with minimal agency (MTDP, 2020).

Migration: Limited economic opportunities and financial pressures drive many young men and women to migrate to urban centers such as Techiman, Kumasi, and Accra in search of menial work, often leaving them vulnerable to exploitation and health-related risks (MTDP, 2020).

2.5 Critical Climate-Related Hazards in Nanumba South District

The assessment highlights three key climate hazards in Nanumba South District: droughts, flooding, and bushfires. These hazards exacerbate socio-economic challenges, disproportionately impacting marginalized groups such as women and smallholder farmers. Their effects deepen existing inequalities, hinder resilience, and slow development efforts in the district.

2.5.1 Drought

Nanumba South District experiences a unimodal rainfall pattern, with a single rainy season from May to October, followed by a prolonged dry period influenced by the northeast trade winds (**Photo 6**). This climatic pattern leads to high evaporation rates and significant water scarcity during the dry months, adversely affecting agriculture and water availability for communities (GSS, 2014). The district's economy is predominantly based on rain-fed agriculture, making it particularly vulnerable to drought conditions. Prolonged dry spells can lead to crop failures, food shortages, and economic hardships for farmers.

A rapid assessment of priority areas impacted by dry spells in central and northern Ghana highlighted that regions heavily reliant on rain-fed agriculture, such as Nanumba South, are especially susceptible to the adverse effects of drought (WFP, 2019). The socioeconomic impact of drought in Nanumba South is profound, exacerbating food insecurity and poverty levels.

The district's Composite Budget for 2023 emphasizes the need for effective water management and agricultural practices to mitigate the effects of drought and enhance resilience among the local population (MoFEP, 2023). When soil fertility diminishes, its ability to retain moisture is significantly reduced, making crops more vulnerable during dry spells. The lack of essential nutrients and organic matter in the soil also weakens plant resilience, limiting their ability to survive prolonged droughts. This directly influences food security and household income.

Photo 6: Maize farm destroyed by drought in Nabayili of Nanumba South District

2.5.2 Flooding

Flooding is an important environmental issue in the Nanumba South District, intensified by the erratic rainfall linked to climatic variability (NSDA, 2023). Unplanned infrastructure development has contributed to poor drainage systems, intensifying the district's vulnerability to flooding (**Photo 7**). Additionally, factors such as deforestation and agricultural expansion have disordered water flow patterns, making the district more prone to floods (Milien et al., 2021).

The impacts of flooding in Nanumba South disrupts livelihood activities, particularly agriculture, which is the largest employment sector in the district. Variability in rainfall patterns negatively distresses crop production, threatening the livelihoods of many, especially smallholder farmers (Yiridomoh et al., 2024), including women, who have limited access to resources like land and agricultural inputs. These disruptions in agriculture can lead to economic insecurity (Nkegbe et al., 2017) disproportionately impacting female-headed households that rely more heavily on farming for their income.

In addition to the agricultural impacts, flooding has social repercussions, including changes in land use and rural-urban migration (Kpenekuu et al., 2024). These shifts can disproportionately affect women's access to land and resources due to existing gender disparities in land ownership and control. Furthermore, increasing temperatures and more frequent droughts heighten the risk of bushfires and environmental degradation. This situation places an additional burden on women, who are often responsible for collecting firewood and managing household resources, making their daily survival even more challenging.

Flooding poses a serious threat to infrastructure, often damaging roads, bridges, and buildings. This disruption limits access to essential services, transportation, and markets, making it harder for women to participate in economic activities or reach healthcare and education facilities. Additionally, the risk of waterborne diseases like cholera and dysentery increases during floods (Dovie et al., 2017). As primary caregivers, women are disproportionately affected, as they must care for sick family members while managing already difficult conditions.

Similarly, severe floods often force people to leave their homes, resulting in temporary or permanent displacement. Women and children are particularly vulnerable in such situations, as displaced households may experience increased violence against women that can lead to reduced access to their basic necessities (NSDA, 2023). Addressing flooding and its associated impacts requires a gender-sensitive approach that considers the specific needs and vulnerabilities of women in planning and response strategies.

Photo 7: Road infrastructure damaged by floods in Wulensi, Nanumba South District

2.5.3 Bushfires

The district faces significant challenges from bushfires, particularly during the dry season when vegetation becomes highly flammable. These fires often result from human activities such as slash-and-burn agriculture, hunting, and the use of fire for land clearing. The prevalence of bushfires in the district contributes to deforestation, loss of biodiversity, and degradation of soil quality, which in turn

affect agricultural productivity and the livelihoods of local communities (MTDP, 2020). The environmental impact of wildfires in Nanumba South is profound (**Photo 8**). The loss of vegetation cover leads to increased soil erosion, reduced soil fertility, and disruption of water cycles, exacerbating the challenges posed by climate change (MTDP, 2020). Efforts to mitigate wildfire occurrences include community education on sustainable land management practices, establishment of fire volunteer squads, and the implementation of early-warning systems. However, limited resources and the deeply rooted nature of traditional farming practices pose challenges to these initiatives.

Photo 8: Bushfire destroys farm produce in Tanbahimi of Nanumba South District

2.6 Impacts of Climate Hazards on Water Resources in Nanumba South District

The Nanumba South District experiences chronic water scarcity due to erratic rainfall patterns, prolonged dry seasons, and increasing temperatures, which reduce available water sources (Nanumba South District Assembly [NSDA], 2023). High evaporation rates and declining groundwater levels have intensified water shortages, making it difficult for households, farmers, and livestock owners to access reliable water supplies (Keeton et al., 2022).

As water bodies shrink, pollutants become more concentrated, further degrading water quality (Williams et al., 2017). This affects public health and makes it even harder for smallholder farmers especially women to access water for irrigation and livestock, threatening food security and livelihoods. Women and children, who are primarily responsible for water collection, often travel long distances in search of safe drinking water, limiting their time for education and economic activities (Amankwaa & Gough, 2023). Inadequate water infrastructure and weak resource management continue to hinder efforts to provide clean and sustainable water access, worsening health and food security challenges in the district (Yiran et al., 2024).

The district faces persistent water scarcity, deteriorated by high temperatures and climate-related hazards (NSDA, 2023). As temperature rises, evaporation increases, with reducing surface water availability, which is critical for domestic, agricultural, and livestock use (Keeton et. al. 2022). This affects health and also diminishes the ability of smallholder farmers to use water for dry season gardening and livestock, further affecting food and livelihood security. Clean water shortages in Nanumba South District leads to severe health, economic, and social challenges. Many communities in the district rely on unsafe water sources, increasing the risk of waterborne diseases like cholera and dysentery. The burden of fetching water falls primarily on women and children, forcing them to travel long distances, which limits their time for education, income-generating activities, and household responsibilities. Reduced access to clean water also affects food security, as women farmers struggle to irrigate crops and sustain livestock. Weak water infrastructure and poor resource management further worsen these challenges, making clean water access a critical issue for community well-being.

3. Methodological Framework

3.1 Introduction

The section highlights the key methodological framework employed for the assessment of climate change vulnerability in the Nanumba South District. By combining qualitative and quantitative approaches, the CRVA: (i) assesses the vulnerabilities and risks specific to men, women, and marginalized groups in the Nanumba South District; (ii) identifies disparities in access to critical resources, climate information, and decision-making processes, which hinder equitable participation in adaptation efforts in the Nanumba South District; and (iii) provides evidence-based recommendations for gender-responsive adaptation policies and interventions.

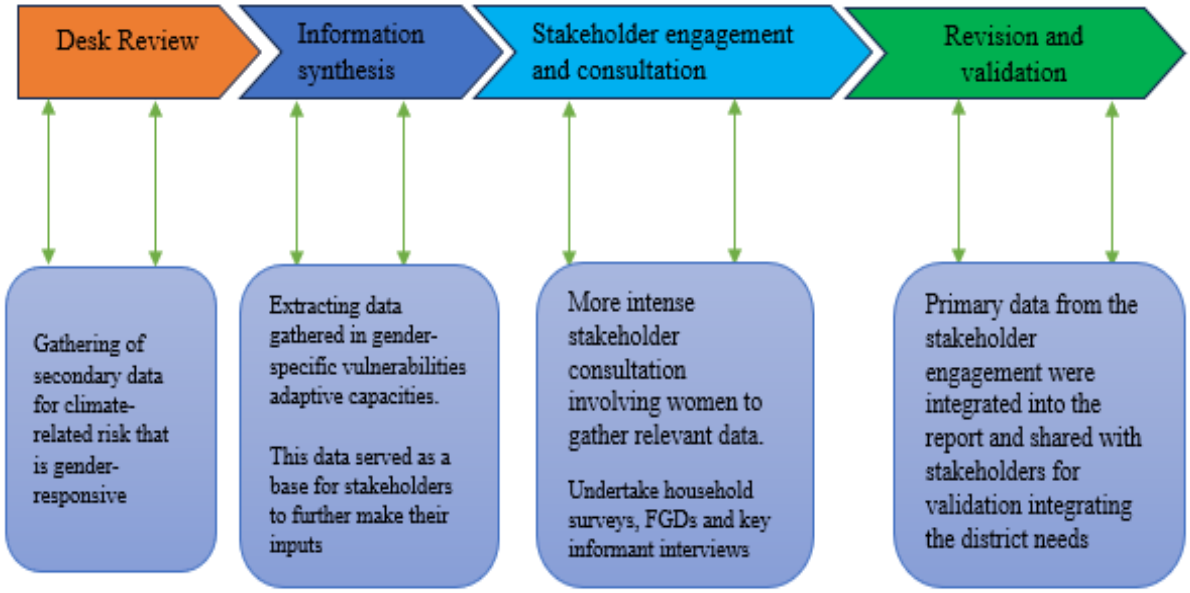
3.2 Phases of the Assessment and Gender-Sensitive Assessment Process

The methodological framework adopted for the climate risk assessment in Nanumba South District used qualitative and quantitative approaches to assess climate risks, vulnerabilities, and adaptive capacities of the district. The process was structured into four key phases: Desktop Review, Information Synthesis, Stakeholder Consultation, and Revision and Final Validation (see **Figure 12**). The methodology was designed to incorporate inclusivity and gender responsiveness, which ensures the active participation of diverse stakeholders, including women, youth, and marginalized groups. Furthermore, this chapter explains the primary data collection and analysis approaches, including household surveys, focus group discussions, and key informant interviews, which have been employed to gather gender-specific insights and local perspectives of the district.

3.2.1 Desktop Review

The desk review serves as the initial phase in the climate risk assessment process providing a foundational understanding of the Nanumba South District's climate-related challenges. The review revealed adaptation strategies that are inclusive and gender-sensitive

Figure 12: Overall work approach for the Nanumba South District climate risk assessment



3.2.2 Information Synthesis

The synthesis phase merged the insights from the desktop review to inform fieldwork and refine the assessment methodology. This was done by critically decoding the raw data into actionable understandings, indicating significant findings, trends, and gaps identified during the desk review highlighting climate change, vulnerability, and inequalities in the district.

3.2.3 Stakeholder Consultation

Stakeholder consultation is crucial for aligning climate risk assessment in a comprehensive, participatory manner that is grounded in local realities. This process involves broad consultation with stakeholders through a district-level engagement workshop, aimed at collecting their perspectives and insights on climate hazards within the district.

The stakeholders include representatives from local governments, community organizations, businesses, academic institutions, and other relevant entities. Their involvement is crucial, as they offer unique local knowledge, experiences, and expertise that can greatly enhance the assessment. Stakeholder engagement fosters opportunities for open dialogue that encourages the sharing of different perspectives in identifying relevant individual risks and opportunities. For the consultation to be effective, the preliminary findings from the synthesis report are presented, and stakeholders are invited to provide feedback. This collaborative approach ensures the assessment is scientifically rigorous and culturally relevant to the community. Localized stakeholder engagements can highlight specific vulnerabilities, propose mitigation strategies, and identify practical adaptation measures that may not be apparent through secondary data alone. Also, the consultation process fosters trust and ownership among stakeholders, making it easier for them to adopt the outcomes and recommendations. Finally, this step highlights the importance of a participatory approach in addressing climate risks, ensuring that the solutions developed are effective and reasonable.

3.2.4 Revision and Final Validation

This phase focused on validating the data collected and refining the findings to ensure accuracy, relevance, and alignment with the district's needs. A draft report was developed, incorporating insights from all previous phases, including climate risks, vulnerabilities, and gender-responsive adaptation strategies. Validation workshops with stakeholders such as local authorities, women-led groups, and civil society organizations were held to review and provide feedback. This feedback was integrated into the final report.

3.3 Gender-Sensitive Climate Risk Assessment Methodology

The methodology for the CRVA for the Nanumba South District adopted a framework similar to that of Norman et al. (2014) explaining gender-related risks in climate vulnerability (**Figure 13**). This assessment approach is structured to identify and assess climate risks, with a focus on designing adaptation strategies that will be inclusive and gender-responsive, ensuring the active participation of a diverse range of stakeholders, including women, youth, and marginalized groups, to capture a broad spectrum of perspectives and needs. It incorporated various data collection and analysis approaches, such as household surveys, focus group discussions, and key informant interviews, which were specifically aimed at gathering localized and gender-sensitive insights. These methods were carefully chosen to reflect the distinct experiences and challenges faced by different demographic groups within the communities.

3.3.1 Stage 1: Risk Identification

The risk identification process for the Nanumba South District involved defining the key parameters that shape climate risk management in the area. Desk reviews were instrumental in gathering relevant information to understand the district's environmental and socioeconomic context. This foundational analysis provided a solid basis for recognizing and evaluating climate change-related risks. Once the context was established, additional risks, such as extreme weather events, were identified. This phase focused on documenting potential climate change risks and assessing their likely impacts on the district to include activities such as:

- **Collecting Gender-sensitive data:** Secondary data, including climate models, weather patterns, and socio-economic reports, provided the foundation for the assessment. The analysis focused on how climate risks impact women, youth, and marginalized groups in different ways.

- **Evaluating Climate Risks:** The review examined past and present climate impacts such as droughts, floods, and heatwaves focusing on their effects on different groups, particularly women in Nanumba South District.

- **Understanding Socioeconomic and Gender Factors:** The district's socioeconomic factors, including exclusion from decision-making, limited access to land, and restricted credit facilities, heighten the vulnerability of women and marginalized groups to climate change. Despite their crucial role in farming and household management, women face structural barriers that limit their access to essential resources such as land, credit, and agricultural inputs, reducing their productivity and economic independence. Addressing these challenges is vital for enhancing resilience and promoting equitable development in the district.

- **Identifying Data Gaps:** Gaps in localized and gender-specific data were identified, guiding the design of subsequent fieldwork and consultations. This ensured that the assessment would capture experiences of diverse groups in the district. This stage laid the groundwork for a gender-inclusive climate risk assessment, ensuring a thorough and inclusive approach.

3.3.2 Stage 2: Risk Assessment

The second stage involved systematic identification of risks and evaluation to understand the potential impacts and probabilities. This assessment was enriched through consultations with a wide range of stakeholders, including local community members, government officials, women-led organizations, and experts. This stage highlighted the need for targeted actions to address the gendered aspects of climate risks, ensuring that the resulting adaptation strategies were equitable and reflective of local realities. Key activities included:

- **Stakeholder Engagement:** The engagements were gender-inclusive, using household surveys, focus group discussions (FGDs), and key informant interviews (KIIs). Specific sessions were conducted for women, youth, and other vulnerable groups to ensure their voices were heard. For instance, women-led FGDs provided key insights into how climate risks impact their daily activities and livelihoods, such as reduced crop yields affecting food security and increased caregiving responsibilities during extreme weather events.

- **Gender-Sensitive Risk Evaluation:** Assessment of the climate risks encompassing severity of climate risks, likelihood, and impacts on different demographic groups.

- **Risks Prioritization Criteria:** Risks were prioritized based on their potential adverse effects, adaptation costs, and the district’s capacity to manage the adverse impacts of climate-related risks. Gender-specific vulnerabilities such as limited mobility during floods, and exclusion from resource distribution were integral to the prioritization process.

3.3.3 Adaptation Action Plan

This phase focused on developing a gender-responsive adaptation action plan tailor-made to fit Nanumba South District's specific needs. This action plan was to reduce climate vulnerabilities, enhance adaptive capacity, and promote gender equity. Specific elements included:

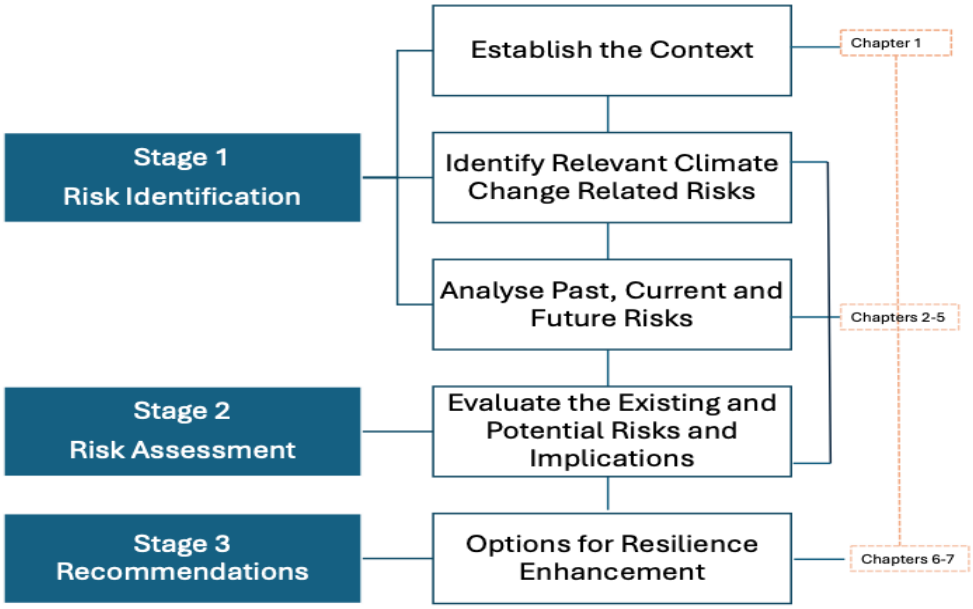
- **Strategic Interventions:** Climate adaptation interventions were planned to focus on addressing key development challenges, particularly those exacerbated by climate change. These include initiatives aimed at building community resilience, improving access to resources, promoting sustainable livelihoods, and ensuring equitable inclusion for all demographic groups. Emphasis is placed on climate-smart agriculture, water resource management, disaster preparedness, and gender-sensitive policies to tackle vulnerabilities specific to women and marginalized groups.

- **Inclusive and Participatory Planning:** The plan was developed through desktop research, stakeholder consultations, and expert analysis to ensure a comprehensive and balanced approach. Women, people with disabilities, and youth were actively involved in shaping key measures, such as the need for early warning systems, designed to address their needs and priorities.

- **Addressing Gender Inequalities:** Special attention was given to recommending measures to reduce gender disparities by improving women's access to credit facilities for climate adaptation investments, promoting their participation in decision-making processes, and empowering women-led organizations to spearhead adaptation initiatives.

- **Alignment with Development Goals:** The action plan aligned with national and global objectives, including SDG 5 (Gender Equality) and SDG 13 (Climate Action), by fostering inclusive adaptation strategies that tackle systemic inequities and build community resilience. This phase ensured that the adaptation strategies helped mitigate climate risks and reinforce social equity, making the district more resilient to future climate impacts.

Figure 13: Methodology for climate change risk assessment for the Nanumba South District



3.4 Data Collection Approaches

3.4.1 Workshop and Participatory Exercises

Climate change vulnerability and risk assessments are expected to be a participatory process to ensure the inclusion of diverse perspectives and knowledge, leading to more comprehensive and effective solutions. A consultative workshop was held in August 2024 at the Nanumba South District Assembly to co-develop a district-specific risk and vulnerability assessment and formulate priority adaptation plans. The workshop focused on identifying the unique climate risks and vulnerabilities faced by the district, developing tailored adaptation strategies, and fostering collaboration to enhance resilience within Nanumba South District's communities.

A diverse group of relevant stakeholders attended, representing various sectors within the district, including district officials, government agencies involved in climate resilience, the private sector, local NGOs and CSOs, politicians, religious and traditional leaders, women's groups, persons with disabilities, and other local stakeholders (**Photo 9**).

