SIGRA

Strengthening Investments in Gender-Responsive Climate Adaptation

Cowater Ghana

In partnership with Canada

Climate Change Risk and Vulnerability Assessment

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AKATSI NORTH DISTRICT

FREEDOM AND JUSTICE

epa

NATIONAL ADAPTATION PLAN GHANA

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TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS vi

EXECUTIVE SUMMARY I

1. Introduction 1

1.1 Project Background 1
1.2 Defining Climate Change Risks and Vulnerability 2
1.2.1 IPCC Risk and Vulnerability Framework 2
1.2.2 CARE International's Climate Vulnerability and Capacity Analysis 3
1.2.3 Adoption of Other Risk and Vulnerability Assessment 3
1.3 Study Aims and Objectives 4
1.3.1 Study Aim 4
1.3.2 Specific Objectives 4
1.4 Document Purpose 4

2. Akatsi North District Profile 7

2.1 Geography and Climate-Related Profiles 7
2.1.1 Location and Size 7
2.1.2 Physical and Environmental Features 7
2.1.3 Topography and Climate 8
2.2 Demographics and Gender Characteristics 9
2.2.1 Key Economic Activities in the District 9
2.2.2 Observed Gender Gaps in the Akatsi North District 9
2.3 Critical Climate-Related Hazards in Akatsi North District 11
2.3.1 Water Resources 11
2.3.2 Flooding 12
2.3.3 Drought 12
2.3.4 Wildfires 12

3. Methodological Framework 15

3.1 Introduction 15
3.2 Assessment Process 15
3.2.1 Desktop Review 15
3.2.2 Information Synthesis 15
3.2.3 Stakeholder Consultation 16
3.2.4 Revision and Final Validation 16
3.3 Gender-Sensitive Climate Risk Assessment Methodology 16
3.3.1 Stage 1: Risk Identification 16
3.3.2 Stage 2: Risk Assessment 17
3.3.3 Stage 3: Adaptation Action Plan 17

3.4 Data Collection Approaches 18
3.4.1 Workshop and Participatory Exercises 18
3.4.2 Focus Group Discussions 20
3.4.3 Household Questionnaire Surveys 21
3.5 Climate Projections Methodology 23
3.5.1 Projection Data Sources 23
3.5.2 Projection Period 23
3.5.3 Projection Analysis 23

4. Findings and Implications 25

4.1 Stakeholder Engagement 25
4.1.1 Mapping of Most Vulnerable and At-Risk Locations and Hazard Identification and Prioritization 25
4.1.2 Historical Timeline of Major Climate Induced Events 28
4.1.3 Seasonality Calendars of Climate Hazards 29
4.1.4 Vulnerability Matrix and Analysis of Hazards on Livelihoods 31
4.2 Quantitative and Qualitative Analysis 35
4.2.1 Demographics of Households Engaged 35
4.2.2 Economic Vulnerabilities 35
4.2.3 Climate Awareness and Perception 37
4.2.4 Household Physical Vulnerability 38
4.2.5 Household Adaptive Capacity 41
4.3 Projected Climate Trends and Implications 43
4.3.1 Projected Climate Trends 43
4.3.2 Projected Climate Change Trends and Gender Vulnerability 47
4.3.3 Projected Climate Implications on Community Vulnerability 50

5. Implications for Gender-Responsive Climate Adaptation Planning and Resilience Building 57

5.1 Economic Adaptation Strategies 57
5.2 Physical Adaptation Strategies 59
5.3 Social Adaptation Strategies 60

6. Community Specific Recommendations 63

6.1 Ave Xevi: Enhancing Livelihoods, Resilience, and Sustainability 63
6.2 Nyitawuta: Strategies for Addressing Critical Resource Challenges and Enhancing Sustainable Development 64
6.3 Avevi: Community-Led Adaptation Options to Address Water Scarcity, Economic Instability, and Environmental Challenges 65
6.4 Ave Dzadzepe: Strategies to Improve Climate Vulnerabilities and Agricultural Challenges 67
6.5 Ave Afiadenyigba: Climate Variability and Economic Challenges 67
6.6 Ave Dakpa: Community Livelihood Options and Access to Water 69

7. Institutional Capacity Building and Adaptation Policy Implications 71

7.1 Introduction 71
7.1.1 Strengthening the Enabling Environment for Climate Finance 72
7.1.2 Implementing a Gender-Responsive National Adaptation Plan 73
7.1.3 Enhancing Planning and Execution of Inclusive Projects 73
7.1.4 Collaboration Between Key Institutions and Stakeholders 74
7.2 Policy Implications 74
7.2.1 Strengthening Climate-Resilient Infrastructure and Natural Resource Management 74
7.2.2 Integrating Gender-Responsive Approaches into Adaptation Policies 74
7.2.3 Promoting Inclusive Economic Adaptation Strategies 75
7.2.4 Addressing Systemic Barriers to Resource Access 75
7.2.5 Aligning Local Adaptation Efforts with National and International Frameworks 76

8. Conclusions, Recommendations and Ways Forward 77

8.1 Conclusion 77
8.2 Recommendation 78

REFERENCES 81

List of Tables

Table 1: Communities selected for FGD and survey 20
Table 2: Population sampling for survey 22
Table 3: ETCCDI climate indices 24
Table 4: Seasonal calendar of climate induced activities 30
Table 5: Vulnerability matrix of climate impact of activities 31
Table 6: Vulnerability matrix of annual climate induced activities 33
Table 7: Distribution of respondents interviewed in each community 35
Table 8: Summary of projected climate trends in Akatsi North District 46
Table 9: Projected impacts of changing climate on changes in livelihoods and economic changes by gender from the participatory stakeholder engagement and FGDs 47
Table 10: Projected impacts of changing climate on access to resources by gender from the participatory stakeholder engagement and FGDs 48
Table 11: Projected impacts of climate change on responsibilities within households and communities from the participatory stakeholder engagement and FGDs 49
Table 12: Strategies to address economic vulnerabilities in Akatsi North District 58
Table 13: Strategies to address physical vulnerabilities in Akatsi North District 59
Table 14: Strategies to address social vulnerabilities in Akatsi North District 60
Table 15: Adaptation strategies for enhancing livelihoods, resilience, and sustainability in Ave Xevi .63
Table 16: Adaptation strategies for addressing critical resource challenges and enhancing sustainable development in Nyitawuta 65
Table 17: Community-led adaptation options to address water scarcity and environmental challenges in Avevi 66
Table 18: Adaptation strategies to improve climate vulnerabilities and agricultural challenges in Ave Dzadzepe 67
Table 19: Climate variability and economic challenges in Ave Afiadenyigba 68
Table 20: Strategies to improve community livelihood options and access to water 69
Table 21: Key actions, expected outcomes, and collaborators for strengthening the enabling environment for climate finance 72
Table 22: Key actions, expected outcomes, and collaborators for implementing a gender-responsive NAP 73
Table 23: Key actions, expected outcomes, and collaborators for enhancing planning and Execution of Inclusive Projects 73
Table 24: Strengthening climate-resilient infrastructure and natural resource management 74
Table 25: Integrating gender-responsive approaches into adaptation policies 75
Table 26: Promoting inclusive economic adaptation strategies 75
Table 27: Policy recommendations for addressing systematic barriers to resource access 76
Table 28: Aligning local adaptation efforts with national and international frameworks 76

List of Figures

Figure 1: The IPCC risk and vulnerability framework illustrating the interaction of hazards, exposure, and vulnerability in shaping climate risks, with socio-economic processes influencing overall resilience 3
Figure 2: District map of Akatsi North showing national and regional context 7
Figure 3: Average temperatures and precipitation Akatsi 8
Figure 4: Phases for the assessment process 15
Figure 5: General overview of the risk assessment process 18
Figure 6: Maps (up and down) – Visualization of critical infrastructure, key resources and vulnerable areas, Akatsi North District 25