Photo 9: Stakeholder engagements workshop at the Nanumba South District

The participatory workshop began with an introductory session that contextualized Ghana's National Adaptation Plan process and underscored the importance of conducting a vulnerability risk assessment specific to the Nanumba South District Assembly. The session emphasized identifying key climatic hazards and vulnerable areas within the district. Subsequently, participants were divided into smaller groups to pinpoint specific climatic risks, map areas and resources at risk, and exchange insights on existing community adaptation strategies.

A gender-responsive adaptation session highlighted the different impacts of climate-related risks on women, elderly people, persons with disability, and the youth, emphasizing the importance of gender and vulnerability considerations in effective adaptation planning. Following these breakout sessions, participants reconvened in plenary to collectively prioritize hazards based on their severity and potential impacts. The stakeholders were broken into groups to map out physical resources, indicate climate trends, historical timeline and seasonality. They also identified climate hazards for the district, livelihood risks and explored coping patterns and adaptation strategies.

3.4.2 Matrix of Function Development

The Matrix of Function (MoF) is a spatial planning tool used to assess adaptive capacity in the face of climate change. It analyzes how the district's spatial structure supports or limits resilience to climate hazards such as droughts, floods, and heat waves. By mapping these hazards against essential functions, the matrix helps identify vulnerabilities across different sectors and highlights areas requiring adaptation or mitigation strategies. This approach enables decision makers to prioritize actions based on the severity of impacts, sector resilience, and response capacity, ensuring a more focused and effective strategy for managing climate risks.

3.4.3 Participatory Exercises and Selection of Communities

The workshop provided a platform to identify specific communities for qualitative discussions and the quantitative survey (**Photo 10**).

The selection of communities followed a participatory process based on vulnerability levels agreed upon by stakeholders in Nanumba South District. Facilitated discussions helped identify the most climate-vulnerable communities by considering exposure to risks, socioeconomic conditions, and existing adaptive capacities. Communities were categorized into three vulnerability levels: low, moderate, and high. Those at higher risk were prioritized for the survey to ensure the most at-risk populations were well represented. This approach also guaranteed that diverse climate risks across the district were captured, incorporating the perspectives of those most affected by climate change.

Photo 10: Community-specific mapping at Nanumba South District

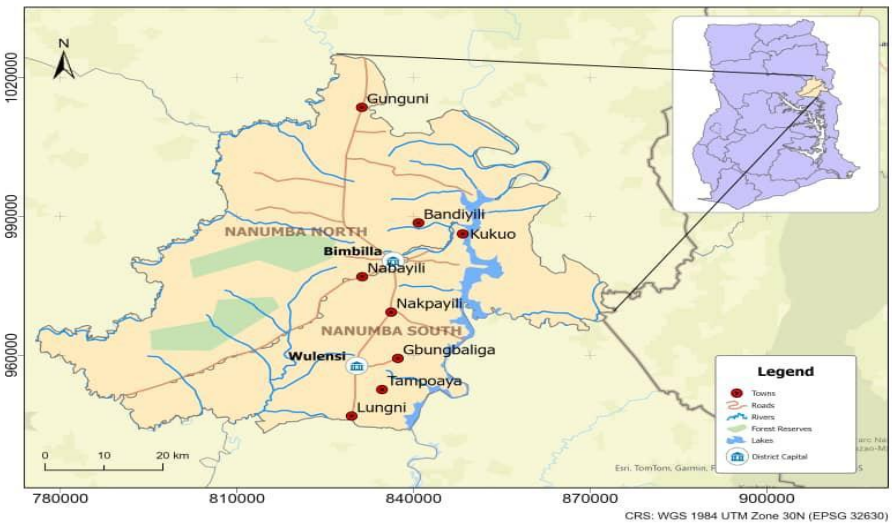
3.4.4 Hazard Mapping in the Nanumba South District

Officers from the National Disaster Management Organization and the District Physical Panning Officer led stakeholders to identify the district hazards during the participatory session and the sectors that are heavily affected. The discussants identified floods, droughts, bushfires, deforestation, and soil erosion, highlighting the vulnerability of the district. This analysis informed targeted interventions to mitigate risks and enhance resilience. During the discussion, the participants actively played important roles in sharing their knowledge and experiences through interactive learning highlighting past climate events and their impacts. Their inputs were instrumental in identifying district-specific climate vulnerabilities. Legends were added to clarify the various features depicted on the map, ensuring its clarity and enhancing its usability. The process further fosters discourse on the district's vulnerabilities and opportunities for disaster risk reduction.

3.4.5 Focus Group Discussions

The selection of communities for the FGDs was part of a larger participatory process led by stakeholders including the District Planning Officer and the District Physical Planning Officer. The selection process was meticulously designed to ensure that the chosen communities had no prior involvement in SIGRA's team activities, creating an opportunity for new insights. The sampled communities were used to collect both qualitative and quantitative data collection. (**Figure 24**)

Figure 24: Map showing the communities for the Nanumba South District



The focus groups were designed to gather qualitative data that would complement the quantitative survey on climate risks. The process involved a participatory approach to ensure that community members' perceptions, experiences, and knowledge were captured, particularly regarding their vulnerability to climate hazards. The discussions were guided by a set of semi-structured questions such as (i) the impact of climate change on the district's vulnerable communities, focusing on observed changes, (ii) existing adaptation practices, needs for future adaptation, and (iii) the sustainability of the existing adaptation actions.

The FGDs were conducted in person, in each of the selected communities, with groups typically consisting of 8-12 participants. Data was collected through audio recordings, with consent from all participants, and detailed notes were taken to capture key points and insights. The sessions were facilitated by trained moderators who were familiar with the local context and climate issues. To ensure the discussions were gender-responsive and inclusive, separate FGDs were conducted for women, men, PWDs and the elderly after general group discussions (**Photo 11**). This approach allowed for a deeper exploration of the unique challenges each group faced in adapting to climate risks.

Photo 11: FGDs with women's groups, PWDs, migrants and the elderly in the three Council Zones

3.4.6 Entry into Selected Communities

Following the stakeholder engagement, proper community entry protocols were implemented to raise awareness, foster acceptance, and facilitate the initiation of transect walks to allow for tangible, visual evidence of climate challenges such as poor farming activities and offer an opportunity for real-time discussions about local priorities and solutions (**Table 1**). This was followed by a field survey to gather community members' perspectives on climate-related issues.

Table 1: Communities selected for the FGD and survey

S/N	Level of Vulnerability	Community for FGD	Community for Survey	Area Council
1	2 = Moderate	Nakpayili	Bandiyili	Bondalikadibu
2	3 = High	Tampoaya	Tanbahimi	
3	2 = Moderate	Lungni	Tampoaya	
4	1 = High	Gaunguni	Nakpayili	Dachamba
5	2 = Moderate		Gaunguni	
6	3 = High		Nabayili	
7	3 = High		Lungni	Sunkuli
8	2 = Moderate		Kotoya	
9	3 = High		Kukuo	
10	3 = High		Gbungbaliga	

3.4.7 Key Informant Interviews

Using the snowball sampling technique, the study conducted 12 key informant interviews with vital stakeholders, carefully selected for their extensive experience in climate change and agricultural development within the Nanumba South District. Key informants were strategically selected for their deep, long-standing experience with climate change and gender issues in the district. The key informants included the district Gender Desk Officer, District Disease Control Officer, Women in Agriculture Development Officer, District Planning Officer, and many others.

3.5 Household Questionnaire Surveys

3.5.1 Survey Design

The household survey was designed and conducted to capture essential data on climate change impacts, vulnerabilities, and adaptation practices at the household level in communities across the Nanumba South District. The questionnaire was structured to collect both demographic and climate-related information. The survey plan ensured that the questions were localized, relevant and contribute to understanding of key vulnerabilities and adaptation strategies for Nanumba South District.

3.5.2 Sampling Method

The sampling method for the household survey was based on probabilistic sampling to the level of vulnerability. This approach aimed to ensure that the field survey included an adequate representation of households from communities with varying levels of vulnerability to climate hazards, as identified through a participatory process (see **Table 2**). Sampling from each of these categories ensured that the field survey captured the perspectives of households from areas most affected by climate change, as well as those from less vulnerable areas. Within each selected community, heads of households were randomly selected to participate in the survey. This approach ensured that the survey included diverse demographic groups, such as men, women, youth, and other vulnerable populations. Building on the foundation established during the stakeholder and community engagement workshop in the district, 450 household heads were sampled across the three zonal councils of the district. The population sizes were sourced from the Nanumba South District Assembly Development Planning Unit.

This assessment adopted Cochran's formula determining sample size for a finite population (106, 374).

Z value = 1.96 for a 95% confidence level
Population Proportion= 50%
Margin of error = 0.05 and adjusted sample size = 450

Table 2: Population sampling for quantitative survey

Community	Respondent		Total
	Males	Females	
Bandiyili	18	7	25
Tanbahimi	17	7	24
Kukuo	33	10	43
Nakpayili	61	23	84
Gaunguni	21	9	30
Nabayili	20	8	28
Lungni	48	16	64
Kotoya	30	12	42
Tampoaya	31	12	43
Gbungbaliga	49	17	67
Total	**328**	**122**	**450**

3.5.3 Household Data Collection

The data was collected through face-to-face interviews with the heads of selected households. Trained enumerators conducted these interviews using structured questionnaires, covering topics such as perceptions of climate change, vulnerabilities, adaptive practices, and community-based responses to climate risks. The data collection took place from November to December 2024, with surveys scheduled at the participants' convenience. Each interview lasted on average 40 minutes.

3.5.4 Analysis of Qualitative and Quantitative Data

The qualitative data was transcribed, coded, and analyzed thematically to identify common patterns and emerging themes related to the impacts of climate hazards, vulnerabilities, and adaptation strategies (Nowell et al., 2017). The findings were then compared with quantitative survey data to provide a deeper understanding of the district's climate risks and the effectiveness of current adaptation measures. The insights gained from the FGDs played a crucial role in validating the survey findings and shaping the district's adaptation planning. This ensured that adaptation strategies were informed by the lived experiences of the communities most at risk.

The quantitative data analysis aimed at assessing gender-differentiated climate vulnerability by examining variations in exposure, sensitivity, and adaptive capacity. Household demographic characteristics including the gender of the household head, family composition, and the presence of differently-abled individuals were analyzed to evaluate their influence on decision-making processes and access to resources using IBM SPSS software package version 21. The economic indicators were examined to identify gender-based disparities in resilience strategies, providing insights into the differential coping mechanisms employed by men and women. The study investigated gendered perceptions of climate change impacts, highlighting variations in risk exposure, adaptation responses, and overall climate resilience.

3.6 Methodology for the Climate Projections

This study assessed historical climate projections for the Nanumba South District by evaluating datasets and incorporating input from local stakeholders, to reflect the district's specific context and climate patterns.

3.6.1 Projection Data Sources

The study employed three key datasets to analyse historical and projected climate conditions in Nanumba South.

1. **Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS):** This dataset provides specific daily precipitation data at a spatial resolution of 0.05°, ideal for capturing precipitation variability across the selected districts in Ghana.
2. **ERA5 Reanalysis:** ERA5 offers hourly temperature data at a spatial resolution of 0.25°, suitable for evaluating temperature extremes over time.
3. **Coupled Model Intercomparison Project Phase 6 (CMIP6):** The dataset was used for climate projection data on precipitation and temperatures under various Shared Socioeconomic Pathways (SSPs). CMIP6 provides multi-model climate projections essential for understanding future climate scenarios and assessing potential changes in climate extremes.

3.6.2 Projection Period

The historical analysis focuses on the period from 1991 to 2020, consistent with the IPCC's current historical regime for climate assessment. This period allows for a robust analysis of trends in precipitation and temperature extremes. Projections have been categorized into near-term (2021–2040), mid-century (2041–2060), and end-century (2081–2100) intervals, offering insights into anticipated climatic changes across different time scales.

3.6.3 Projection Analysis

The analysis examined trends in climate extremes, focusing on rainfall and temperature changes over time. It assessed potential shifts under different climate scenarios while incorporating stakeholder input to ensure locally relevant and actionable findings for the decision-making process. To evaluate climate extremes, specific indices measured rainfall and temperature variability. Rainfall metrics included the most intense one-day rainfall (Rx1day), total rainfall over five consecutive days (Rx5day), prolonged dry spells (CDD), extended wet periods (CWD), and extreme rainfall above the 95th percentile (R95p). Temperature metrics captured the highest and lowest daytime and nighttime temperatures (TXx, TNx, TXn, TNn) to identify heatwaves, cold snaps, and other extreme events. The analysis proceeded on a structured six-step approach (**Table 3**).

1. The data on rainfall and temperature was sourced from CHIRPS and ERA5 for past records, while CMIP6 data informed projections.
2. Rigorous quality checks were done to guarantee accuracy and daily data, as summarized into seasonal and annual formats to compute indices.
3. Extreme climate indices were derived using tools like ClimPACT2.
4. Trend analyses employed statistical methods such as the Mann-Kendall test and Sen’s slope estimator to detect significant changes.
5. Future projections under different SSPs were analysed to anticipate shifts in climate indices.
6. Community input, including participatory mapping and seasonal calendars, enriched the interpretation, grounding results in the local context.

Table 3: ETCCDI climate indices

Category	Metric	Description	Interpretation	Units
Precipitation	Rx1day	Maximum 1-day precipitation: The highest amount of precipitation recorded in a single day during a given year or season.	Indicates the intensity of the most extreme daily rainfall event, highlighting potential for flash floods and extreme weather.	mm
	Rx5day	Maximum 5-day precipitation: The highest accumulated precipitation over any consecutive 5-day period within a given year or season.	Captures the intensity of extended heavy rainfall periods, which could lead to river flooding or waterlogging issues.	mm
	CDD	Consecutive dry days: The maximum number of consecutive days with less than 1 mm of rainfall.	Reflects drought conditions by showing prolonged periods without significant rainfall.	days
	CWD	Consecutive wet days: The maximum number of consecutive days with at least 1 mm of rainfall.	Represents extended wet spells, which may increase the risk of flooding, landslides, or crop saturation.	days
	R95p	Very wet days: Total precipitation from days when rainfall exceeded the 95th percentile of daily precipitation during a reference period.	Indicates the frequency and volume of extremely wet days, showing potential for extreme weather events driven by climate variability or change.	mm
	R95pTOT	Total precipitation from very wet days: The total amount of precipitation occurring on days with rainfall above the 95th percentile.	Indicates the contribution of extreme rainfall events to the total annual precipitation.	mm
	SDII	Simple daily intensity index: The ratio of total precipitation to the number of wet days (days with 1 mm precipitation or more).	Measures the average precipitation intensity on wet days, reflecting the nature of rainfall events.	mm/day
Temperature	TXx	Maximum daily maximum temperature: The highest daytime temperature observed in a given year or season.	Reflects the intensity of heatwaves and extreme hot days, which can impact health, agriculture, and energy demand.	°C
	TNx	Maximum daily minimum temperature: The highest nighttime temperature observed in a given year or season.	Tracks warm nighttime temperatures, which can influence heat stress, particularly in urban areas, and impact human health and agricultural productivity.	°C
	TXn	Minimum daily maximum temperature: The lowest daytime high temperature recorded in a given year or season.	Highlights cooler days, potentially beneficial during extreme heat periods but also indicative of cold snaps or unseasonal weather.	°C
	TNn	Minimum daily minimum temperature: The lowest nighttime temperature observed in a given year or season.	Reflects the occurrence of cold nights, important for assessing frost risks, agricultural impacts, and extreme cold weather events.	°C

3.7 Validation Workshops and Incorporation of Feedback

A stakeholder validation workshop was held on 12 March 2025 with relevant stakeholders to validate the findings from the climate change vulnerability assessment (**Photo 12**). In all, 40 stakeholders drawn from governmental agencies including NADMO, EPA, Ghana Health Service, MoFA Officers, Gender Desk Officers, District Development and Spatial Planning Officers attended the workshop. Others include women's group, youth groups, faith-based organisation, traditional authority and PWD (see **Appendix II**). Participants critiqued the report and provided feedback on the data, ensuring the recommendations are actionable and context specific. The feedback from workshop participants were incorporated before finalizing the document. The finalized report serves as a crucial resource for guiding climate adaptation strategies in Nanumba South District.

Photo 12: Validation workshop with key stakeholders in Nanumba South District

4. Findings and Implications

Photo 13: CAMFED women group at Nakpayili, Nanumba South District

4.1 Findings from Stakeholder Consultations

4.1.1 Mapping at-Risk Locations and Hazard Identification and Prioritization

The assessment identified communities in Nanumba South District as highly vulnerable to environmental hazards, particularly drought and bushfires, highlighting the need for targeted interventions (**Figure 14**). This required gender-sensitive solutions to mitigate the impacts on vulnerable populations. The identified high-risk areas include:

Drought-Prone Locations

Most of the communities in the Nanumba South are susceptible to drought especially Wullensi, Nakpayili and Lungni. Other communities include Bladjai and Jilo. Communities that depend on rain-fed farming are especially vulnerable.

- **Impacts on Agriculture:** In Nanumba South District, climate change impacts women by disrupting agriculture, which many depend on for their livelihoods. For example, prolonged droughts reduce crop yields, disproportionately affecting women who are primary food producers. The impact of droughts on agriculture ultimately leads to crop failure and reduced staple crop yields such as yam (*Dioscorea spp.*), maize *(Zea mays*), and groundnuts (*Arachis hypogaea*). For instance, the production of millet, an important crop has been declining since 1990 due to inadequate rainfall before the flowering stage (Yiridomoh et al., 2024).

Flood-Prone Communities

Many communities such as Chichagi, Lahato, Egambo, and Mualaa in the Nanumba South District continue to suffer as floods wreak havoc in people's homes and farms. Residents in Kukuo, Wulensi, Lungni and Nakpayili are especially exposed to floods due to their low-lying nature. Flooding can destroy homes, farmland, and infrastructure, leading to displacement, loss of crops, and economic losses. It also affects access to basic services like healthcare and education.

- **Impact on farmlands:** Heavy downpours habitually wash away topsoil, leaving farmland infertile and reducing productivity in subsequent planting seasons. In flood-prone communities such as Chichagi, Lahato, Egambo, and Mualaa, the 2020 rainy season caused significant damage to road infrastructure, farmlands, and crops.

- **Impacts of floods on livelihoods:** In the Lahato community of the Nanumba South District, a combination of prolonged drought and severe flooding in the 2020 rainy season caused widespread food shortages. Women from the community reported losing their livelihoods to the flood, leaving many households being pushed to extreme poverty level.
- **Damage to infrastructure:** Floods frequently damage homes, roads, and bridges isolating communities and hindering access to markets and services. For example, during the heavy rains in 2009, 2016, and 2020, a stretch of the Tamale Road connecting several districts became impassable, cutting off key agricultural trade routes, delaying the transport of perishable goods, and impacting peoples' livelihoods (MTDP, 2020).

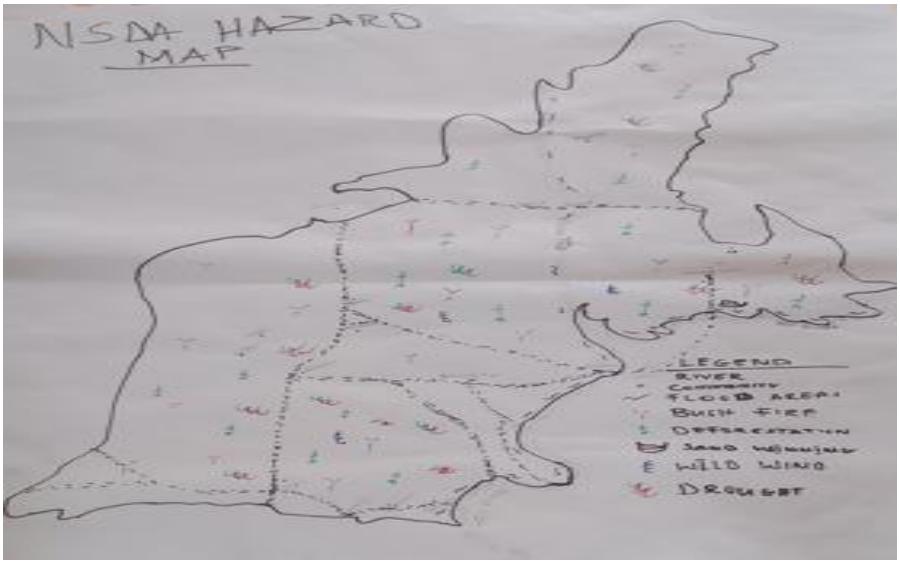
Bushfires in Communities

Farmlands in several communities across the district are at high risk of bushfires during the dry season, typically from January to May. Bushfires are a significant concern in the Nanumba South District, with profound effects on agriculture and the livelihoods of its predominantly rural population. Frequent bushfires pose a major threat to farmlands and settlements, especially in areas where farmers practice slash-and-burn agriculture. Communities such as Kpabia, Kabonwule, Nakpayili, and Lungni are particularly vulnerable due to prolonged dry seasons and traditional farming methods. Furthermore, the practice of burning vegetation by hunters for bush meat and by herdsmen to encourage fresh grass to feed livestock exacerbates the bushfire risks, increasing the vulnerability of these areas to both fire and drought.

The prevalence of bushfires poses several challenges:

- **Impacts of bushfires on crops and farmlands:** Uncontrolled fires can devastate crops, leading to significant financial losses for farmers.
- **Soil degradation:** Repeated burning reduces soil fertility by destroying organic matter and essential nutrients, thereby diminishing agricultural productivity over time. Farmers have expressed concerns about the detrimental effects of fires on soil health and crop yields.
- **Threats to livestock:** Beyond crops, bushfires endanger livestock by destroying grazing areas and causing direct harm to animals, further impacting the food security and income of farming households.

Figure 14: Hazard map of Nanumba South District

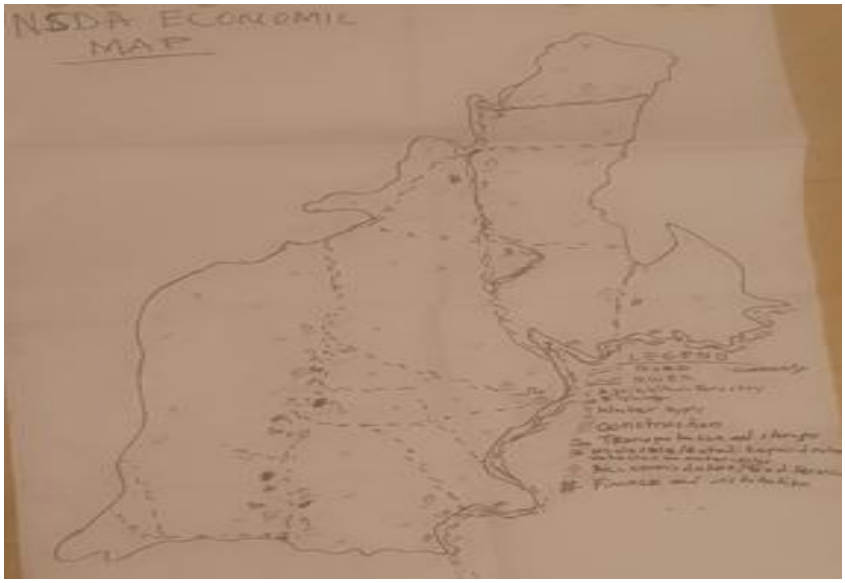


4.1.2 District-Level Resource Mapping

The District Planning Officer spearheaded the discussion to map out essential resources across the Nanumba South District (**Figure 15**). With simple tools like flip charts and papers, participants identified available assets, infrastructure, and key stakeholders within Nanumba South District to support climate adaptation efforts. It highlighted gaps in resources, prioritized areas for investment, and informed the development of targeted, efficient interventions. Symbols were used to specifically highlight rivers,

villages, and hazard zones. The participatory approach ensures the map reflects local knowledge and priorities, that foster community engagement and ownership.

Figure 15: Resource map of Nanumba South District



4.1.3 Key Landmarks and Community Resources

The assessment identified key infrastructure and community resources in the Nanumba South District, highlighting their vulnerabilities to environmental hazards and the need for resilient planning and targeted interventions. These landmarks and resources include:

- **Water infrastructure:** River Oti is a vital water source supporting fishing, irrigation, and transportation. Wulensi and Nakpayili Earth Dams, are the few water reservoirs used for dry-season farming and livestock but easily dry up during the dry season (**Photo 14**).

Photo 14: Water infrastructure in Kukuo, Tampoaya and Lungni

- **Cultural and Social Centers:** Traditional Shrines and Sacred Groves are important cultural and spiritual sites preserving indigenous traditions. Churches and mosques are available to address the population's spiritual needs.
- **Market Facility:** The district can boast of only one major market in the district capital, where the district's largest trading hub, facilitating commerce and agricultural trade takes place (**Photo 15**).

Photo 15: Wulensi market in Nanumba South District

- **Health Facilities:** The district has one main healthcare facility, serving as the primary referral hospital for over 30 communities (**Photo 16**). Additionally, there are smaller health facilities scattered across various communities to provide basic medical services. One of the Agenda 111 hospitals is under construction in the district.

Photo 16: CHPS compounds in Tampoaya and Nakpayili

- **Educational Facilities:** There are a few primary, Junior High and one Senior High/Technical Schools located in the district capital, Wulensi, Nakpayili, and other communities providing education (**Photo 17**).

Photo 17: Wulensi Senior High School and Junior High School in Gbaugbaliga

4.2 Assessment of Community Services through Matrix of Function

The results of the Matrix of Functions (MoF) of different villages within the Nanumba South District showed that the district is mainly rural and lacks infrastructure and development. The key highlights are described below:

- **Public Utilities and Facilities:** The result from the MoF analysis revealed that there is limited access to essential utilities, such as pipe-borne water in the district. This undermines resilience

to water shortages and sanitation issues, increasing public health risks and reducing adaptive capacity in the face of climate-induced changes in water availability. A few communities in the district have access to mobile telephoning and connectivity, and access to weather information via radio and television sets.

- **Transportation Infrastructure:** Road connectivity is poor, with unpaved roads dominating the district. Transportation amenities such as bus stations are sparse, and many roads are in poor condition and unmotorable. These restrictions hinder inter-community accessibility and economic activity, particularly the ability to access markets and essential services. Seven communities Wulensi, Nakpayili, Montanaya, and Lungni have motorable roads. Improved road infrastructure could significantly enhance equitable access and regional economic opportunities.
- **Market and Financial Services:** Communities like Nakpayili, Kanjo and Wulensi benefit from local markets, while many others lack similar facilities. Limited market access constrains local economic potential, particularly for farmers and producers. Financial services are also scarce in smaller towns, further limiting economic opportunities.
- **Healthcare Access:** While CHIP compounds are sparsely located, specialized care, such as midwifery, pharmacies, and laboratory scientists, is unavailable in most communities to provide and meet the population's health needs. Communities often face long travel distances to access critical healthcare, affecting timely treatment and overall health outcomes.
- **Educational Facilities:** Basic educational institutions are readily available, with only one Senior High School located in Wulensi, the capital of the District. This limits access to students' progression in education, serving as a barrier to higher education and skill development.
- **Trades:** Young men are engaging in small-scale and self-employed livelihood activities to support themselves and their families, including learning trades like mechanic and hair dressing crafts.
- **Ecosystem Services and Agriculture:** Ecosystem services in Nanumba South District play a vital role in supporting agriculture and livelihoods. The district's Guinea Savanna vegetation provides grazing land, fuelwood, and non-timber forest products like shea and dawadawa, which contribute to household incomes. However, deforestation, bushfires, and land degradation threaten these resources.

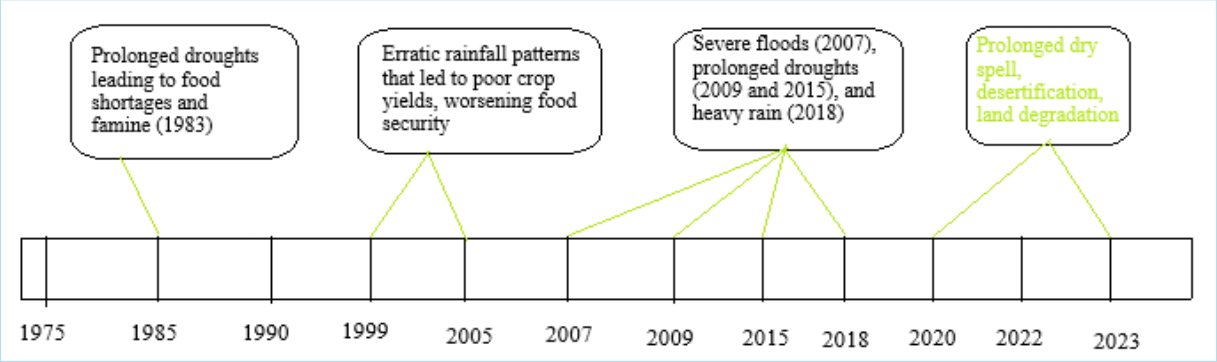
4.2.1 Historical Timeline of Major Climate Induced Events

The historical timeline of Nanumba South District, as recounted by stakeholders, makes known critical events impacting its agricultural, economic sectors, and water resources (**Figure 16**). For instance, in 1975-1977 and 1983, the district like other districts in northern Ghana were hit by severe drought, that affected people's water resilience and food security. Floods occur in 2007 and 2018 causing several destructions to properties including crops.

The 1977 and 1983 drought in Ghana were critical periods causing food insecurity in the district. Food insecurity was particularly critical among women-headed households, children, and the elderly. The drought significantly disrupted agriculture and transportation, leading to long-lasting economic difficulties and reduced access to essential resources. More recent reports are of prolonged dry spells affecting the planting season, leading to reduced maize and yam yields. 2022 witnessed unseasonal rainfall patterns that caused post-harvest losses for farmers and in 2023, concerns over desertification and land degradation due to erratic rainfall and deforestation were raised.

These events highlight the district's vulnerability to extreme weather conditions and their disruptive impacts. Lessons from past occurrences can guide strategic investments in resilient infrastructure, adaptive capacity, and inclusive planning to protect communities from recurring environmental challenges.

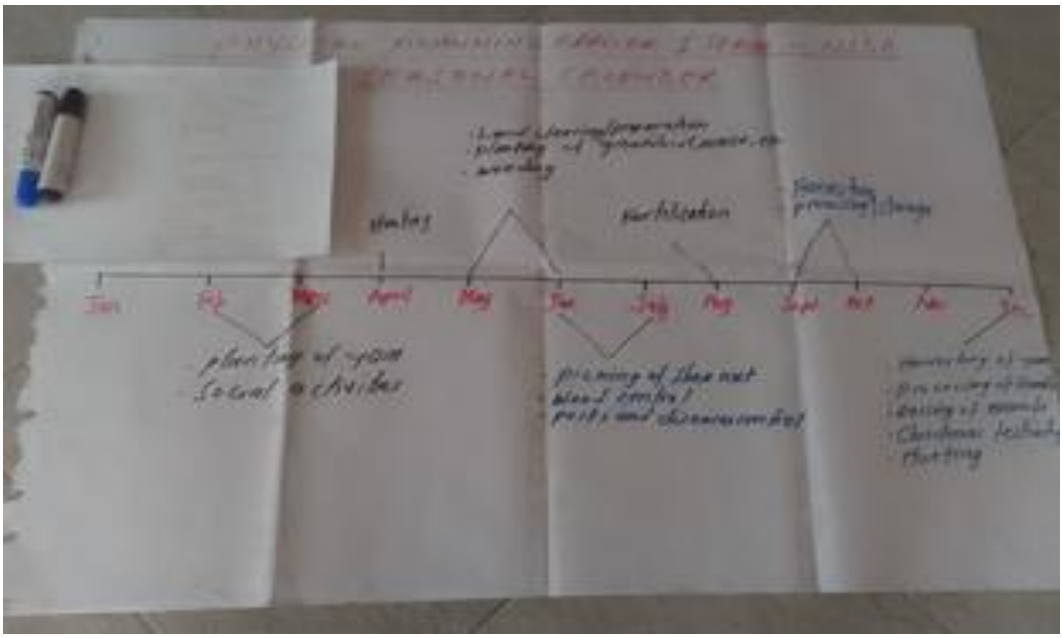
Figure 16: Historical timeline of major events in Nanumba South District Assembly



4.2.2 Seasonality Calendars of Climate Hazards

The creation of a seasonal calendar is a hands-on exercise that documents historical climate trends and helps plan actions to mitigate their impact. Through collaborative learning, participants identified major agricultural activities (planting, harvesting, fertilizer application), social events (festivals, weddings), and environmental challenges (droughts, floods, bushfires). The calendar provides a month-by-month overview of these activities and hazards highlighting critical periods of vulnerability to improve preparedness and resource allocation (**Figure 17**).

Figure 17: Nanumba South District seasonal calendar



4.2.3 Periods of Stress and Vulnerability

The district's seasonal calendar identifies key periods of increased stress and vulnerability caused by climate conditions, resource shortages, and labor demands. These challenges significantly affect livelihoods and food security throughout the district. The seasonal calendar highlights the need for targeted interventions during the dry season, planting periods, and harvest cycles to mitigate risks and ensure food security. Key adaptation strategies comprise reducing labor burdens, particularly for women, and improving access to essential resources such as water and firewood. Addressing challenges like erratic rainfall, pest infestations, and health risks during vulnerable periods could strengthen the district's resilience to seasonal stresses (**Table 4**).

Table 4: Seasonality calendars of climate hazards in Nanumba South District

Event	Time	Description
Dry Season		
Harmattan winds	December-March	Characterized by dry and dusty winds from the Sahara, leading to lower humidity and cooler temperatures in the mornings and evenings.
Amplified fire Risk	October-December	The dry conditions elevate the risk of bushfires, which can adversely affect agriculture and settlements.
Rainy Season		
Farming Activity	April-June	Land preparation for Planting Season: Onset of the rainy season from April to June, farmers both men and women are engaged in land preparation and planting of staple crops such as maize, yam, beans, groundnut, and rice.
Rainy season peaks	July-September	This period experiences the highest rainfall, essential for crop growth. Intense and prolonged rainfall can lead to flooding, especially in low-lying areas, affecting agriculture and transportation.
Decreasing Rainfall Renewed Fire Risk	October-December	Rainfall begins to decline, leading to the end of the growing season. Farmers typically harvest their crops during this time. As vegetation dries, the risk of bushfires increases again.

4.2.4 Participatory Assessment of Critical Climate Hazards and Risks

The assessment identified communities in Nanumba South District as highly vulnerable to environmental hazards, particularly drought, floods and bushfires, highlighting the need for targeted interventions (**Table 5**).

Table 5: Participatory assessment of critical climate hazards for Nanumba South District

Climate Hazard	Sector Affected	Levels of Severity			
		Very High	High	Medium	Low
Droughts	Agriculture				
Floods	Agriculture Education Health Critical infrastructure				
Heatwaves	Health Agriculture				
Bushfires	Agriculture Health				
Windstorms	Critical Infrastructure				

4.2.5 Key Landmarks and Community Resources

The assessment identified important landmarks, critical infrastructure and community resources that play a central role in the local economy, culture, and way of life. Below are some of the key landmarks and community resources in Nanumba South District, along with their vulnerabilities to environmental hazards emphasizing the need for resilient infrastructure planning and targeted interventions to mitigate the impacts of environmental hazards on such critical community resources.

- **Market: Five markets are located in Wulensi, Lungni, Nakpayili, Gbaungbaliga communities in the Nanumba South District:** These markets serve as the hub of commercial

activity, where agricultural products, such as yams, maize, millet, and beans, are bought and sold. The market provides a livelihood for many of the residents, particularly those involved in agriculture, acting as a meeting point for people from surrounding villages, making it an important part of the social and economic fabric of Wulensi.

- **Traditional Palaces:** Nanumba South District has a rich cultural heritage tied to the traditional authority. The **chief's palace** in Wulensi, as part of the larger Nanumba traditional governance system, is an important cultural landmark. The traditional authority and the chief's palace help to maintain social order, resolve disputes, and promote the preservation of local customs. Traditional festivals and ceremonies are also organized in Wulensi, contributing to the cultural life of the community.

- **Agricultural Land and Farmlands: Farmlands** around the Nanumba South District, including large tracts of fertile land, are essential landmarks in the district. The land is used for the cultivation of staple crops like **maize, millet, groundnuts, yams, and sorghum.** Livestock farming (such as goats and cattle) is also an important part of the agricultural economy.

Community-based organizations and NGOs: **Many NGOs and community-based organizations** operate in Wulensi, Lungni, Tampoaya and Nakpayili working to improve the lives of residents. These organizations play important roles in providing educational programs, agricultural training, health services and environmental conservation initiatives. They work in partnership with local authorities to address issues like health, water scarcity, and food security.

4.3 Vulnerability Analysis of Climate Hazards on Livelihoods

During the stakeholder engagements in the Nanumba South District, major socio-economic activities for the seasonal calendar were ranked based on gendered climate-induced vulnerabilities, as observed and reported by key stakeholders. The stakeholders used a vulnerability matrix to assess climate hazards' impact in Nanumba South District, considering gender-specific vulnerabilities. The key climatic hazards identified included droughts, erratic rainfall, bushfires, and floods. **Table 6** shows that crop production was given the highest vulnerability by both men and women across the climate hazards. Men also ranked livestock production, access to clean water and food security as highly vulnerably across the most climatic hazards. Whereas women reported agro-processing and health care as highly vulnerable across the most climatic hazards.

Table 6: Vulnerability analysis of climate risk on socio-economic activities

Event	Erratic Rains		Drought		Deforestation		Flood		Bushfires	
Crop production	3	3	3	3	3	2	3	3	3	3
Livestock production	3	2	3	2	3	1	3	2	2	3
Agro-processing	1	3	2	3	3	3	1	3	1	3
Marketing/Trading	3	3	3	2	1	2	3	3	1	1
Access to clean water	3	3	3	3	2	2	3	3	3	2
Fishing	1	3	1	3			1	3		
Education	3	2	1	3			3	3	1	3
Health care	3	3	1	3			3	3	1	3
Post-harvest activities	3	1	2	2	3	2	3	3	1	3
Food security	3	2	3	2	3	3	3	3	2	2

Δ = male Δ = female [3 = high vulnerability; 2 = medium vulnerability; 1 = low vulnerability]

4.4 Effects of Climate Change on Ecosystem Services

Ecosystem services are classified into provisioning, regulating, supporting, and cultural services, and are essential for sustaining life, economic activities, and environmental stability. The Nanumba South

Ditrsict is characterized by its semi-arid climate, and is highly vulnerable to climate change, which significantly impacts ecosystem services.

When crucial ecosystem services are lost, it can trigger overarching changes. Over time, these changes can cause the entire ecological system to shift into a new state. Climate change has ramifications for environmental quality and ecosystem services that support livelihood (Anokye et al., 2021). This statement was confirmed by a District Agriculture Officer: "*The loss of crucial ecosystem services, can lead to extensive changes which, over time, may result in the socio-ecological system changing state*."

Provisioning Services: Climate change has led to erratic rainfall patterns, prolonged droughts, and increased temperatures, adversely affecting agricultural productivity (Onyeaka et al., 2024). For instance, in the Nanumba South District, unpredictable rainfall has resulted in poor maize and millet harvests, forcing farmers to rely on food aid. Water scarcity has also become critical in communities like Bawku, where boreholes frequently dry up, impacting both domestic use and livestock farming (Zonderland-Thomassen et al., 2024).

Regulating Services: The increased frequency of extreme weather events, such as floods and droughts, disrupts natural regulatory mechanisms (Furtak & Wolińska, 2023). Deforestation due to the expansion of charcoal production in places like Nabayili, Kotoya and the likes has further exacerbated desertification, reducing the land's ability to sequester carbon and regulate climate (Vunibola et al., 2024).

Supporting Services: Biodiversity loss is a critical issue as changing climatic conditions alter habitats and migration patterns (Chapman et al., 2025). The decline of shea trees in areas like Tamale and Yendi, due to prolonged dry spells, affects both pollination services and the livelihoods of women who rely on Shea butter processing (Pienaah et al., 2024).

Cultural Services: Climate change also impacts cultural ecosystem services, particularly traditional practices and ecotourism (Bhatt et al., 2024).