Figure 7: Historical timeline of major events in Akatsi North 29
Figure 8: Stakeholders adaptation of the climate seasonal calendar of Akatsi North districts 29
Figure 9: Gender-differentiated annual climate induced activities 32
Figure 10: Main source of income for residents in Akatsi North District 35
Figure 11: Average monthly income 36
Figure 12: Household exposure to climate hazards 39
Figure 13: Word cloud with size should the level of sensitivity in the sector to climate hazard in Akatsi North District. Total (Green), Women (Red), Men (Blue). 40
Figure 14: Barriers to women's access to resources 43
Figure 15: Historical and projected annual mean precipitation for Akatsi North 44
Figure 16: Historical and projected climate extreme metrics across Akatsi North District 45
Figure 17: Historical and projected mean temperature for Akatsi North (four periods) 45

List of Photos

Photo 1: Only engineered dam, in Ave-Afiadenigba partly covered with plants 11
Photo 2: Photocall of participation in the first stakeholder engagement workshop at the Akatsi North District Assembly building 19
Photo 3: Image of stakeholders mapping resources and hazard-prone areas in Akatsi North 27
Photo 4: Focus group discussions in Nyitawuta 51
Photo 5: Focus group discussions in Avevi 52
Photo 6: Focus group discussions in Ave Dzadzepe 53
Photo 7: Focus group discussions in Ave Afiadenyigba 54
Photo 8: Focus group discussions in Ave Dakpa 54
Photo 9: Focus group discussions in Ave Xevi 55
Photo 10: Main community dam at Xevi, almost fully covered with plants 63
Photo 11: Only community primary school (top left), newly constructed community clinic (top right), household water from community stream (down center) 64
Photo 12: Avevi only community mechanized borehole (left). Community waste dump (right).....66
Photo 13: Only engineered dam in ANDA partially covered with water plants in Ave Afiadenyigba 68

ACRONYMS AND ABBREVIATIONS

ANDA	Akatsi North District Assembly
CDD	Consecutive Dry Days
CHIRPS	Climate Hazards Group InfraRed Precipitation with Station Data
CMIP6	Coupled Model Intercomparison Project - Phase 6
CRM	Climate Risk Management
CRVA	Climate Change Risk and Vulnerability Assessment
CSO	Civil Society Organization
CSPG	Cross Sectoral Policy Groups
CVCA	Climate Vulnerability and Capacity Analysis
CWD	Consecutive Wet Days
CWSA	Community Water and Sanitation Agency
DA	District Assembly
EPA	Environmental Protection Agency
ETCCDI	Expert Team on Climate Change Detection and Indices
FBO	Farmer Based Organization
FC	Forestry Commission
FF	Far-Future
FGD	Focus Group Discussion
FoE	Friends of the Earth
GAC	Global Affairs Canada
GEA	Ghana Enterprises Agency
GEF	Global Environmental Facility
GES	Ghana Education Service
GHS	Ghana Health Service
GIDA	Ghana Irrigation Development Authority
GIZ	*Deutsche Gesellschaft für Internationale Zusammenarbei*t (German Agency for International Development)
GoG	Government of Ghana
GPRTU	Ghana Private Road Transport Union
GSS	Ghana Statistical Service
IFAD	International Fund for Agricultural Development
IPCC	Intergovernmental Panel on Climate Change
KII	Key Informant Interview
LEAP	Livelihood Empowerment Against Poverty
LGS	Local Government Service
LI	Legislative Instrument
MASLOC	Microfinance and Small Loans Centre
MDAs	Ministries, Departments and Agencies
MF	Mid-Future
MHH	Men Households
MLGRD	Ministry of Local Government, Decentralization and Rural Development
MMDAs	Metropolitan, Municipal and District Assemblies

MoF	Ministry of Finance
MoF	Matrix of Function
MoFA	Ministry of Food and Agriculture
MoGCSP	Ministry of Gender, Children and Social Protection
MRH	Ministry of Roads and Highways
MTDP	Medium-Term Development Plan
MWRS	Ministry of Water Resources and Sanitation
NADMO	National Disaster Management Organization
NAP	National Adaptation Plan
NF	Near-Future
NGO	Non-Governmental Organization
NTC	National Technical Committee
NVTI	National Vocational Training Institute
PHC	Population and Housing Census
PWD	Person with Disability
R95p	Rainfall above the 95th percentile
RCC	Regional Coordinating Council
REP	Rural Enterprises Programme
Rx5day	Maximum 5-day precipitation
SDG	Sustainable Development Goal
SDII	Simple Daily Intensity Index
SIGRA	Strengthening Investments in Gender-Responsive Climate Adaptation
SSP	Shared Socio-Economic Pathways
TNn	Minimum daily minimum temperature
TNx	Maximum daily minimum temperature
TXn	Minimum daily maximum temperature
TXx	Maximum daily maximum temperature
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
WHH	Women Headed-Households
WIAD	Women in Agricultural 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 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 the Global Affairs Canada (GAC), under auspices of the "Strengthening Investments in Gender-Responsive Climate Adaptation" (SIGRA) project commissioned a Climate Change Risk and Vulnerability Assessment (CRVA) in the Akatsi North District of the Volta region of Ghana to support evidence-based decision making and planning in climate change adaptation at the local level. This report presents the findings of the CRVA conducted by the SIGRA project in the Akatsi North District. Climate change exacerbates vulnerabilities among marginalized groups, including women, youth, and the elderly, who depend heavily on natural resources for their livelihoods. Addressing these challenges requires a comprehensive risk assessment approach that effectively aligns local needs with climate adaptation planning. The assessment therefore examines how climate change affects different socio-economic groups in Akatsi North, with a focus on marginalized and vulnerable populations. Increasing climate threats – erratic rainfall, droughts, floods, water scarcity, bushfires, and pest infestations – are worsening agricultural challenges, food insecurity, and economic instability. Gender dynamics are central, recognizing that women, youth, the elderly, persons with disabilities (PWDs), and migrant communities experience climate risks differently due to systemic inequalities. Women often bear greater caregiving and food security burdens, while youth face migration pressures from declining rural job opportunities. Using a socially inclusive and gender-responsive approach, the assessment informs equitable climate adaptation policies at district and national levels. Aligned with Ghana's National Adaptation Plan (NAP) and global resilience frameworks, the SIGRA project provides localized insights into vulnerability and adaptation, strengthening climate action planning in Akatsi North.

District Profile

Akatsi North District is located within the coastal savannah equatorial climate zone in Ghana's south-eastern Volta Region. The district is predominantly rural and heavily dependent on agriculture (agriculture accounts for 60.2% of employment, followed by services - 28.1% and industry - 11.7%), with 67% of the population engaged in farming. Poverty remains widespread, particularly among agricultural households, due to limited economic diversification and scarce employment opportunities outside farming. Structural challenges in education, healthcare, water access, and economic participation disproportionately affect women and marginalized groups. The district faces increasing climate variability, highlighting the urgent need for adaptive strategies to strengthen water resource management and agricultural resilience.

Methodology

The CRVA applied both qualitative and quantitative methods to analyze climate risks and vulnerabilities in 10 communities across Akatsi North District. Household surveys collected data on livelihoods, climate risks, and adaptation strategies, while Focus Group Discussions (FGDs) engaged women, youth, migrants, and persons with disabilities (PWDs) to capture social disparities. There were further engagements with local authorities, agricultural officers, and community leaders to provide institutional perspectives on climate adaptation efforts. Field observations assessed environmental conditions such as soil erosion, water accessibility and land degradation, offering real-time insights into local vulnerabilities. Additionally, secondary data reviews aligned local findings with national climate projections and policy frameworks, ensuring the assessment contributes to evidence-based climate adaptation planning and action in Akatsi North District.

Key Findings

Climate Hazards and Community Vulnerability

The risk and hazard assessment in Akatsi North District reveals significant environmental vulnerabilities, including flood-prone areas in communities such as Ave Dzadzepe, Ave Havi, Nyitawuta, and Ashiagborvi, as well as widespread bushfire risks in Zemu and Agormor. Severe drought conditions in

Kpegbedza disproportionately affect women due to their roles in water collection and food security. Agricultural productivity is further threatened by pest infestations, particularly from fall army worms and termites, leading to income losses and heightened food insecurity.