4.5 Specific Vulnerabilities to Climate Risks

Table 7 shows the impacts of climate change on critical sectors and vulnerable socioeconomic groups.

- ***Men's Vulnerability:*** Men relying on rain-fed farming are vulnerable to erratic rainfall and drought. Water shortages during droughts disrupt their agricultural activities, limiting crop yields and destabilizing their financial stability. Lower harvests directly affect household incomes and threaten their livelihoods.
- ***Women's Vulnerability:*** Women in Nanumba South District face significant vulnerability to climate risks due to their socioeconomic roles, reliance on subsistence agriculture, and limited access to resources. Climate change exacerbates existing inequalities and poses serious threats to their livelihoods, health, and overall well-being.
- ***Youth's Vulnerability:*** Youth in Nanumba South District face significant challenges to climate change due to erratic rainfall, prolonged droughts, and frequent flooding. These risks threaten their livelihoods, particularly in agriculture, which many depend on. Poor infrastructure and inadequate institutional support leave youth with fewer options to cope with climate-related disruptions.
- ***Migrant's Vulnerability:*** Migrants, who constitute a significant portion of the district's population, face heightened vulnerability due to limited access to resources, insecure livelihoods, and weak institutional support.
- ***People with Disabilities:*** People with disabilities in Nanumba South District face heightened vulnerability to climate change due to social, economic, and environmental challenges. Extreme weather events such as floods, droughts, and erratic rainfall disproportionately distress them, limiting their mobility, access to resources, and ability to adapt. Many face barriers in securing stable livelihoods, as climate change disrupts agriculture and other economic activities. Inadequate healthcare system and lack of inclusive disaster response strategies increase their risks.

Table 7: Impacts of climate change on critical sectors and vulnerable groups

Sector	Specific Vulnerabilities	Impacts on Women	Impacts on Elderly	Impacts on Youth	Impacts on Migrants	Impacts on PWD	Impacts on Men
Agriculture	Erratic rainfall prolonged droughts, soil salinity, low crop yields, and declining livestock productivity.	Declining crop yields undermine subsistence farming, raise workload, and elevate mental stress; reduced income opportunities affect overall well being.	Reduced capacity to adapt due to outdated techniques; increased stress from food insecurity and diminished income sources.	Loss of schooling and reduced access to modern training limit future prospects; early entry into labor often disrupts education.	Limited opportunities for stable agricultural work reinforce dependency on seasonal and informal labor, perpetuating economic vulnerability.	Physical challenge hinder participation in labor-intensive farming increasing dependency on caregivers during climatic shocks.	Men involved large-scale farming and livestock rearing face reduced harvests and declining livestock health, directly impacting household income and economic stability.
Water resources	Water scarcity, seasonal variability, reliance on rainwater harvesting and unclean water sources.	Extended journeys to fetch water impose significant physical strain and risk of waterborne diseases.	Difficulties accessing distant or unsafe water points; increased health risks when mobility is limited.	Children often miss school or leisure time to help fetch water, exposing them to contamination and fatigue.	Competition over scarce water resources intensify marginalization and can lead to disputes with host communities.	Inability to reach water points independently necessitates reliance on others or adaptive technologies.	Men experience indirect impacts through challenges in managing water for livestock and market needs, further stressing household budgets.
Community Health	Extreme heat, increased prevalence of respiratory tract infections, skin heat rashes, cholera, and malaria.	Elevated exposure to fire-wood smoke from cooking and outdoor works: the dual burden of caregiving heightens mental and physical stress.	Heightened vulnerability to stress and chronic health issues: challenges in accessing timely healthcare.	Greater risk of infectious diseases and malnutrition, with health issues interrupting education and overall development.	Exposure to harsh working conditions and limited healthcare access exacerbate health risks-related infections.	Mobility challenges restrict access to treatment and healthcare facilities, increasing dependency on family support during emergencies.	Men engaged in labor-intensive activities face significant health risks from extreme heat and poor air quality, which impair their capacity to maintain the families.

Sector	Specific Vulnerabilities	Impacts on Women	Impacts on Elderly	Impacts on Youth	Impacts on Migrants	Impacts on PWD	Impacts on Men
Infrastructure	Poor resilience to climate extremes, deteriorating houses, inadequate roads.	Loss of safe and secure shelters, along with disrupted community recovery efforts, adds to the burden during emergency.	Difficulty rebuilding homes during disasters like prolonged droughts and floods hazards.	Disruption of housing and community facilities interrupts schooling and daily routines.	Inability to secure safe shelters, coupled with deteriorating infrastructure, deepens economic instability.	Inaccessible evacuation routes heighten risk during disasters, forcing greater support from community assistance.	Bad roads directly affect men's ability to access markets and secure livelihoods, further intensifying. economic pressures.

4.6 Gendered Roles, Responsibilities and Livelihood Activities

Most women engage in small-scale farming, which is highly dependent on rainfall. Irregular weather patterns, soil degradation, and prolonged droughts reduce crop yields, threatening food security (**Table 8**). As a result, women struggle to provide for their families, and malnutrition rates increase, particularly among children and pregnant women. Water scarcity and food shortages during droughts affect women more severely. Their daily responsibilities, such as caregiving and meal preparation, become even more demanding, increasing their overall hardship and vulnerability.

Household decision-making on livelihood strategies is uneven, with women bearing a heavier workload. The seasonal calendar emphasizes how men and women have distinct but interconnected roles in responding to climate-related challenges, particularly in agriculture and household management. During harvest and marketing seasons, women's labor demands increase significantly, especially in agriculture and trade, creating a greater seasonal burden compared to men. There are also responsibilities that are continuous throughout the year, women often bear responsibility for tasks like collecting water for household use, while men focus on activities such as cattle grazing meaning that as climate pressures such as droughts or unpredictable rainfall increase, the demand for labor and resources also rises. These dynamics highlight the ongoing strain on both men and women, reinforcing the need for targeted interventions to support their resilience and adaptive capacity.

Table 8: Seasonal calendar of livelihood activities for men and women in Nanumba South

Events	Jan	Feb	March	April	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Drought & bush burning	+	+	+	+	+							+
Land preparation/weeding		+	+				+ o	+ o				
Planting					o	o	o					
Harvesting										+ o	+ o	+ o
Post-harvest activities	o						o	o	o			o
Livestock grazing	+	+	+	+	+	+	+	+	+	+	+	+
Firewood collection	o	o	o								o	o
Cultural norms/festivals							+ o			+ o		
Food security	+ o	+ o	+ o	+ o					+ o	+ o		
Marketing	+ o	+ o	+ o	+ o	+ o			o	o			o
Agro-processing	+ o	+ o	+ o								+ o	+ o
Dry season farming	+ o	+ o										+ o
Domestic water collection	o	o	o	o	o	o	o	o	o	o	o	o

Key: o = Women; + = Men

4.7 Findings from Quantitative Surveys

4.7.1 Demographics of Study Respondents

Table 9 presents the summary statistics of sociodemographic characteristics of the selected sample. A total of 450 respondents were selected for the study comprising 122 (27.1%) females and 328 (72.9%) males from 10 communities. A significant proportion of respondents (90%) were married 5.7% of the respondents were widowed. Education levels among respondents indicated high percentage of respondents with no formal education. A notable 33% of respondents reported no formal education, making this the most common educational status. The majority had attained basic to secondary education, while post-secondary and vocational/technical education were the least achieved levels. This highlights educational gaps within the district, particularly in access to higher education and skill-based training.

Table 9: Distribution of respondents interviewed in each community

Community	Respondent		Total	
	Male	Female	N	Percentage
Bandiyili	18	7	25	5.6
Tanbahimi	17	7	24	5.3
Kukuo	33	10	43	9.5
Nakpayili	61	23	84	18.7
Gaunguni	21	9	30	6.7
Nabayili	20	8	28	6.2
Lungni	48	16	64	14.2
Kotoya	30	12	42	9.3
Tampoaya	31	12	43	9.5
Gbungbaliga	49	17	67	14.9
Total	**328**	**122**	**450**	**100**

4.7.2 Economic Vulnerability

About 90% of the study respondents depend on agriculture for their livelihood (**Figure 18**). Women in the district often refer to climate change as "almighty climate change" due to its disruptive and severe impact on their lives. Women primarily cultivate “women-loving crops” such as groundnut, pepper, and soybeans. Financial constraints further limit their productivity. Women have limited access to formal financial resources, and when they receive credit, they are often pressured to sell their farm produce prematurely at low prices to repay debts. This deepens their economic vulnerability. Both men and women farmers struggle to access fertilizers, which are available only at the district level and come at a high cost with transportation challenges. The repeated use of the same seeds lowers yields and increases the risk of pest and disease infestations. Women farmers also face instability, as they sometimes must relocate whenever their husbands decide to move, further disrupting their agricultural activities and economic security.

While 86% of men have secondary employment opportunities, only 14% of women do, underscoring economic inequality between gender. Income distribution further reflects economic disparity, with 78% of respondents earning less than 500 GHS per month, barely above Ghana’s minimum wage of 490.05 GHS. This widespread low income increases economic vulnerability and limits purchasing power, making households more susceptible to climate change impacts. Additionally, the data suggests a scarcity of higher earners in the district, restricting upward economic mobility. These findings highlight the urgent need for targeted development strategies to increase income levels and enhance financial resilience for all households.

Figure 18: Main source of income for study respondents in the Nanumba South District

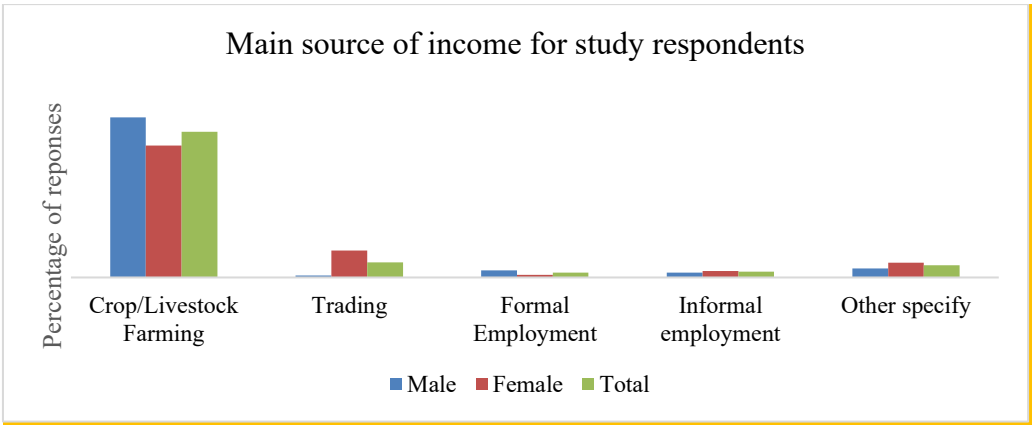
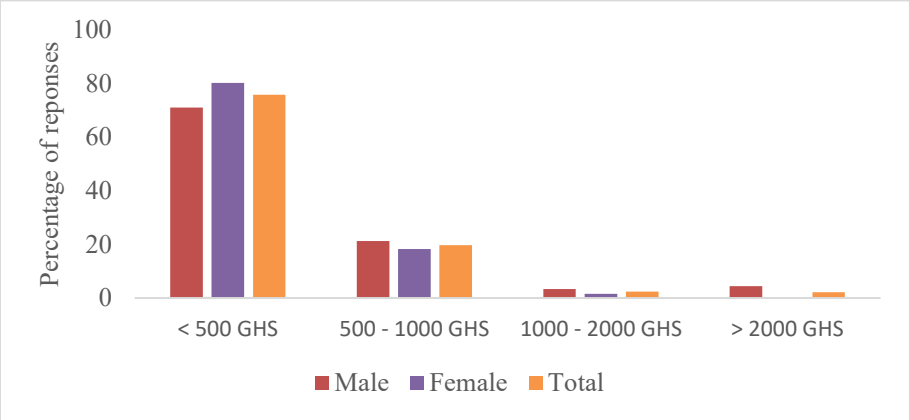


Figure 19: Household income distribution by gender in the Nanumba South District



Asset ownership reflects gender disparities. Land inheritance follows a patrilineal system, limiting women's direct ownership. Men typically own larger livestock, while women focus on small-scale poultry farming. Motorbikes and bicycles are mostly owned by men, restricting women's mobility. These trends highlight the need for targeted interventions to promote equitable asset ownership and economic empowerment for women (**Figure 19**).

4.7.3 Climate Awareness and Perception

Perceptions of climate change are mainly influenced by the direct effects people experience and the frequency of extreme weather events. These local impacts serve as the primary source of knowledge, with communities forming their understanding of climate change based on real, observable consequences rather than scientific predictions. Over 85% respondents indicated that climate and weather changes have occurred over the past 10 years. Participants' observation of changes in weather patterns were attributed to their perceived experiences on rainfall variability, seasonal calendars of climate events and climate impacts. For instance, participants from focus group discussions in Nakpayili, Gbungbaliga, Gunguni, and Lungni underscored the shifts in climate patterns.

"The rain patterns have changed. For about 10 years, we have been experiencing delayed onset and shorter rain, and longer dry days. It is difficult to tell when to begin farming and when to stop. The weather is always very hot during the dry season, with high temperatures and heat stresses in our communities. We have always experienced harmattan, but it has intensified, with severe health consequences these days." Because of the change in the weather pattern, there is always crop failures leading to low yield. This has affected our household food needs."

"Because of the drought, whenever we plant, the crops do not grow well, and the yield is not as much as before."

Participants observed changes in weather patterns based on their experiences with rainfall variability, shifting seasonal calendars, and climate impacts. The survey shows that climate change has significantly affected agriculture, with 64% of respondents reporting increased food insecurity, 45% noting reduced crop yields, and 34% struggling with water access. These challenges contribute to rising poverty in the district.

4.7.4 Physical/Environmental Vulnerability

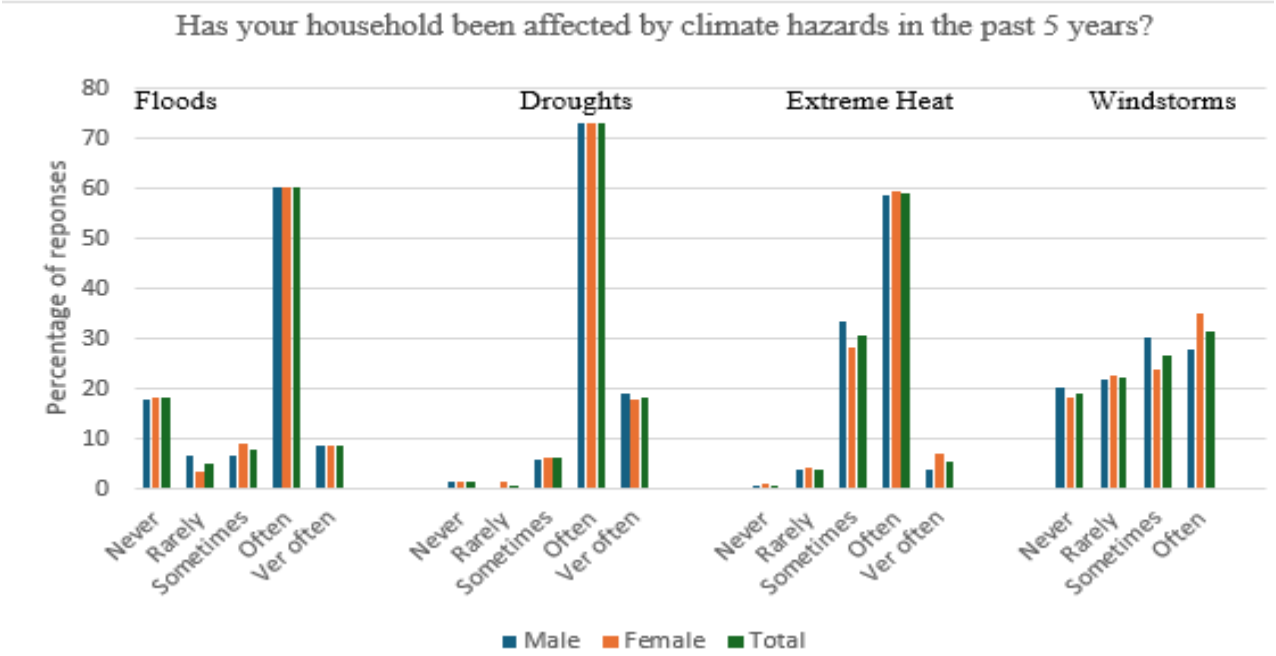
The Nanumba South District frequently experiences natural hazards such as floods, droughts, and windstorms which significantly affect livelihoods. Droughts are particularly disruptive to farming, affecting crop yields and food security. Meanwhile, short but intense rainfall leads to flooding, which damages crops, displaces residents, and increases the spread of diseases. Windstorms as well destroy homes and community infrastructure, further aggravating the economic hardships of the district. However, vulnerability varies across communities, influenced by geographic and socioeconomic factors. Remote settlements with limited access to early warning systems are especially at risk, making them more susceptible to climate-related disasters.

4.7.4.1 Exposure to Climate Hazards

The survey data highlights household exposure to climate hazards over the past five years in the district, revealing varying levels of impact (**Figure 20**). For instance, droughts emerged as the most severe and consistent hazard, affecting over 70% of respondents. Extreme heat was also a common challenge, reported by 43.6% of respondents. Flooding was a frequent issue, with 21% of respondents experiencing it very often. Windstorms showed a more varied occurrence, with 23% of households facing them often and 27% sometimes, indicating a moderate prevalence compared to droughts and extreme heat. These findings underscore the diverse climate challenges households in the district face.

Both male and female study respondents highlighted the varied impacts of climate hazards on them. Droughts and bushfires were reported to have high impacts on communities' well-being. Unlike floods, which affect specific areas, droughts have widespread consequences, particularly on agriculture, the district's economic backbone. Extreme heat was reported to have medium to high impacts, while bushfires were noted to cause low to very low impacts, except in farming communities where traditional slash-and-burn practices increase vulnerability.

Figure 20: Gender household perception to climate hazards exposure



4.7.4.2 Sensitivity to Climate Hazards

The study further analysed the sensitivity of key sectors in Nanumba South, targeting climate-induced hazards such as floods, droughts, soil erosion, bushfires, windstorms, sea level rise, pests and diseases, and both low and excessive rainfall. In the health sector, 60% respondents revealed that they have access to healthcare facilities, while 39% have access to health but with difficulty. Stakeholder engagements highlighted that healthcare services in the district are at a basic level, with the district having no hospital. This underscores the district's vulnerability to higher-level and emergency health needs in the face of climate-related stresses.

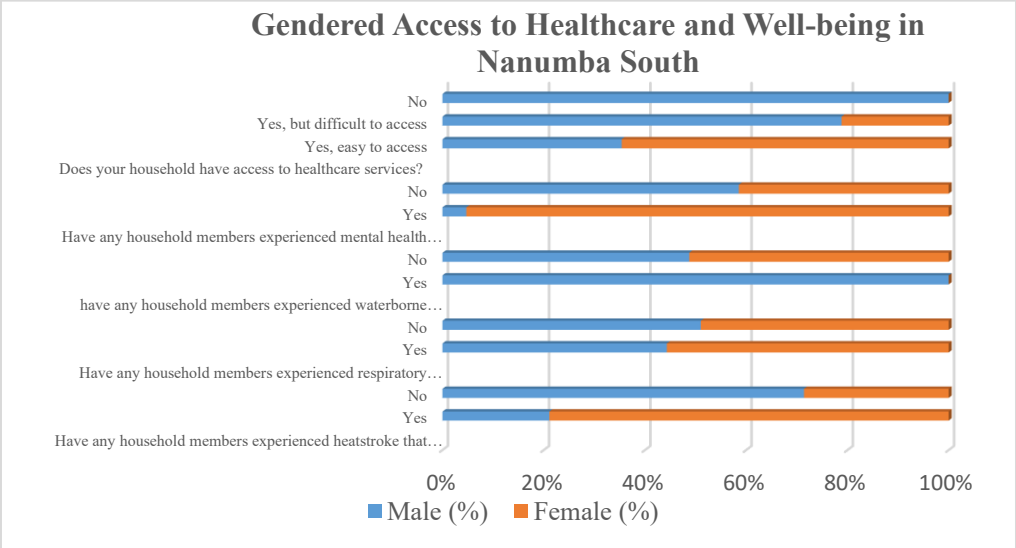
The region's high poverty levels and environmental degradation make it particularly vulnerable to climate hazards. These hazards threaten local flora and fauna, disrupting ecosystem balance and reducing biodiversity. The surveyed data indicates that low rainfall is the most sensitive factor affecting ecosystem services, with 53% of respondents recognizing its impact, compared to 29% for excessive rainfall. Drought also poses a significant threat, with a 40% sensitivity level. These findings highlight the urgent need for sustainable environmental and climate adaptation strategies in the district.