Critical infrastructure – including the Ave Dakpa Dam, schools, healthcare facilities, markets, and transportation networks – faces increasing climate risks, necessitating resilient planning. Recurrent floods, droughts, erratic rainfall, and extreme heat disrupt agriculture, the district's primary economic activity, while also straining water resources, health services, and infrastructure. The absence of early warning systems further exacerbates household vulnerability, with nearly all respondents reporting a lack of advance warnings. These findings underscore the urgent need for adaptive strategies to enhance community resilience and safeguard livelihoods.

Economic Vulnerabilities

Economic vulnerability is a critical challenge, significantly limiting households' ability to adopt climate-resilient practices. Many families struggle to afford essential infrastructure improvements, modern agricultural technologies, or alternative livelihood options, leaving them highly exposed to climate risks. Limited access to credit, high input costs, and fluctuating market prices further constrain their adaptive capacity. Additionally, economic and social inequalities – such as disparities in land ownership, access to financial services, and employment opportunities – exacerbate vulnerability. With most households earning minimal incomes, their capacity to invest in long-term climate adaptation strategies remains severely restricted, increasing their dependence on subsistence farming and making them more susceptible to climate shocks.

Physical Vulnerabilities

The district faces significant infrastructural deficits, including poor road networks, inadequate healthcare services, and insufficient communal water systems, all of which exacerbate its vulnerability to climate change. Poorly maintained roads limit access to markets, healthcare, and other essential services, constraining economic opportunities and emergency response efforts. Inadequate health facilities and water supply systems further weaken the community's ability to cope with climate-related health risks, such as waterborne diseases and heat stress. These infrastructural weaknesses highlight the urgent need for investments in resilient infrastructure that can withstand climate shocks, enhance service delivery, and strengthen the district's overall adaptive capacity.

Social Vulnerabilities

The gender-sensitive vulnerability analysis highlighted significant gender-differentiated risks in Akatsi North District, driven by climate change and deepened by socio-economic and infrastructural barriers. Female-headed households, in particular, face multiple challenges, including restricted access to land, credit, agricultural inputs, and extension services. These limitations are further reinforced by social norms, legal barriers, and economic constraints, reducing their ability to adopt climate-resilient practices. Additionally, women bear a disproportionate burden in household water collection, food security, and caregiving, increasing their exposure to climate-related hardships. This disparity underscores the urgent need for gender-responsive adaptation strategies that enhance women's access to resources, strengthen their resilience, and promote meaningful participation in decision-making processes at both community and policy levels.

Projected Climate Trends and Future Risks

Future climate projections for Akatsi North indicate shifting rainfall patterns, rising temperatures, and increasing climate variability. Historical rainfall data show significant fluctuations, while future scenarios, particularly under high emissions, suggest drier conditions with prolonged dry spells and fewer intense rainfall events. Temperatures are expected to rise steadily, with accelerated warming toward the end of the century, increasing heat stress and reducing agricultural productivity. These changes will further strain water availability, food security, and livelihoods, disproportionately affecting women, youth, and other vulnerable groups. Urgent adaptation measures are needed to build resilience against these evolving climate risks.

Conclusions and Recommendations

Understanding vulnerabilities to both climatic and non-climatic stressors is crucial to ensuring that adaptation actions do not inadvertently increase risks. This assessment highlights several interconnected challenges that shape Akatsi North District's capacity to adapt to climate change.

A socially inclusive and gender-responsive adaptation approach in the district integrates economic, social, and physical strategies to enhance resilience, particularly for marginalized groups such as women, youth, and persons with disabilities.

Economic strategies focus on diversifying income sources through climate-smart agriculture, vocational training, improved access to financial services, and promoting women's entrepreneurship to enhance economic independence. Economic strategies that address income inequality, improve access to affordable adaptation technologies, and diversify livelihoods for the district's long-term sustainability and resilience are recommended.