4.7.4.3 Access to Health and Well-Being

The data highlights significant disparities in health issues and healthcare access between male-headed (47.2%) and female-headed households (86.1%). While healthcare is available, barriers like medication shortages and costs pose challenges, especially for female-headed households. Climate-related health issues vary between groups. Heatstroke and heat exhaustion are more common in female-headed households (67.2%) than male-headed ones (8.2%), while respiratory problems affect male-headed households more (13.7%) with no cases reported among female-headed households. Waterborne diseases are slightly present in male-headed households (4.8%) but absent in female-headed ones. Malnutrition is minimal, affecting 0.8% of female-headed households and 8.2% of male-headed households, suggesting greater food insecurity for females.

Mental health issues are rare, with only 1.5% of male-headed households reporting them. Climate-related injuries are reported by 5.2% of male-headed and 6.6% of female-headed households. Regarding healthcare access, 47.2% of male-headed and 86.1% of female-headed households report easy access. However, 51.8% of male-headed and 13.9% of female-headed households struggle with access due to distance, cost, or other barriers. From focus group discussions and key informant interviews, lack of healthcare workers, quality care and cost of accessing healthcare services in the district are major barriers to accessing healthcare.

Figure 21: Gendered access to healthcare and well-being in the Nanumba South District



4.7.5 Social and Decision-Making Roles

In many households within Nanumba South, decision-making is male dominated, with men often controlling financial resources, land ownership, and agricultural priorities. Women often have limited influence in decision-making processes at the household, community, and district levels. Culturally, their voices are not given much recognition in strategic decisions, despite their crucial role in the household economy. Gender roles are clearly defined and rigid, with women primarily responsible for domestic chores such as fetching water and firewood, caring for children, and engaging in subsistence farming. Unlike women, men are more involved in hard labour such as large-scale farming, livestock management, and community leadership roles. These disaggregated roles place a disproportionate burden on women, affecting both their economic activities and their ability to sustain the household.

Women in Nanumba South District face overwhelming dual responsibilities in households and agricultural activities. This burden deepens during adverse conditions such as droughts and floods, as they are responsible for managing homes such as caring for children and securing food for the family. The overburdening workloads disproportionately affect women's participation in discussions and decisions related to climate adaptation and resource management, such as selecting drought-resistant crops or planning for disaster responses. This strain undermines their well-being and limits their ability to contribute to and benefit from adaptation strategies.

In many households, the responsibility of water collection predominantly falls on females, a trend that is even more pronounced in female-headed households (**Table 10**). The surveyed data indicates that in male-headed households, only 7% of males take on the task of fetching water, reinforcing the notion that women are the primary individuals responsible for this duty. However, in female-headed households, a striking 91% of males report being responsible for water collection, which highlights a shift in gender roles within such household structures. Furthermore, the concept of shared responsibility in water collection varies significantly between male-headed and female-headed households.

Table 10: Decision-making roles in farming and water collection in Nanumba South District

Who primarily performs farming?			
	Male Household	**Female Household**	**Total**
Male	250 (76.2)	87 (71.3)	337 (74.8)
Female	4 (1.2)	12 (9.8)	16 (3.6)
Shared	74 (20.9)	23 (18.9)	97 (21.6)
Total	**328 (92.9)**	**122 (100.0)**	**450 (100.0)**
Who primarily collects water?			
	Male Household	**Female Household**	**Total**
Male	24 (6.8)	1 (0.8)	25 (5.6)
Female	240 (73.1)	111 (91.0)	351 (78.0)
Shared	64 (19.6)	10 (8.2)	74 (16.4)
Total	**328 (100.0)**	**122 (100.0)**	**450 (100.0)**

Dams, providing water, play a vital role in improving livelihoods. However, many are poorly maintained, with plants and sand covering much of the water, limiting availability for consumption, crops, and livestock. Stakeholder engagements and FGDs revealed that the water quality and quantity of the dams are insufficient to meet the needs of the community including agriculture, the mainstay of the district's livelihood, and are extremely vulnerable to climatic conditions.

At the community levels, respondents indicated that they had limited sources of water to undertake dry season gardening. This means that any significant shifts in the rainfall patterns of the area could potentially cause crop failure that impedes livelihood activities in the district. Furthermore, residents indicated that there is no agricultural insurance available in the district to provide support during times of need. As a result, all farms in the area remain uninsured against climate-related disasters. About 95% of the participants indicated that they do not have access to improved seeds and do not belong to any farmer-based organisations. Infrastructure is key in moving goods and service in and out of the communities, most of the participants revealed that they had no access to good road network hence cutting them off from accessing markets to sell their farm produce and from essential services.

4.7.6 Access to Resources for Addressing Climate Risks

The study highlights gender disparities in resource access, with women facing greater disadvantages. **Table 9** shows that 98% of female-headed and 90% of male-headed households lack savings to manage climate risks. Both groups report limited access to insurance (99%), social support (91%), weather forecasts (96%), and agricultural services (61%).

Table 9: Access to resources to address the impacts of climate risks

	Gender of Household Head		
	Male (%)	**Female (%)**	**Total (%)**
Do you have access to savings to cope with climate impacts?			
Yes	31 (9.5)	3 (2.5)	34 (7.6)
No	297 (90.5)	119 (97.5)	416 (92.4)
Total	328 (100.0)	122 (100.0)	450 (100.0)

	Gender of Household Head		
	Male (%)	**Female (%)**	**Total (%)**
Do you have access to insurance to cope with climate impacts?			
Yes	1 (0.3)	0 (0.0)	1 (0.2)
No	327 (99.7)	122 (100.0)	449 (99.8)
Total	328 (100.0)	122 (100.0)	450 (100.0)
Do you have access to social support networks to cope with climate impacts?			
Yes	30 (9.2)	12 (9.8)	42 (9.3)
No	298 (90.8)	110 (90.2)	408 (90.7)
Total	328 (100.0)	122 (100.0)	450 (100.0)

4.7.7 Access to Climate Information

Access to climate information is essential for agricultural communities (Antwi-Agyei et al., 2021), especially in rural areas like Nanumba South District. However, gender disparities influence how men and women access, interpret, and utilize climate-related information, leading to unequal adaptation capacities. For instance, the study shows that only 5.5% of men have access to weather forecast information, while none of the female respondents reported having access to such information (**Table 10**). Additionally, 35% of female respondents indicated that they have access to agricultural extension services, compared to approximately 40% of male respondents. These disparities highlight the need for targeted interventions to ensure equitable access to climate information for both men and women.

Table 10: Access to climate information in Nanumba South District

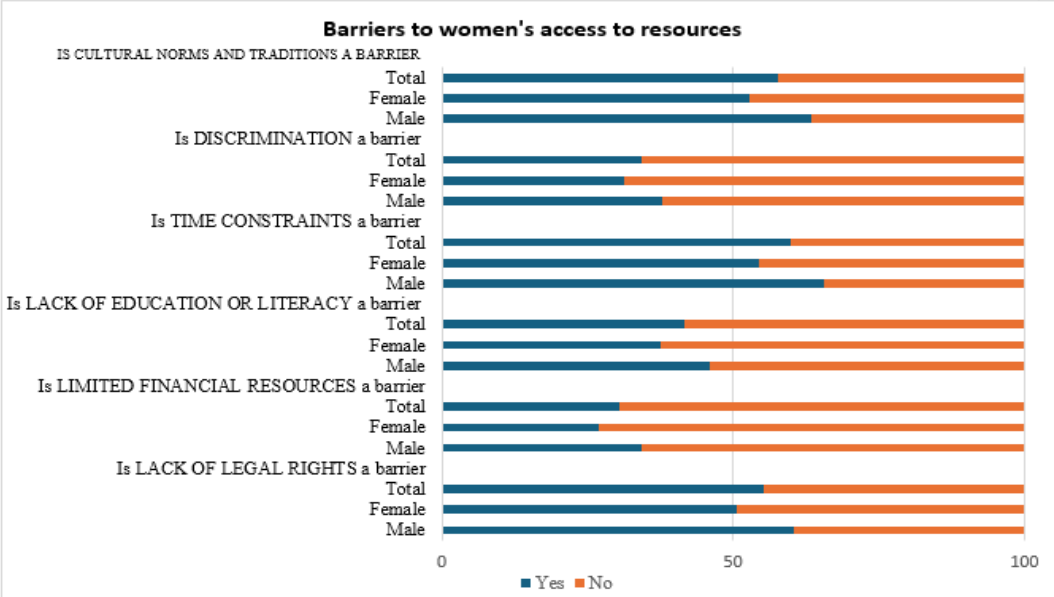
	Gender (Household)		
	Male (%)	**Female (%)**	**Total (%)**
Do you have access to information (*eg,* weather forecasts) to cope with climate impact?			
Yes	18 (5.5)	0 (0.0)	18 (4.0)
No	310 (94.5)	122 (100.0)	432 (96.0)
Total	328 (100.0)	122 (100.0)	450 (100.0)
Do you have access to agricultural extension services to cope with climate impact?			
Yes	130 (39.6)	43 (35.2)	173 (38.4)
No	198 (60.4)	79 (64.8)	302 (61.6)
Total	328 (100.0)	122 (100.0)	450 (100.0)

Women often have less access to productive resources such as land, credit, agricultural inputs, and education compared to men. Traditional inheritance systems and cultural norms restrict women's ability to own and control land, which is crucial for livelihood enhancement. Gender biases in social constructions also limit women's mobility and participation in decision-making platforms. Aggravated by an uncertain future and limited access to financial resources, women are prevented from investing in productive activities that could enhance their economic status and livelihood well-being. Lower literacy among the population in the district particularly women reduces their access to quality information on adaptive strategies and economic opportunities. Social vulnerability in Nanumba South is deeply ingrained in gender inequalities that limit women's confidence in participating effectively in decision-making, access to resources, and participation in adaptation strategies. As the Gender Desk Officer put it, "*Women lack the confidence to voice their views among their peers, let alone in public*."

4.7.8 Barriers to Women's Access to Resources in the Nanumba South District

Figure 22 presents barriers to women's access to resources to cope with climate risks. 42% of male-headed households mention cultural norms as a barrier, and 79% of female-headed households agree. Financial challenges, education, and literacy also hinder access to resources. While only 29% of male-headed households see discrimination as a barrier, 93% of female-headed households believe it is.

Figure 22: Perceived barriers to women's access to resources by gender in the Nanumba South District



Addressing these vulnerabilities requires empowering women through education and training, equitable resource allocation, and inclusive decision-making processes. Strengthening community support systems and promoting gender-sensitive policies are also critical to building social resilience in the district. To advance gender equality and tackle climate challenges, it is essential to empower women through targeted training on gender and climate issues, alongside providing access to credit support programs such as the Ghana Productive Network.

4.7.9 Support and Empowerment

The study reveals a significant gap in local organizational support for women adapting to climate change. Only 5.5% of male-headed households and a mere 0.8% of female-headed households report the existence of such support, suggesting that male heads may have greater awareness or access to these networks. On the other hand, an overwhelming majority 94.5% of male-headed and 99.2% of female-headed households lack access to support and empowerment initiatives. This underscores a critical deficiency in community-based support systems, further exacerbating the challenges women face in building resilience to climate change. Without targeted interventions to improve awareness and accessibility, women remain disproportionately vulnerable to climate-related risks.

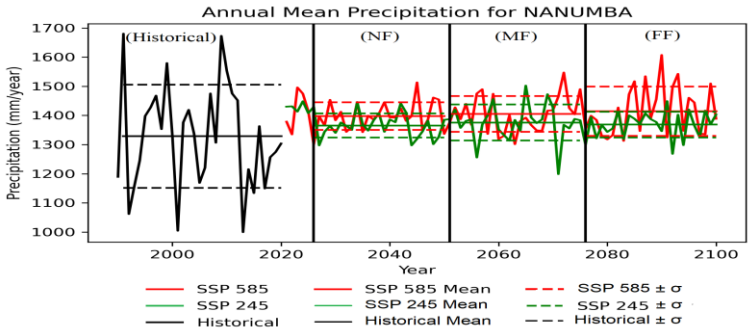
4.7.10 Projected Climate Trends and Implications in Nanumba South District

This section provides an analysis of projected climate trends in the Nanumba South District, focusing on how these changes impact gender-specific vulnerabilities and the resilience of the community.

4.7.11 Assessing Historical and Projected Climate Trends

Precipitation: The historical analysis focuses on the period (1991-2020), consistent with the IPCC's current historical regime for climate assessment. This period allows for a robust analysis of trends in precipitation and temperature extremes. In Nanumba South District, the analysis of annual total precipitation shows historical patterns with significant interannual variability (1000 - 1680) mm. The projection period shows a marginal increasing pattern in precipitation, especially under SSP 5-8.5, like the other locations in northern districts. Within the near future (NF: ~2020–2040), the SSP 5-8.5 scenario (red) projects marginally higher precipitation compared to SSP 2-4.5 (green) but further increases towards the end of the century (**Figure 23**), highlighting more wetness towards mid-future to far-future. Under SSP 2-4.5, precipitation remains relatively stable across the projection periods, with lower variability and only a marginal increase in rainfall from the near-future to the mid-future period.

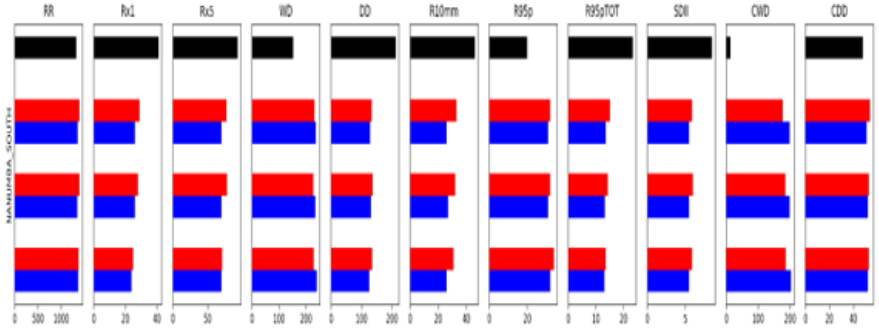
Figure 23: Historical and projected mean precipitation patterns under SSP 5-8.5 and SSP 2-4.5 scenarios for Nanumba South District



The projection period under future climate scenarios shows a reduction in precipitation variability. This reduction could be attributed to the model-simulated smoothing effect over long-term projections, although it does not eliminate the potential for extremes.

Climate indices for the Nanumba South District project an increase in RR and a decline in Rx1 and Rx5 events, the frequency of dry days, moderate rainfall days (R10mm), very wet days' contribution to total precipitation (R95pTOT), and the simple daily intensity index (SDII) (**Figure 24**).

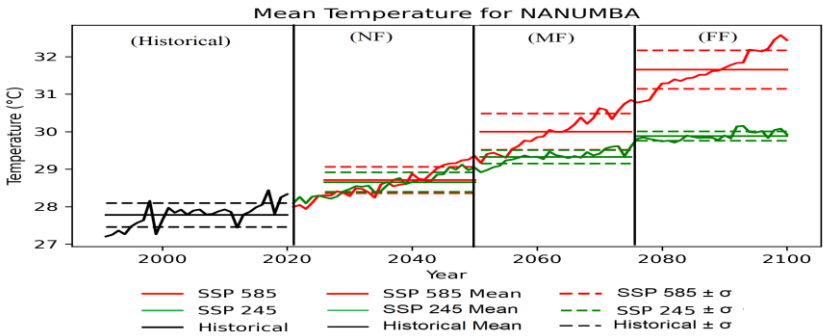
Figure 24: Historical and projected climate extreme metrics across the Nanumba South District



Black bars denote the historical pattern, and the red and blue boxes denote SSP 2-4.5 and SSP 5-8.5 respectively for the projection periods.

Temperature: Figure 25 indicates the temperature projections for Nanumba South reveal a consistent upward trend throughout. By the end of the century, temperatures under the SSP 5-8.5 high-emissions scenario are expected to peak at around 33°C, which is approximately 3°C higher than projections under the moderate SSP 2-4.5 scenario. This significant difference highlights the considerable effect of greenhouse gas emissions on regional temperature increases and emphasizes the importance of adopting climate mitigation strategies to limit the intensity of future warming.

Figure 25: Historical and projected mean temperature patterns under SSP 5-8 and SSP 2-4.5 scenarios for Nanumba South District



4.7.12 Summary of Projected Climate Trends and Implications for Nanumba South District

As illustrated in **Table 11**, the projected climate trends for Nanumba South District include:

- **Rainfall Amount**: For rainfall amount, projections indicate that Nanumba South, as part of the northern regions, is expected to experience a marginal increase.
- **R10 mm days (Rainfall Days Over 10 mm):** Significant decreases in R10 mm days (days with rainfall over 10 mm) are anticipated into the future. Nanumba South, as part of northern regions, will see a significant reduction. This reflects a shift toward fewer intense rainfall events.
- **Consecutive Dry Days (CDD)**: CDDs are expected to have a slight increase in Nanumba South in the future for both scenarios.
- **Simple Daily Intensity Index (SDII):** SDII is projected to drop significantly across both northern and southern locations of the country. However, northern locations like Nanumba South exhibit less variation between the two scenarios even for the future periods.

Table 11: Summary of projected climate trends in Nanumba South District

Climate Variable	Key Findings	Implications
Rainfall Patterns	Increasing wet days under both SSP scenarios.	Affect farming activities, delay planting and harvesting, reduce crop yields due to waterlogging, and increase susceptibility to pests and diseases.
Annual Precipitation	Historical variability of 1000–1680 mm reduces under future projections. SSP 5-8.5 shows a significant increase in mean precipitation but less variability in the far future (~2060–2100). SSP 2-4.5 indicates stable precipitation with fewer signs of long-term variability.	Reduced variability under SSP 2-4.5 could benefit agricultural planning, while long-term increase under SSP 5-8.5 may disrupt crop water requirements.
Rainfall Extremes	Heavy rain days (R95p) and intensity (SDII) are projected to decrease significantly. Consecutive wet days (CWD) increase significantly, while consecutive dry days (CDD) also rise marginally to over 40 days compared to approximately 30 days historically. Intense rainfall days (R10mm) drop significantly to around 3 days compared to over 30 days historically.	Fewer extreme rainfall events reduce flash flood risks but may lead to extended dry spells and significant water disruptions for crops.
Mean Temperature	Temperatures are projected to increase throughout the 21st century, with 31°C projected under SSP 5-8.5 by century's end. A 3°C difference between SSP 2-4.5 and SSP 5-8.5 highlights the impact of emissions on warming.	Increased temperatures can heighten evapotranspiration, stress crops, and reduce agricultural productivity, intensifying drought and water management challenges.

4.7.13 Projected Impacts of Climate Change on Access to Resources in Nanumba South District

Climate change in Nanumba South will impact infrastructure, health services, and access to water. Women will struggle with water scarcity and increased household demands, while men will face challenges securing water for farming and livestock. Youth will encounter barriers to essential education and farming resources, and people with disabilities will face greater difficulties accessing water and health care for their well-being and resilience. Flooding and soil erosion will further strain irrigation and

agricultural tools, intensifying competition for arable land and leaving vulnerable groups struggling to meet basic needs as indicated during focus group discussions in the various communities across the three zonal councils (**Photo 18**).

Photo 18: Flood victims in Kukuo and Lahhato, living close to Oti River, Nanumba South District

Many communities in the Nanumba South District lack access to clean water for domestic use, making women and girls walk long distances to fetch water from river bodies (**Photo 19**). The time spent walking that long distance to fetch water takes away from women's ability to engage in other productive economic activities. This can serve as a barrier to young girls' education and their reproductive health.

Photo 19: Women and girls in search of water in Lungni of Nanumba South District

The impact on women, youth and people with disabilities is particularly alarming, as their ability to contribute to and benefit from agricultural work is increasingly constrained by climate-related challenges. Limited access to water, land, and essential farming tools not only threatens food security but also deepens social inequalities within these communities (**Table 12**).

Table 12: Projected impacts of changing climate on access to resources by various groups

Area Zone	Climate Hazards	Women	Men	Youth	PWD
Bondalikadibu Area Zone					
Bandiyili Tampoaya Tanbahimi	Drought Flood Bushfires Erratic rainfall	Increased time collecting water and managing household shortages.	Difficulty accessing irrigation and fertilizers. Resources diverted to rebuilding efforts.	Challenges finding affordable resources. Healthcare challenges.	Reliance on others for water and mobility.

Area Zone	Climate Hazards	Women	Men	Youth	PWD
Dachamba Area Zone					
Nakpayili **Gaunguni** **Nabayili**	Drought Deforestation Bushfires Temperature variations	Competing needs for shared water resources. Struggles to secure consistent water for households. Compromised access to health and agricultural resources.	Difficulty managing water for livestock and irrigation. Difficulty maintaining irrigation and crop systems.	Limited access to climate-adaptive tools. Reduced involvement in education due to infrastructure impacts.	Reduced mobility to collect essentials.
Sunkuli Area Zone					
Lungni **Kotoya** **Kukuo** **Gbungbaliga**	Droughts Flood and River Oti Overflow Soil erosion	Struggle to secure water for households. Restricted access to household and community water.	Difficulty maintaining irrigation and crop systems. Loss of agricultural access routes and farm produce	Limited economic diversification. Education is affected	Heightened vulnerability to resource scarcity. Difficulty navigating damaged infrastructure.

5. Gender-Responsive Climate Adaptation Options

A gender-responsive climate adaptation approach in the Nanumba South District is crucial for fostering sustainable development and resilience. By ensuring equal access to resources, enhancing participation in decision-making, and supporting climate-smart solutions, both men and women can contribute effectively to climate adaptation, ultimately improving community well-being and environmental sustainability. In Nanumba South, proposed climate adaptation strategies focus on enhancing resilience while promoting sustainable development. These include improving access to water through sustainable irrigation systems and boreholes, strengthening agricultural productivity by providing training and modern farming inputs, promoting alternative livelihoods to reduce reliance on climate-sensitive activities and promoting inclusiveness in adaptation efforts. These measures align with key global goals in resilience building such as gender equality (SDG 5), climate action (SDG 13), and reducing inequalities (SDG 10).

5.1 Economic Adaptation Strategies

In the Nanumba South District, economic adaptation strategies should be tailored to strengthen the resilience of vulnerable groups, including women, youth, and marginalized communities, against the impacts of climate change. These strategies must be tailored to diversifying income sources, expanding access to credit services to expand their businesses, promoting climate-smart agricultural practices, and fostering economic empowerment. Key interventions include training on sustainable livelihoods, facilitating access to climate-resilient farming inputs such as fertilizers, and drought-resistant crops, supporting small-scale women entrepreneurs with credit facilities, and improving access to technology and markets. Moreover, investments in climate-resilient infrastructure, technical and vocational training, and locally based enterprises are crucial to ensuring long-term economic stability. These energies aim at reducing economic vulnerabilities, enhancing self-reliance, and promoting inclusive and equitable growth for all communities in the district.

Agencies such as the Ministry of Food and Agriculture, Northern Development Agency, and the Nanumba South District Assembly collaborate with international organizations like SEND Ghana, and CARE International Ghana among others to design policy frameworks to empower the population in the district (**Table 13**). By leveraging the expertise and resources of these partners, Nanumba South District can effectively implement its economic adaptation strategies, ensuring sustainable development and resilience against climate change. This will economically empower women and youth.

Table 13: Strategies to address economic vulnerabilities in the Nanumba South District

Adaptation Option	Adaptation Objective	Justification	Potential Partners
Early Warning System/Climate Information Services	To increase productivity and ensure food security by addressing rainfall variability through timely information.	Early warning systems and climate information services are critical tools for farmers to manage risks proactively and adapt to changing climatic conditions.	GMet, EPA, Telecommunications companies, NGOs focused on digital literacy (Esoko), and local government.
Promotion and Construction of Irrigation System	To lessen the impacts of drought and long dry spells on crop production by allowing farmers to practice all-year-round production.	Irrigation systems mitigate the risk of crop failure during droughts, enhance food security, promote sustainable water use, and enable diversification of crops.	MoFA, MLGRD, District Assembly and International Organizations focus on improving smallholder farmers.
Promote Adoption of Drought-Resistant Varieties	To lessen impacts of droughts or long dry spells on crop production.	Adoption of drought-resistant varieties ensures food security by enabling crop production despite reduced rainfall.	MoFA, local cooperatives, seed suppliers, NGOs focused on livelihoods.

Adaptation Option	Adaptation Objective	Justification	Potential Partners
Sensitization and Farmers' Education on Climate	To raise awareness and build farmers' capacity to understand and respond effectively to the impacts of climate change.	Education and sensitization campaigns enhance farmers' understanding of climate change impacts and adaptation measures.	Department of Agriculture, Agricultural Extension Officers and NGOs interested in improving small-scale farmers livelihoods.
Improve Extension and Education on Climate Smart Agriculture	To promote sustainable and climate-resilient agriculture.	Improving extension and education on climate-smart agriculture enhances farmers' knowledge and skills.	Department of Agriculture, Extension Officers, NGOs focus on improving smallholder farmers' livelihoods.
Sensitization and Farmers' Education on Climate	To raise awareness and build farmers' capacity to understand and respond effectively to the impacts of climate change.	Education and sensitization campaigns enhance farmers' understanding of climate change impacts and adaptation measures.	Department of Agriculture, Agricultural Extension Officers and NGOs interested in improving small-scale farmers' livelihoods.
Improve Extension and Education on Climate Smart Agriculture	To promote sustainable and climate-resilient agriculture.	Improving extension and education on climate-smart agriculture enhances farmers' knowledge and skills.	Department of Agriculture, Extension Officers, NGOs focus on improving smallholder farmers' livelihoods.
Create Conditions for Access to Credit	Reduce gender inequalities.	Women, youth, and PWDs face limited access to credit.	Women's groups (VSLAs), local government, agricultural input suppliers.
Provide Training in Alternative Livelihoods	Improve skills in manufacturing for women and marginalized groups dependent on climate-sensitive agriculture.	Women and marginalized groups disproportionately affected by climate change impacts on agriculture.	Local businesses, NGOs focused on skills development like SEND-Ghana.
Provide Incentives for Green Businesses	Foster sustainable development, build climate resilience, and promote environmentally friendly businesses.	Encourages development of technologies, products, and services to mitigate climate change impacts.	Local cooperatives, agricultural value chain actors, and development organizations interested in reducing GHGs emissions.
Educate, Communicate, and Sensitize Traders	Reduce trade losses from climate variability and change.	Increases awareness of climate hazards among traders.	Department of Agriculture, Agricultural Extension Officers, local radio stations/information centers.

5.2 Physical Adaptation Strategies

In the Nanumba South District, resilience development must prioritize physical adaptation strategies tailored to the district's specific needs. This includes upgrading key infrastructure such as feeder roads to enhance accessibility, improving water supply systems to ensure year-round availability, and strengthening flood control mechanisms to mitigate climate-related risks. These initiatives should be driven by a collaborative effort between the Nanumba South District Assembly, the Ghana Irrigation Development Authority (GIDA), the Ministry of Roads and Highways (MRH), and the Ministry of

Sanitation and Water Resources (MSWR) (**Table 14**). Additionally, local community engagement and traditional leadership involvement will be essential in ensuring sustainable implementation and long-term impact.

To ensure access to water for agricultural purposes, the district must prioritize the construction of small dams and boreholes. The development of earth dams in Nakpayili and Wulensi has been beneficial in supporting farming and livestock rearing. However, these water bodies require regular maintenance and expansion to increase their capacity and reach more communities. Also, most farmers in the district rely on rain-fed agriculture, making them vulnerable to droughts. Expanding and maintaining irrigation schemes, such as the rehabilitation of existing water reservoirs and the construction of additional irrigation canals, will enable farmers to cultivate crops throughout the year.

Table 14: Strategies to address physical vulnerabilities in the Nanumba South District

Adaptation Options	Adaptation Objective	Justification	Potential Partners
Construction of dug-out wells and dams for water storage and irrigation.	Improve water accessibility and availability	Increased water availability for domestic and agricultural use during dry periods.	District Assembly, Water Resources Commission, and CWSA.
Construction of flood barriers and implementation of erosion control measures along key roads and water bodies.	Strengthen flood management infrastructure	Reduced flood damage to homes, farmlands, and critical infrastructure.	District Assembly, NADMO, and local communities.
Improve road network across communities.	Improve road infrastructure to enhance accessibility	Easier access to farmlands and for the transportation of farm goods.	District Assembly, local communities, local Farmers.
Building of climate-resilient homes, focusing on flood and wind resistance.	Enhance climate-resilient housing and infrastructure	Improved shelter and increase durability for homes against storm damage.	District Assembly, Local Builders, Local Communities, Ministry of Works and Housing (MWH)
Upgrading health centres with reliable water and energy systems.	Improve healthcare infrastructure for climate-related risks	Enhanced healthcare services during extreme weather events and power outages.	District Assembly, Ministry of Health, Local Communities, and Ministry of Energy.
Tree planting along roads and around water bodies.	Promote sustainable land management practices	Reduced land degradation and enhanced agricultural productivity Enhanced water retention and reduction of soil erosion.	Forestry Commission, Farmers, Department of Agriculture, Local Communities, NGOs.

5.3 Social Adaptation Strategies

The social adaptations across the communities in the Nanumba South District reflect a variety of strategies designed to address climate-related challenges and build resilience. These adaptations emphasize strengthening community structures, promoting livelihood diversification, improving education, and ensuring more equitable access to resources. One of the key approaches to the resilience building is the role of community groups in mobilizing resources and sharing knowledge. For instance, the Wulensi Farmers' Cooperative plays a critical role in supporting smallholder farmers by providing access to improved farming techniques, quality seeds, and financial resources. Similarly,

women's self-help groups in Nakpayili and Lungni have proven effective in fostering economic empowerment by facilitating microloans and savings schemes. These groups help women invest in income-generating activities such as shea butter processing, basket weaving, and petty trading, thereby enhancing household financial stability.

Another crucial adaptation strategy is empowering women through targeted agricultural support. Providing subsidies for essential farming inputs such as fertilizers, modern tools, and improved seeds has significantly increased agricultural productivity. This support not only enhances food security but also fosters gender equality by enabling women to take on leadership roles in farming cooperatives and participate more actively in decision-making processes at the household and community levels. Encouraging local youth organizations, in collaboration with local government bodies and NGOs focused on youth empowerment and development, can facilitate youth-led community development projects (**Table 15**). In Wulensi, youth groups have been engaged in tree-planting initiatives to combat deforestation and soil erosion, while in Nakpayili, young people have played a key role in constructing rainwater harvesting systems to address water scarcity challenges.

Table 15: Strategies to address social vulnerabilities in the Nanumba South District

Adaptation Options	Adaptation Objective	Justification	Potential Partners
Organize gender-responsive workshops for local governance and facilitate women's participation in decision-making process.	Encourage women's participation in household decision-making process.	Empowerment of women, increased gender equality, and inclusivity in decision-making.	Gender-focused NGOs, local government, women's groups, and local communities.
Organize community-based seed banks and provide agricultural inputs at subsidies for smallholder farmers.	Access to seeds and farming tools will enhance climate-resilient household.	Improved access to resources increased agricultural productivity, and enhanced food security.	Agricultural extension services, NGOs focus on improving smallholder farmers' livelihoods, and District Assembly.
Strengthen women and youth groups for joint action on climate resilience.	Community-based groups for collective action help to promote sustainable land management practices.	Improved social cohesion, network, collective efforts in addressing climate change, enhanced community resilience.	Community organizations, Local leaders, youth groups, Forestry Commission, Farmers, Department of Agriculture, NGOs.
Integrate climate change education into school curricula and conduct training on sustainable farming, water management, and climate change impacts.	Education and awareness on climate adaptation.	Increased climate change awareness, adoption of sustainable practices, better preparedness.	District Assembly, Local environmental NGOs, CSOs, Ministry of Education, Schools, NGOs.
Expand local healthcare infrastructure to climate-resilient health services.	Strengthening healthcare services.	Better health outcomes for vulnerable groups, reduced climate-induced health risks, improved access to healthcare.	Ministry of Health, local health services, and NGOs.
Establish support networks for vulnerable families.	Strengthen community social safety nets.	Improved community support systems, enhanced social safety nets.	Local government, community groups, social welfare organizations.
Establish youth-led community development projects.	Increase youth engagement in community development.	Increased youth involvement in community resilience, empowerment through active participation.	Local youth groups, local government, NGOs focused on youth empowerment.

Education also serves as a vital tool in promoting climate resilience. Agricultural extension officers in the district have taken climate change awareness directly to farmers and even to students in schools, equipping them with knowledge of sustainable agricultural practices and environmental conservation. Additionally, local radio programs broadcast in the Dagbani language provide valuable information on climate adaptation techniques, further extending outreach efforts to the wider community. Equitable access to resources remains a priority in climate adaptation efforts. Programs such as beekeeping and aquaculture aimed at providing vulnerable households with access to alternative sources of livelihood are gaining traction to mitigate the adverse effects of erratic rainfall patterns.

Finally, women in the Nanumba South District have adopted a multifaceted approach to climate and livelihood resilience, leveraging community organizations, agricultural support, youth engagement, education, and equitable resource distribution. These strategies not only address immediate climate challenges but also contribute to long-term sustainability and improved livelihoods across the district.

5.4 Nature-Based Solutions to Climate Change Risks

Climate change risks such as erratic rainfall, prolonged droughts, and land degradation threaten agricultural productivity, food security, and livelihoods in the region. Nature-based solutions (NbS) offer sustainable approaches to enhancing climate resilience in agriculture while preserving ecosystems and biodiversity (Simelton et al., 2021). One effective NbS in the district is agroforestry, where farmers integrate trees and shrubs with crop cultivation and livestock farming (Amoako, 2012). The cultivation of drought-resistant tree species such as Parkia biglobosa (African locust bean) and Faidherbia albida (Gao tree) helps improve soil fertility, reduces erosion, and provides additional sources of income through non-timber products like shea butter and dawadawa (Alhassan et al., 2023).

Intercropping nitrogen-fixing trees with staple crops like maize and millet enhances soil nutrients and boosts yields (Addae-Frimpomaah et al., 2022). Cover cropping, which involves planting non-cash crops during off-seasons, helps protect the soil from erosion and improves fertility is also employed by smallholder farmers to mitigate climatic risks (Issaka et al., 2021).

Additionally, Integrated Pest Management (IPM) methods, such as introducing beneficial insects and improving habitat conditions, are NbS that are used to help reduce reliance on chemical pesticides (Ibrahim, 2022). These strategies include the use of natural predators like ladybugs and parasitoid wasps to control pests, implementing crop diversity to disrupt pest cycles, and fostering healthy soil microbiomes to enhance plant resistance. By reducing the use of synthetic pesticides, IPM contributes to soil health, biodiversity conservation, and long-term agricultural sustainability (Ogidi et al., 2023).

Organic farming is another key approach used by smallholder farmers in the Nanumba South District to reduce the use of synthetic fertilizers and pesticides while promoting soil health, biodiversity, and water quality (Baakoh, 2023). A significant aspect of organic farming is the use of compost and manure as natural fertilizers. This not only boosts crop yields but also enhances water retention, minimizes soil degradation, and supports a more sustainable farming system.

6. Institutional Capacity Building and Policy Implications

Adaptation governance requires intentional efforts and adequate capacity at all levels both human and institutional. Strong institutional frameworks play a key role in promoting sustainable adaptation, enabling the Assembly to access climate funding and align with Ghana's National Adaptation Plan (NAP). By integrating local knowledge with national policies, the district is better positioned to enhance food security, water management, and infrastructure resilience. A major lesson that has emerged from all our CRVA experiences, especially at the subnational level, and in the district, is the lack of climate adaptation governance capacity. This remains a national challenge and one that we have tried, as much as it has been possible, to use our current assignments and engagements with the Assemblies to address. In all instances, we have approached our work in the districts as learning and capacity building journeys and in ways that bring a conscious focus on the need to co-produce knowledge and to build the capacity of district/municipal staff, as well as other critical stakeholders in adaptation planning and areas such as climate risk and vulnerability assessments, and climate-informed decision-making.

While we have done our best, there is still a capacity gap at the institutional level that needs to be addressed. We proceeded from the premise that the Nanumba South District is not an exception even though it remains at the forefront of providing the requisite governance machinery for adaptation planning and resilience building in the district. The Assembly, therefore, is supposed to provide leadership to address the district's unique climate impacts and vulnerabilities, which include flooding, drought, soil erosion, and resource scarcity. Our engagements therefore targeted key personnel from the Assembly and relevant stakeholders within the district and the objective was to use participatory learning processes to develop knowledge and build capacity.

These collaborative efforts, as we have learned, enriched the process by ensuring inclusion, voice, ownership and incorporating diverse perspectives. The collaborative processes especially using tools such as participatory risk mapping, seasonal calendar analysis, matrix of function, etc., highlighted the pressing issues faced by communities, particularly women, youth, and other marginalized groups. The different discussions also provided an understanding of the climate change phenomenon, the nature of impact manifestations and how different groups such as women, children the elderly, etc. experienced impacts and vulnerabilities in different ways and the need for targeted adaptation interventions.

This report underscores the critical importance of the Assembly in providing the requisite climate change governance leadership and how capacity at multi-levels also becomes a critical imperative for effective and proactive adaptation planning. We also highlight an unavoidable concern: Climate Finance, as a necessary topic for broader engagement and discussion. In our view, climate finance is at the very core of adaptation planning both at the national and subnational levels. Thus, we as a consultant team, have been conscious and intentional about making the topic a part of our process and as an effort towards institutional strengthening and capacity building. We provided insights and directions on how to identify funding sources and what to do to attract funding.

Additionally, we have also been very intentional about locating this work within the broader Ghana National Adaptation Plan (NAP) process by educating stakeholders on how the implementation of adaptation actions in the district contributed to the NAP process at the national level. We demonstrated the link between national and subnational level processes and how they respond to the vertical integration approach adopted by the Ghana NAP process. By aligning district level planning processes to national level aspirations, we demonstrated what vertical integration means and how such processes could distill and highlight unique needs and particularities at the district level and how they might be prioritized within national policy regimes. A case in point is the issue of gendered vulnerabilities, biophysical challenges and the diversity and extremity of climate constraints and associated adaptation needs in specific local communities. A principal organizing philosophy that underscored this work was awareness creation, knowledge co-production and understanding of the complex linkages between national level climate risk and vulnerabilities and subnational risk and vulnerabilities. More importantly, we highlighted the gendered nature of climate impacts, risks and vulnerabilities and the critical imperative for gender-responsive adaptation interventions.

6.1 Strengthening Institutional Capacity

6.1.1 Strengthening the Enabling Environment for Climate Finance

The Nanumba South District is taking steps to enhance its capacity to access and utilize climate finance to address its pressing climate challenges. Participatory workshops conducted during the assessment process brought together community members, District Assembly staff, CSOs, and traditional leaders to highlight the challenges and opportunities of accessing resources such as the Green Climate Fund (GCF) and Adaptation Fund (AF) (**Table 16**). These workshops emphasized the need for enhanced technical capacity, streamlined processes, and collaboration among stakeholders to navigate the complexities of climate finance. By fostering an enabling environment, the district aims to secure funding for critical adaptation and mitigation projects that focus on drought resilience, flood prevention, sustainable agriculture, and water resource management. A key part of this effort involves building institutional capacity through training programs for Assembly staff, equipping them with the skills needed to develop climate finance proposals and implement projects effectively. Additionally, partnerships with civil society organizations (CSOs), private sector actors, and development agencies have been instrumental in mobilizing resources and technical support. Aligning with Ghana's National Adaptation Plan (NAP) and other national climate policies, the district needs to ensure that its strategies reflect broader climate resilience goals. By integrating local knowledge and community participation into project planning, Nanumba South District is positioning itself to access and utilize climate finance in a way that directly benefits its most vulnerable populations, including women, men, youth, and marginalized groups. Through these efforts, the district is strengthening its ability to attract climate investments and drive sustainable development, ensuring long-term resilience against climate change impacts.