Social adaptations emphasize inclusive governance, ensuring women's active participation in decision-making, and strengthening community networks such as women's and youth groups to foster collective action.

Physical strategies aim to improve access to climate-resilient infrastructure, including durable housing, better road networks, and reliable water systems, reducing vulnerabilities and ensuring equitable access to essential resources.

Overall, the findings stress the need for a comprehensive and inclusive approach to climate adaptation in Akatsi North, one that addresses gender inequality, economic vulnerability, and infrastructural deficits while fostering long-term resilience across all sectors of society.

1. Introduction

1.1 Project Background

In support of Ghana's 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 Planning (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 a 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 demonstrate 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 their 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 does not only enhance understandings around gender-responsive adaptation planning, but also, and perhaps more importantly, they facilitate 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 (Manteaw 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 learning process, which requires intentional processes that creates 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. And, the logical process is that this work – CRVA – as has been completed for the Akatsi North 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 Assessments provide an effective means of evaluating the socio-economic and physical impacts of climate change on populations and ecosystems. This study integrates frameworks developed by the IPCC and CARE International, to ensure a comprehensive approach. The IPCC framework offers a theoretical basis for analyzing climate risks, emphasizing the interaction between hazards, exposure, and vulnerability. In contrast, the CARE International framework prioritize the application of practical tools and participatory methods, focusing on socio-economic and gender-specific vulnerabilities within communities. This combined approach ensures both a robust theoretical foundation and actionable insights, making the assessment relevant for addressing localized climate challenges and fostering inclusive adaptation strategies 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

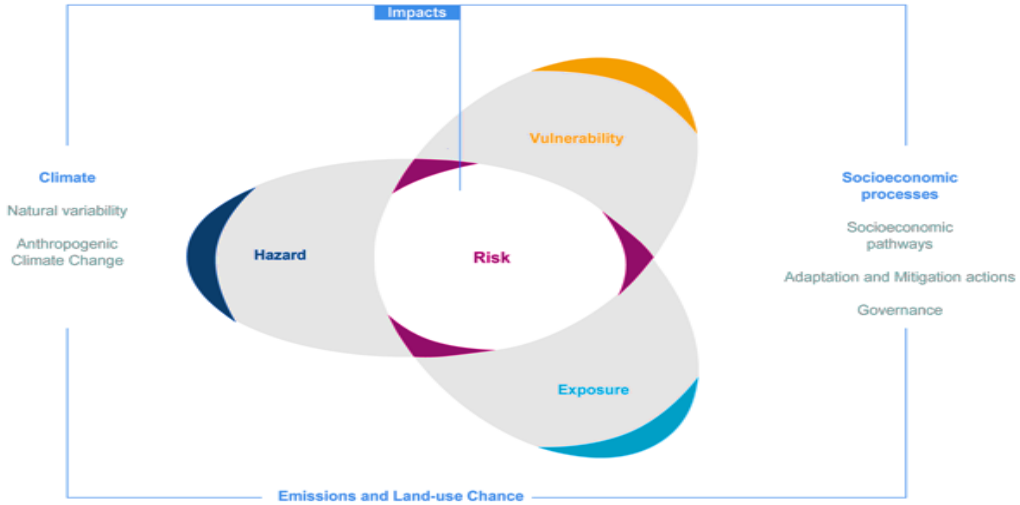
The IPCC Risk and Vulnerability Framework evaluates climate change risks through the interconnected components of hazards, exposure, and vulnerability (**Figure 1**) (IPCC, 2022). Hazards refer to climate-related events such as prolonged droughts or erratic rainfall. Exposure highlights the presence of people, ecosystems, and resources in areas affected by these events, while vulnerability reflects the susceptibility of individuals and systems to harm. This susceptibility is shaped by factors such as social inequality, limited access to resources, and inadequate adaptive capacity.

The framework underscores that climate risk is not solely determined by the severity of hazards but is significantly influenced by socio-economic conditions that shape exposure and vulnerability. In Akatsi North, for example, limited access to clean water, systemic challenges like restricted land ownership rights for women, and weak infrastructure amplify vulnerabilities to drought and water scarcity. These socio-economic factors constrain the district's ability to adapt to climate shocks.