Table 16: Key actions, expected outcomes, and collaborators for strengthening the enabling environment for climate finance

Key Actions	Expected Outcomes	Key Collaborators
Train Assembly staff on proposal development and accessing climate finance mechanisms.	Increased ability to draft and submit competitive proposals to secure climate funding.	District Assembly, Ghana EPA, Development Partners
Develop and disseminate guidelines for transparent financial management of climate projects.	Improved donor trust and accountability, ensuring sustained funding.	Financial Institutions, Development Partners
Simplify internal administrative processes for budgeting and resource allocation.	Faster and more transparent disbursement of funds to priority projects.	Nanumba South District Assembly, CSOs
Organize workshops on climate finance policy frameworks for local stakeholders.	Enhanced understanding of funding opportunities and their application processes.	Ministry of Finance, Local NGOs
Foster partnerships with CSOs and international agencies to strengthen funding applications.	Improved technical expertise and resource mobilization for climate adaptation projects.	UNDP, World Bank, Local NGOs

6.1.2 Implementing a Gender-Responsive National Adaptation Plan

Climate change in Nanumba South District disproportionately affects women, youth, and marginalized groups, who play key roles in managing water and food resources. Limited access to land, credit, and decision-making opportunities worsen their vulnerabilities. A gender-responsive National Adaptation Plan should address these inequalities by promoting inclusive participation in climate efforts. This includes training women in agriculture and entrepreneurship, equipping youth with climate-resilient skills, and fostering governance structures that represent all community members (**Table 17**). Prioritizing gender equity will enhance adaptation efforts and strengthen social cohesion.

Table 17: Key actions, expected outcomes, and collaborators for implementing a gender-responsive NAP

Key Actions	Expected Outcomes	Key Collaborators
Train women's groups in climate-resilient agricultural practices and entrepreneurship.	Increased adaptive capacity and economic resilience among women.	Women's Associations, Ministry of Gender, CSOs
Conduct youth-focused workshops on climate-resilient skills and leadership development.	Empowered youth capable of leading adaptation initiatives in their communities.	Youth Organizations, Traditional Leaders, NGOs
Facilitate training on integrating gender-sensitive approaches into planning and governance.	More inclusive adaptation policies that address the unique vulnerabilities of women and marginalized groups.	Ghana EPA, MoFA, CSOs
Develop district-level guidelines to integrate gender considerations into adaptation projects.	Projects that address unique vulnerabilities of women, youth, and marginalized groups.	MoGCSP, EPA, CSOs
Create gender-responsive monitoring indicators to assess project impact.	Improved accountability and ability to measure progress in reducing gender inequalities.	MoGCSP, Local NGOs, UNDP

6.1.3 Enhancing Planning and Execution of Inclusive Projects

The district's adaptation strategies must prioritize inclusivity by incorporating diverse community perspectives into project planning and execution. This involves participatory workshops, community engagement sessions, and transparent decision-making processes to ensure that all voices are heard, particularly those of vulnerable groups. Effective planning should focus on aligning local initiatives with broader development goals such as food security, water resource management, and sustainable livelihoods, while fostering accountability and equity (**Table 18**).

Table 18: Key actions, expected outcomes, and collaborators for planning and implementation of inclusive projects

Key Actions	Expected Outcomes	Key Collaborators
Train community representatives on participatory project planning and monitoring.	Strengthened local ownership and alignment of projects with community priorities.	District Assembly, Local NGOs, CSOs, Youth Groups
Organize capacity-building sessions for Assembly staff on inclusive governance frameworks.	Improved design and implementation of equitable adaptation projects.	Governance Experts, Government Agencies like EPA, Development Partners
Develop district-level guidelines to integrate gender considerations into adaptation projects.	Projects that address unique vulnerabilities of women, youth, and marginalized groups.	MoGCSP, EPA, CSOs
Conduct participatory planning workshops to co-design adaptation initiatives with communities.	Locally relevant projects that address specific vulnerabilities, fostering ownership and trust.	District Assemblies, CSOs, Local Leaders
Create gender-responsive monitoring indicators to assess project impact.	Improved accountability and ability to measure progress in reducing gender inequalities.	MoGCSP, Local NGOs, UNDP
Establish robust monitoring and evaluation systems to track project impacts.	Enhanced accountability, timely course corrections, and data-driven improvements in project design.	EPA, Development Partners, Local NGOs

6.1.4 Collaboration Between Key Institutions and Stakeholders in Nanumba South

Building climate resilience in the Nanumba South District requires a collaborative approach involving the District Assembly, civil society organizations (CSOs), and private sector actors. By working together, these stakeholders can enhance resource mobilization, align policies, and integrate local knowledge into climate adaptation strategies. Strengthening partnerships with research institutions and technical experts will also ensure evidence-based decision-making and the successful implementation of climate-resilient infrastructure and social interventions. At the same time, fostering an enabling environment for climate finance is essential for securing funding to address the district's pressing climate challenges, such as droughts, floods, soil erosion, and water scarcity. Institutional capacity-building initiatives, including training for Assembly staff, will equip local authorities with the skills needed to develop strong climate finance proposals and implement effective adaptation projects (**Table 19**).

Table 19: Key institutions and roles for collaboration between key institutions and stakeholders

Institution/Agency	Role in Climate Adaptation
The Nanumba South District Assembly	Solicits for funding for Climate change adaptation and mitigation.
Traditional Authority	Enacts byelaws to regulate deforestation and bush burning.
Ministry of Environment, Science, Technology and Innovation (MESTI)	Formulates policies and a regulatory framework to promote the use of appropriate environmentally friendly practices.
Environmental Protection Authority	Provides technical guidance and ensures alignment with Ghana's NAP.
Ministry of Gender, Children, and Social Protection (MoGCSP)	Advocates for gender-responsive adaptation strategies and supports capacity building for women and marginalized groups.
Savanna Agricultural Research Institute (SARI)	Delivers research-based solutions for climate-smart agricultural practices.
Civil Society Organizations (CSOs)	Facilitate community engagement, provide technical assistance, and advocate for inclusive and gender-responsive policies.
Development Partners (UNDP), World Bank, GCF	Offer funding, technical expertise, and capacity-building support to enhance local adaptation efforts.

6.2 Policy Implications

6.2.1 Strengthening Climate-Resilient Infrastructure and Natural Resource

Nanumba South District lacks significant infrastructure and natural resource management, which intensify the impacts of climate change on local communities. Poor road networks restrict access to markets and farms, limiting economic opportunities and driving up transportation costs. At the same time, inadequate water infrastructure makes communities highly vulnerable to prolonged droughts and water shortages, especially during the dry season. Also, environmental degradation caused by deforestation, bush burning, and soil erosion weakens the district's resilience, leading to declining agricultural productivity and biodiversity loss. To address these challenges (**Table 20**), a comprehensive approach is needed, focusing on climate-resilient infrastructure development such as constructing durable roads to improve connectivity, installing mechanized boreholes and small dams to enhance water security, and promoting sustainable practices such as afforestation and community-led natural resource management. The effective implementation of climate adaptation strategies at the district level relies on the effectiveness of local government structures. This therefore implies that MMDAs as governance institutions should have the requisite capacity to lead tailored and gender-responsive adaptation planning.

Table 20: Strengthening climate-resilient infrastructure and natural resource management

Recommendation	Action	Expected Outcome	Case Study
Improve water access by constructing small dams and boreholes.	Construct mechanized boreholes and small dams in strategic locations.	Reliable year-round water supply for farming and households.	Boreholes installed in Lungni for drinking water and dam in Wulensi for dry season vegetable production.
Enhance road networks to improve access to farms.	Rehabilitate roads with proper drainage and culverts.	Reduced transportation challenges for farmers and traders.	Construction of motorable roads connecting communities such as Tampoaya to the district capital.
Promote tree planting and sustainable land management.	Provide tree seedlings and train communities in afforestation.	Minimized deforestation and improved soil health.	Establishment of community-managed teak and cashew plantation in Nabayili and Lungni.

6.2.2 Integrating Gender-Responsive Approaches into Adaptation Policies

Climate change affects different groups in society in varying ways, with women, youth, and marginalized populations often facing the greatest risks. In Nanumba South District, integrating gender-responsive approaches into climate adaptation policies is essential for ensuring equitable and effective resilience-building efforts. A gender-responsive approach involves recognizing and addressing the unique vulnerabilities, roles, and contributions of women and other disadvantaged groups in climate adaptation. Women in the district, for example, play a key role in agriculture, water management, and household food security but often have limited access to land, financial resources, and climate-related information. Strengthening their participation in decision-making processes can help design more inclusive and impactful adaptation strategies (**Table 21**).

Table 21: Integrating gender-responsive approaches into adaptation policies

Recommendation	Action	Expected Outcome	Case study
Safeguard equitable participation in governance.	Include women and youth in local climate adaptation committees.	Increased representation and tailored solutions for vulnerable groups.	Form women-led farmer groups to guide resource allocation.
Address capacity gaps among vulnerable groups.	Provide gender-sensitive training on climate-smart practices and adaptation techniques.	Enhanced knowledge and skills for resilience.	Workshops on climate-smart agriculture practices for women in Wulensi of the district.
Promote equitable resource distribution.	Prioritize women and marginalized groups in accessing farming inputs and equipment.	Improved resource access for disadvantaged groups.	Provide subsidized irrigation implements to women farmers.

6.2.3 Promoting Inclusive Economic Adaptation Strategies

Building climate resilience in Nanumba South District requires economic strategies that are inclusive, sustainable, and responsive to the needs of all community members. Climate change disproportionately affects vulnerable groups, including smallholder farmers, women, youth, and marginalized populations, making it imperative to develop adaptation strategies that enhance economic opportunities while reducing climate risks. Economic adaptation strategies should empower vulnerable groups by

promoting alternative livelihoods, enhancing agricultural value chains, and fostering entrepreneurship. Through inclusive resource distribution and capacity building, the district can create sustainable, climate-resilient income opportunities, strengthening economic stability and community well-being (**Table 22**).

Table 22: Promoting inclusive economic adaptation strategies

Recommendation	Action	Expected Outcome	Case Study
Support women with alternative livelihoods.	Train women in palm oil production and other trades.	Improved income generation and economic independence.	Establish women-led vegetable farming in Wulensi.
Build agricultural value chains.	Facilitate access to processing equipment for tomatoes and rice.	Reduced post-harvest losses and increased profits.	Set up cassava and yam processing factories in Nakpayili.
Encourage youth entrepreneurship.	Provide artisanal training in tailoring, carpentry, hairdressing, sowing and masonry.	Diversified income sources for youth and reduced reliance on agriculture.	Launch vocational training hubs in Wulensi, Nakpayili, Lungni and Tampoaya.

6.2.4 Addressing Systemic Barriers to Resource Access

Limited access to essential resources such as land, finance, technology, and markets remains a major challenge for many communities in Nanumba South District, particularly for women, youth, and marginalized groups. Addressing these systemic barriers is critical to improving livelihoods and ensuring inclusive economic growth. Addressing these barriers requires transparent resource allocation, improved infrastructure, and strong stakeholder collaboration to ensure fair access (**Table 23**). By overcoming these systemic challenges, the district can promote social equity, enhance livelihoods, and strengthen community resilience to climate impacts.

Table 23: Policy recommendations for addressing systematic barriers to resource access

Barrier	Action	Expected Outcome	Case Study
Inequitable distribution of farming resources.	Provide equitable access of land to women farmers to secure credit.	This will help to improve access for all.	Traditional leaders and the District Assembly
Limited access to water for farming and households.	Construct and rehabilitate mechanized boreholes and dams.	Increased water availability and reduced water stress.	Improve access to dam for irrigation, Wulensi and Lungni
Financial resource constraints.	Develop microfinance policies mandating low-interest loans for women-led enterprises.	Partner with financial institutions to establish loan guarantee schemes.	Microfinance support for vegetable production, VSLA and NORSAAC in Nabayili and Lungni
Land ownership disparities affecting youth and women.	Facilitate inclusive land access schemes.	Expanded agricultural opportunities for marginalized groups.	Traditional leaders supporting women-led reforestation initiatives in Nakpayili and Gbaungbaliga.

6.2.5 Positioning Local Adaptation Efforts within Ghana's National Adaptation Plan and International Frameworks

Nanumba South District's adaptation strategies should align with Ghana's National Adaptation Plan (NAP) and global frameworks like the Sustainable Development Goals (SDGs) to secure resources and ensure long-term scalability. By integrating global best practices while addressing local vulnerabilities, the district can enhance its climate resilience. Strengthening institutional capacity

to access climate finance and fostering partnerships with national and international stakeholders are key to sustaining adaptation efforts (**Table 24**). This alignment ensures that local projects effectively meet community needs while contributing to broader climate resilience and sustainable development goals.

Table 24: Aligning local adaptation efforts with national and international frameworks

Framework	Action	Expected Outcome	Practical Example
Ghana's National Adaptation Plan (NAP).	Align local adaptation initiatives with NAP priorities.	Coherent adaptation planning and resource access.	Integrate water resource management projects into NAP goals.
Sustainable Development Goals (SDGs).	Incorporate SDG indicators into monitoring frameworks.	Enhanced project relevance and contribution to global goals.	Design irrigation systems targeting clean water (SDG 6).
Climate finance mechanisms (*e.g.*, GCF, PPP).	Train Assembly staff on proposal writing and fund management.	Increased funding and financial sustainability.	Conduct workshops for Nanumba South District Assembly on climate finance.

6.2.6 Expanding Gender-Sensitive Budgeting Strategies

Gender-sensitive budgeting is a critical tool for ensuring that resources are allocated equitably and that climate adaptation initiatives address the unique needs of different groups within the community. This approach requires integrating gender analysis into all stages of the budgeting process, from planning to execution and evaluation (**Table 25**).

Table 25: Gender-sensitive budgeting strategies in Nanumba South District

Key Strategies	Expected Action	Practical Example
Capacity Building for Finance Officials	• Conduct workshops to train district finance and planning officers on integrating gender perspectives into budget formulation and execution • Introduce training on tracking and reporting gender-focused expenditures to ensure accountability.	Supporting Women's Livelihoods: Allocate a specific percentage of the adaptation budget to initiatives that support women-led cooperatives in climate-resilient trades such as shea processing or agroforestry.
Development of Budgeting Tools	• Create standardized templates and checklists to guide the preparation of gender-sensitive budgets for climate adaptation projects. • Include gender impact assessments as a mandatory component of project budget proposals.	Health and Safety: Ensure sufficient budgetary provisions for mobile health units and childcare facilities to support women during climate crises.
Participatory Budgeting Mechanisms	• Involve women, youth, and other marginalized groups in budget planning discussions to ensure their priorities are adequately represented. • Establish community budgeting forums where stakeholders can provide input on resource allocation for adaptation projects.	Youth Inclusion: Design budget lines to fund skill-building programs for youth in adaptive technologies, such as solar irrigation or climate-smart agriculture.

7. Conclusion and Recommendations

7.1 Conclusions

Climate change manifestations coupled with inadequate infrastructure and institutional capacities compromise the capacity of smallholder farming communities in the Nanumba South District to address climate change effects. These impacts disrupt food security, livelihoods, and essential services, deepening poverty and social inequalities. This is critical because most of the households in the district are directly dependent on rain-fed agro livelihoods. Effective adaptation in Nanumba South District requires integrating local knowledge with global frameworks to develop sustainable and gender-responsive solutions. The IPCC's risk framework and CARE International's participatory tools provide valuable pathways to improve community resilience. By aligning adaptation strategies with the United Nations development goals like SDGs 5 and 13, the Nanumba South District can foster resilience, equity, and sustainable growth, ensuring that all community members can thrive in the face of climate change.

A gender-responsive well-coordinated approach is required to strengthen livelihood resilience in the face of climate change. By combining qualitative and quantitative approaches, the report sought to: (i) assess the vulnerabilities and risks specific to men, women, and marginalized groups in the Nanumba South District; (ii) identify disparities in access to critical resources, climate information, and decision-making processes, which hinder equitable participation in adaptation efforts in the Nanumba South District; and (iii) provide evidence-based recommendations for gender-responsive adaptation policies and interventions. The report revealed that climate change affects different socioeconomic groups and that women, the elderly, youth, and migrant farmers are disproportionately affected by climate change effects. More specifically:

1. **Vulnerability and Risk Exposure:** Communities in Nanumba South District face frequent climate hazards, including floods, droughts, erratic rainfall, bush fires and extreme heat. These challenges severely disrupt farming, which is the district's main economic activity. They also impact water resources, health services, and infrastructure, making it harder for communities to recover and adapt. Almost all communities such as Kukuo, Nabayili, and Gunguni are vulnerable to drought. A lack of early warning systems is a major concern to the district. Most people in the district receive no prior warning, leaving them unprepared and more vulnerable to sudden disasters. Addressing these challenges requires better preparedness, improved infrastructure, and support for at-risk communities.
2. **Sectorial sensitivity:** Key sectors in the district, including agriculture, water resources, and health, are highly affected by climate hazards. Agriculture, which is the district's main economic activity, is especially vulnerable to erratic rainfall and droughts. These challenges lead to lower crop yields and food shortages, making life difficult for farmers and households. Water resources are also under pressure due to poor dam maintenance and growing demand, making it harder for communities to access reliable water supplies. At the same time, the health sector faces major challenges, including limited infrastructure and a rise in climate-related illnesses such as malnutrition and respiratory diseases. Addressing these issues requires investment and support for affected communities.
3. **Gender-Differentiated Impacts:** The impacts of climate change in the district affect both men and women in a different way. Women face greater challenges due to their responsibilities in water collection, food management, and caregiving. During droughts, women travel longer distances to fetch water and stretch limited food supplies to feed their families. Men, on the other hand, are more directly affected by crop failures and physically demanding tasks like livestock management. Despite playing a crucial role in adapting to climate challenges, women often lack access to essential resources such as land, credit, and agricultural inputs. This limitation makes it harder for them to respond effectively to the changing climate.
4. **Adaptive Capacity and Resource Limitations:** Women face significant barriers to land ownership, credit facilities, and agricultural inputs, making it difficult for them to adopt effective climate adaptation strategies. Similarly, cultural and religious norms hinder their ability to participate in decision-making processes and to respond to climate impacts. To cope with

climate variability, households use strategies such as planting improved crop varieties, drought-resistant crops, and intercropping. However, these efforts often fall short in addressing larger issues like erratic rainfall and prolonged droughts. Some families turn to alternative livelihoods, such as migration for labour work, animal rearing, and agro-processing to supplement their income, but not everyone has the means to engage in such activities. Nanumba South District faces significant gaps in community-based and institutional support systems for climate adaptation. While organizations like the National Disaster Management Organization (NADMO) offer occasional assistance, its support is often limited and does not reach all vulnerable households. Female-headed households, in particular, struggle with a lack of support networks that address their specific challenges. Limited access to financial aid, training programs, and social safety nets makes it harder for them to recover from climate-related shocks.

5. **Infrastructural Deficiencies:** Nanumba South District's infrastructure is poorly equipped to handle the impacts of climate change. Many roads are in bad condition, making transportation difficult and limiting farmers' access to markets. These challenges also slow down disaster response efforts, leaving communities more vulnerable during emergencies. Health services are basic and unevenly distributed, meaning many communities lack access to advanced medical care. This makes it harder to treat climate-related illnesses such as malnutrition and waterborne diseases. Water and irrigation systems are also unreliable. Many communities depend on earthed dams, which often dry up. This worsens water shortages and increases the risk of disease.

7.2 Recommendations

Addressing the vulnerabilities and building resilience in Nanumba South District requires a multi-pronged approach, integrating short-term relief with long-term planning and capacity building. By implementing these recommendations, communities in Nanumba South District can transform its vulnerabilities into opportunities for growth and resilience.

With regards to precipitation, the report highlights that the Nanumba South district faces significant interannual variability (1000 mm - 1680 mm). Further, temperature projections revealed consistent upward trends throughout. Three critical climate-related hazards: droughts, floods and water scarcity were identified and their implications for different socioeconomic groups have been discussed. The report further suggests that the Nanumba South District is characterised by high levels of economic, physical and social vulnerability that require immediate interventions. The report proposes the following:

1. **Improved adaptive capacity through non-farm skills development:** The report recommends that the government, through its relevant agencies, alongside non-governmental organizations, should provide skills development training for smallholders to enhance their livelihood outcomes. For instance, local government in collaboration with non-governmental organizations could provide training in areas like carpentry, tailoring, masonry, plumbing, and electrical work to the youth and provide funding, expertise, and resources for skill development programs.
2. **Strengthen Village Savings and Loan Associations (VSLAs) and microcredit schemes for women farmers:** To enhance women's financial inclusion and capacity to invest in climate adaptation strategies, it is important to strengthen Village Savings and Loan Associations (VSLAs) and microcredit schemes.
3. **Incorporate indigenous weather forecasting techniques into climate adaptation planning:** There is a need to integrate indigenous weather forecasting techniques, such as plant cycles and animal behavior observations, into climate adaptation planning for more context-specific and community-driven resilience strategies.
4. **Access to early warning systems:** It is recommended that the district assembly adopt an early warning system that can provide quality and timely information on potential climate events for households to fully prepare.
5. **Improved investments in agricultural adaptations:** While climate change poses a direct threat to agricultural productivity, district assemblies often lack the necessary financial resources and political will to prioritize and fund climate-resilient agricultural interventions.

Budget allocations for agricultural projects are often minimal and poorly coordinated, with funds allocated to other sectors such as infrastructure or education, leaving agriculture underfunded. There is a need for a conscious effort to budget funds for climate change adaptation interventions.

6. **Development of district level costed adaptation action plan:** Considering the high levels of economic, physical and social vulnerability in the Nanumba South District, there is the need to urgently develop a costed district adaptation plan and to build the capacity of the assembly for the mainstreaming of adaptation considerations in their Mid-Term Development Plan (MTDP) policies and plans. This will help the district to make long-term planning in relation to climate change adaptation.
7. **Promoting Gender Equity in Resource Access:** There is a need to address challenges that hinder women's access to resources such as land, credit, and agricultural inputs. Empower women and create awareness campaigns to challenge cultural norms that restrict women's economic participation. Establish women's cooperatives and support groups to enhance collective resilience and foster economic opportunities.
8. **Promoting dry season farming:** Efforts should be made through the central government and district assembly to construct earthed dams to facilitate dry season vegetable production to support household food and livelihood security.
9. **Improving decision-making capacity of marginalised socioeconomic groups:** Efforts should be made by the district assembly to provide leadership training to women and girls through education and mentorship programmes to boost their advocacy skills and confidence in decision-making roles.
10. **Improved policy framework for gender mainstreaming:** There is a need to develop a comprehensive gender-responsive policy framework that will address disparities and inequality against women, migrant farmers, and the elderly.

7.3 Next Step Actions

The next step should be the development of a comprehensive Climate Action Plan for Nanumba South District. This plan will detail prioritized adaptation actions addressing key vulnerabilities, ensuring gender sensitivity and inclusivity. It will also identify practical financial options to fund interventions, thereby enhancing climate resilience and sustainable development across communities within the district.

REFERENCES

Addae-Frimpomaah, F., Amenorpe, G., Denwar, N. N., Amiteye, S., Adazebra, G. A., Sossah, F. L., … & Amoatey, H. M. (2022). Participatory approach of preferred traits, production constraints and mitigation strategies: implications for soybean breeding in Guinea Savannah zone of Ghana. Heliyon, 8(5).

Alhassan, A. K., Boateng, V. F., & Danso-Abbeam, G. (2023). Impact of village saving groups on adoption intensity of sustainable agricultural practices among smallholder farmers in Northern region, Ghana. Agricultural Finance Review, 83(4/5), 675-690.

Amankwaa, E. F., & Gough, K. V. (2023). 'We are at the mercy of the floods!': Extreme weather events, disrupted mobilities, and everyday navigation in urban Ghana. Singapore Journal of Tropical Geography, 44(2), 235-254.

Amoako, E. E. (2012). Sustainable land management and tree tenure: The case of Parkia biglobosa in the Northern Region of Ghana. United Nations University Land Restoration Training Programme.

Anokye, J., Logah, V., & Opoku, A. (2021). Soil carbon stock and emission: estimates from three land-use systems in Ghana. Ecological Processes, 10(1). https://doi.org/10.1186/s13717-020-00279-w

Antwi-Agyei, P., Amanor, K., Hogarh, N. J., Dougill, A.J. (2021). Predictors of access to and willingness to pay for climate information services in north-eastern Ghana: A gendered perspective, Environmental Development, Volume 37, 100580, https://doi.org/10.1016/j.envdev.2020.100580

Antwi-Agyei, P., Dougill, A. J., Stringer, L. C., & Codjoe, S. N. A. (2018). Adaptation opportunities and maladaptive outcomes in climate vulnerability hotspots of northern Ghana. Climate Risk Management, 83–93. https://doi.org/10.1016/j.crm.2017.11.003

Antwi-Agyei, P., Dougill, A.J. and Stringer, L.C. (2015) Barriers to Climate Change Adaptation: Evidence from Northeast Ghana in the Context of a Systematic Literature Review. Climate and Development https://doi.org/10.1080/17565529.2014.951013

Baakoh, A. (2023). Farmer Perception and Adaptation to Climate Variability and Change: A Study of Smallholder Yam Famers in the Yendi Municipality and The Nanumba South District of the Northern Region (Doctoral Dissertation).

Chapman C.A. , Abernathy Katherine , Chapman Lauren J. , Downs Colleen , Effiom Edu O. , Gogarten Jan F. , Golooba Martin , Kalbitzer Urs , Lawes Michael J. , Mekonnen Addisu , Omeja Patrick , Razafindratsima Onja , Sheil Douglas , Tabor Gary M., Tumwesigye Charles , Sarkar Dipto. (2022). The future of sub-Saharan Africa's biodiversity in the face of climate and societal change. Frontiers in Ecology and Evolution.
https://www.frontiersin.org/journals/ecology-and-evolution/articles/10.3389/fevo.2022.790552

Dekongmen, Benjamin Wullobayi & Anornu, Geophrey & Kabo-bah, Amos Tiereyangn & Larbi, Isaac & Sunkari, Emmanuel & Dile, Yihun & Asante, Agyare & Gyamfi, Charles. (2022). Groundwater recharge estimation and potential recharge mapping in the Afram Plains of Ghana using SWAT and remote sensing techniques. Groundwater for Sustainable Development. 17. 100741. 10.1016/j.gsd.2022.100741.

Dovie, D. B. K., Dzodzomenyo, M., & Ogunseitan, O. A. (2017). Sensitivity of health sector indicators' response to climate change in Ghana. Science of The Total Environment, 574, 837–846. https://doi.org/10.1016/J.SCITOTENV.2016.09.066

Furtak, K. & Wolińska, A. (2023). The impact of extreme weather events as a consequence of climate change on the soil moisture and on the quality of the soil environment and agriculture – A review, CATENA, Volume 231, 107378, https://doi.org/10.1016/j.catena.2023.107378.

Ghana Statistical Service. (2021). Population of Regions and Districts. Ghana 2021 Population and Housing Census. General Report Volume 3A. https://statsghana.gov.gh/ (Accessed on 27 November 2023). Helen Onyeaka, Uju M. Nwauzoma, Adenike A. Akinsemolu, Phemelo Tamasiga, Keru Duan, Zainab T. Al-Sharify, Kehinde Favour Siyanbola. (2024). The ripple effects of climate change on agricultural sustainability and food security in Africa. Food and Energy Security. https://doi.org/10.1002/fes3.567

Ibrahim, M. (2022). Assessment of Pesticide Use and Impacts Among Smallholder Rice Farmers in the Upper East Region, Ghana (Doctoral dissertation, University of Cape Coast).

Issaka, R. N., Buri, M. M., Sekyi-Annan, E., Musah, M., & Dugan, E. (2021). Enhancing soil productivity in ghana through the use of Leguminous cover crops and tillage practices. West African Journal of Applied Ecology, 29(2), 24-32.

Keeton, R., Reckien, D., Abu, M. (2022) Habitable Study Area Report: Akatsi North District, Ghana. Habitable Project. DOI: 10.3990/1.978903655353

Kpenekuu, F., Antwi-Agyei, P., Nimoh, F., Osei, M. A., & Guodaar, L. (2024). Understanding drought risk management in vulnerable communities in dryland farming systems: Evidence from northwest Ghana. International Journal of Disaster Risk Reduction, 100(September 2022), 104186. https://doi.org/10.1016/j.ijdrr.2023.104186

Pienaah, C.K.A., Saaka, S.A., Batung, E., Mohammed, K., Luginaah, I. (2024). Household water insecurity experience in the Upper West Region of Ghana: Insights for effective water resource management. PLOS journals. https://doi.org/10.1371/journal.pwat.0000216

Milien, E. J., Rocha, K. da S., Brown, I. F., & Perz, S. G. (2021). Roads, deforestation and the mitigating effect of the Chico Mendes extractive reserve in the southwestern Amazon. *Trees, Forests and People*, 3 (August 2020), 100056. https://doi.org/10.1016/j.tfp.2020.100056

Ministry of Finace and Econmic Planning (2023). Composite Budget for 2023-2026 Programme Based Budget Estimates for 2023 - Bole District Assembly. 2023 PBB Estimates - Bole District, 155.

Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic Analysis: Striving to Meet the Trustworthiness Criteria. International Journal of Qualitative Methods, 16 (1), 1-13.

Nanumba South District Assembly (2021). Annual Progress Report: Medium Term Development Plan. http://nanumbasouth.ghanadistricts.gov.gh/

Nkegbe, P. K., Abu, B. M., & Issahaku, H. (2017). Food security in the Savannah Accelerated Development Authority Zone of Ghana: An ordered probit with household hunger scale approach. *Agriculture and Food Security*, *6*(1), 1–11. https://doi.org/10.1186/s40066-017-0111-y

Ogidi, O. I., Izah, S. C., & Akpan, U. M. (2023). Food quality and agrochemical use: integrated monitoring, assessment, and management policies. In One Health Implications of Agrochemicals and their Sustainable Alternatives (pp. 411-440). Singapore: Springer Nature Singapore.

Simelton, E., Carew-Reid, J., Coulier, M., Damen, B., Howell, J., Pottinger-Glass, C., ... & Van Der Meiren, M. (2021). NBS framework for agricultural landscapes. Frontiers in Environmental Science, 9, 678367.

Singh, Suresh. (2024). Bhatt et-al Drought-Bundelkhand Springer-2024.

Vunibola, S., Leweniqila, I., Raisele, K. (2024). Reimagining innovation through Indigenous Agricultural Knowledge (IAK): Indigenous innovations and climate crisis resilience in the Pacific. Pacific Dynamics Journal of Interdisciplinary Research. Vol 8 (1) 2024. https://doi.org/10.26021/15184

WFP (2019). Towards sustainable food security. The World Food Programme in Mali. https://docs.wfp.org/api/documents/WFP0000105546.

Williams, P.A., Crespo, O., Atkinson, C.J. et al. (2017) Impact of climate variability on pineapple production in Ghana. Agric & Food Secur 6:26. https://doi.org/10.1186/s40066-017-0104-x

Zonderland-Thomassen, M.A., Lieffering, M., Ledgard, S.F. (2014). Water footprint of beef cattle and sheep produced in New Zealand: water scarcity and eutrophication impacts, Journal of Cleaner Production, https://doi.org/10.1016/j.jclepro.2013.12.025.

Yiran, G. A. B., Oteng Ababio, M., Allotey, A. N. M., Kofie, R. Y., & Møller-Jensen, L. (2024). Spatial Analysis of Exposure of Roads to Flooding and Its Implications for Mobility in Urban/Peri-Urban Accra. ISPRS International Journal of Geo-Information, 13(4), 111.

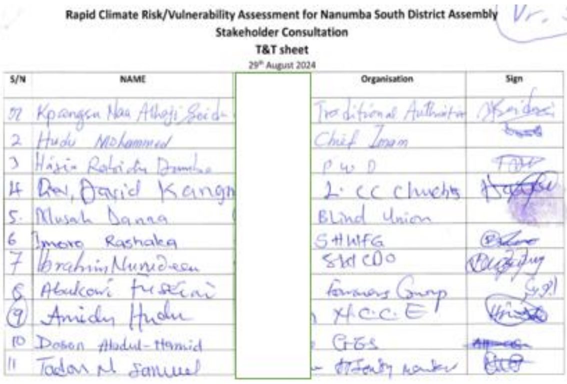
Yiridomoh, G. Y., Bonye, S. Z., & Derbile, E. K. (2024). Reducing vulnerability to climate change among millet and sorghum farmers in Ghana: interrogating the contribution of climate-smart agriculture in northwestern Ghana. Frontiers in Sustainable Food Systems, 8(August), 1–17. https://doi.org/10.3389/fsufs.2024.1357355

APPENDICES

Appendix I
Stakeholder Consultation for SIGRA Rapid Climate Risk/ Vulnerability Assessment for Nanumba South District Assembly

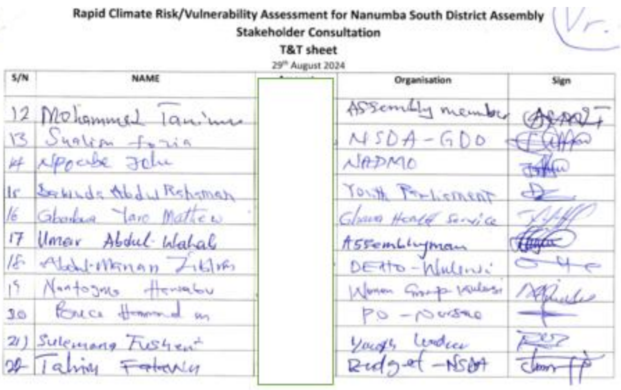
S/N	Name	Institution
1	Hajia Rabiatu Damba	PWD
2	Hudu Mohammed	Chief Imam
3	Musah Danaa	Blind Union
4	Sulemana Fuseini	VSLA
5	Dawuda Abdul Rahaman	Youth Parliament
6	Abubakari Fuseini	Farmer
7	Nantogma Awabu	Farmer
8	Gbarbua Yaro Matthew	GHS
9	Kpangsunaa Alhaji Seidu	Traditional Authority
10	Dason Abdul-Hamid	GES
11	Jakpel Nimome Regina	CAIFINI
12	Sualisu Fazia	NSDA
13	Ibrahim M. Saani	DPO-NSDA
14	Gmabar P. Elizabeth	SEND-GHANA
15	Abubakari Baba	Assembly Member
16	Mohammed Tanimu	Assembly Member
17	Tadon Nasangon Samuel	Assembly Member
18	Amidu Hudu	NCCE
19	Iddrisu Imoro	Department of Agriculture
20	Abu-Hanif Abdul-Garo	ASAWABA Farms
21	Chikpa Augustina	WIAD
22	Wagaar Nsanyaaan Isaac	Department of Agriculture
23	Mark A. Kpenye	NSDA
24	Tahiru Fatawu	NSDA
25	Issah Abdul-Aziz	Bondalikadibu Area Council
26	Imoro Rashaka	SHWFG
27	Ibrahim Nurudeen	Social Welfare Officer-NSDA
28	Rev David Kangma	Local Council of Churches
29	Bruce M. Hammond	Norsaac
30	Abubakari A. Ahda	NSDA
31	Madae Samuel	Dachamba Area Council
32	Ibrahim Abdul Wahab	EPA
33	Umar Abdul-Wahab	BAC
34	Abdul-Hakim Mutaru	NSDA
35	Akabanga Yaw Kego	NSDA
36	Abdul-Masan Ziblim	Environmental Health Unit
37	Adam Abdul-Aziz	Tamale University
38	Felix Kpenekuu	KNUST
39	Npoaba John	NADMO
40	Joseph Banyen	SIGRA
41	Attah Alabani	Farmer
42	Philip Antwi-Agyei	Consultant

Appendix II
Rapid Climate Risk/Vulnerability Assessment for Nanumba South District Assembly Stakeholder Consultation
T&T Sheets



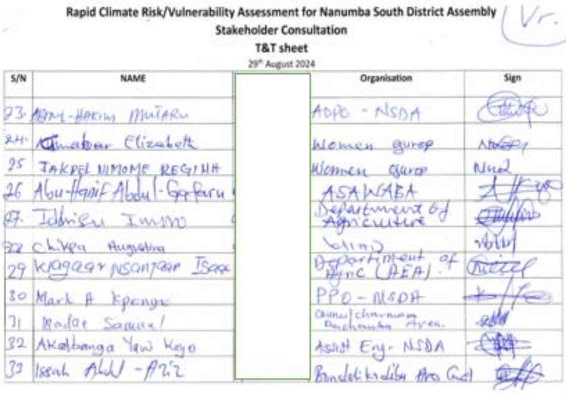
Rapid Climate Risk/Vulnerability Assessment for Nanumba South District Assembly
Stakeholder Consultation
T&T sheet
29th August 2024

S/N	NAME		Organisation	Sign
01	Kpangsu Naa Alhaji Seidu		Traditional Authority	
2	Hudu Mohammed		Chief Imam	
3	Hajia Rabiatu Dumba		PWD	
4	Rev. David Kangn		2. CC Church	
5.	Musah Danaa		Blind Union	
6	Imoro Rashaka		SHWFG	
7	Ibrahim Nurudeen		SSI CDO	
8	Abukari Fuseini		Farmers Group	
9	Amidu Hudu		HCCE	
10	Doson Abdul-Hamid		GES	
11	Todan M Samuel		Forestry worker	



Rapid Climate Risk/Vulnerability Assessment for Nanumba South District Assembly
Stakeholder Consultation
T&T sheet
29th August 2024

S/N	NAME		Organisation	Sign
12	Mohammed Tanimu		Assembly member	
13	Shalim Fazia		NSDA - GDO	
14	Npoabe John		NADMO	
15	Sekinda Abdul Rahaman		Youth Parliament	
16	Gbadua Yaro Matthew		Ghana Health Service	
17	Umar Abdul-Wahab		Assemblyman	
18	Abdul-Manan Zibilla		DEHO - Wulensi	
19	Mantoyma Hawabu		Women Group Wulensi	
20	Bruce Hammond		PO - Nurse	
21)	Sulemana Fushena		Youth leader	
22	Tahiru Fatawu		Budget - NSDA	



Rapid Climate Risk/Vulnerability Assessment for Nanumba South District Assembly
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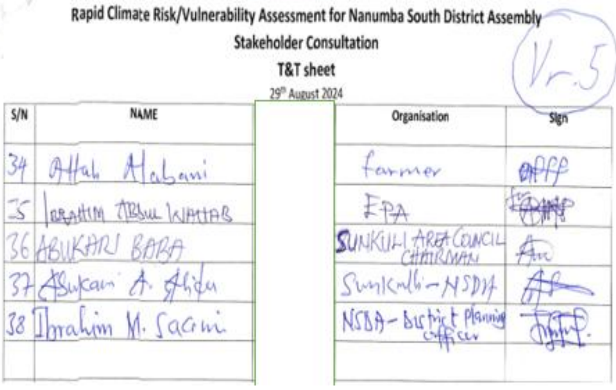
T&T sheet
29th August 2024

S/N	NAME		Organisation	Sign
23.	Abdul-Hakim Mutaru		ADPO - NSDA	
24.	Ajuabar Elizabeth		Women group	
25	Jakpel Nimome Regina		Women group	
26	Abu-Hanif Abdul-Gafaru		ASAWABA	
27.	Iddrisu Imoro		Department of Agriculture	
28	Chikpa Augustina		Blind	
29	Kjagaar Nsonjaar Isaac		Department of Agric (AEA)	
30	Mark A Kpenge		PPO - NSDA	
31	Madat Samuel		Council chairman Bachamba Area	
32	Akalbanga Yaw Kojo		Asst Eng - NSDA	
33	Issah Abdul-Aziz		Bandabkrediba Area Council	



Rapid Climate Risk/Vulnerability Assessment for Nanumba South District Assembly
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S/N	NAME		Organisation	Sign
34	Attah Alabani		farmer	
35	Ibrahim Abdul Wahab		EPA	
36	Abukari Baba		Sunkuli Area Council Chairman	
37	Abukari A. Alidu		Sunkuli - NSDA	
38	Ibrahim M. Sacani		NSDA - District Planning Officer	