The IPCC's concept of interconnected risks is particularly relevant in Akatsi North. For instance, prolonged droughts not only reduce water availability but also lower agricultural productivity, intensify food insecurity, and increase the burden on women to secure water. This additional burden limits women's ability to participate in productive economic activities, creating a cycle of cascading impacts that further deepens vulnerability.

The IPCC framework provides a critical lens for analyzing these complex dynamics in Akatsi North, offering a structured approach to assess hazards, exposure, and vulnerability. By doing so, it guides the development of holistic and inclusive adaptation strategies that address both immediate climate risks and underlying socio-economic inequalities, fostering resilience and sustainable development in the district.

Figure 1: The IPCC risk and vulnerability framework illustrating the interaction of hazards, exposure, and vulnerability in shaping climate risks, with socio-economic processes influencing overall resilience



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 Akatsi North, for instance, participatory mapping could reveal that women's reliance on rain-fed agriculture heightens their vulnerability to drought. FGDs could provide valuable insights into local coping mechanisms, such as the adoption of drought-resistant crops or water conservation practices.

A core focus of the CVCA approach is enhancing adaptive capacity through community-driven solutions. In Akatsi North, 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 ensures 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 (GEF), 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 measure, promoting equitable access to resources and actively involving women in climate governance. The Climate Risk Management (CRM)

methodology it developed combines advanced tools, such as climate modelling and hazard mapping, with participatory techniques to ensure adaptation strategies are tailored to local needs and realities.

Rapid climate risk assessments at the district level are essential for designing adaptation strategies that address local realities. By integrating gender perspectives, these assessments ensure that the unique needs, vulnerabilities, and contributions of all community members particularly women and marginalized groups are recognized and addressed.

This localized approach directly supports the objectives of the Strengthening Investments in Gender-Responsive Climate Adaptation (SIGRA) initiative, which prioritizes equitable access to resources, inclusive decision-making, and sustainable development. By aligning adaptation measures with these principles, district-level assessments provide a strong foundation for targeted, socially equitable strategies that enhance resilience across both community and district levels.

1.3 Study Aims and Objectives

1.3.1 Study Aim

This assessment explores the gender-specific dimensions of climate vulnerability in Akatsi North District - in Ghana's Volta Region. It aims to identify strategies that strengthen community resilience while embedding equity and inclusiveness in climate adaptation efforts. By integrating local insights with global adaptation priorities, the study addresses the unique challenges faced by diverse community groups, particularly women and marginalized populations.

The assessment aligns with key international frameworks that underscore the synergy between gender equity and climate resilience. Sustainable Development Goal (SDG) 5 on Gender Equality emphasizes eliminating gender disparities and empowering women to lead in climate adaptation and resilience building while likewise, SDG 13 on Climate Action highlights the urgency of developing adaptive strategies that safeguard the most vulnerable against climate risks. Together, these goals provide a strategic lens for promoting inclusive, gender-responsive adaptation planning to be applied in Akatsi North District, ensuring that no group is left behind in the pursuit of sustainable development and resilience.

1.3.2 Specific Objectives

- ***Examine Climate Vulnerabilities*:** Assess the vulnerabilities and risks specific to men, women, and marginalized groups in the Akatsi North District. This objective highlights how socio-economic and environmental factors intersect gender to shape exposure and sensitivity to climate impacts.
- ***Identify Gender Gaps*:** Highlight disparities in access to critical resources, climate information, and decision-making processes, which hinder equitable participation in adaptation efforts.
- ***Develop Actionable Solutions:*** Provide evidence-based recommendations for gender-responsive adaptation policies and interventions. These solutions aim to enhance resilience, promote social equity, and address the district's specific needs.

1.4 Document Purpose

The Climate Change Risk and Vulnerability Assessment (CRVA) for Akatsi North District is designed to identify, analyze, and prioritize the gendered perspective of climate vulnerability within the 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 climate vulnerability assessment involved consultation with communities, women, and vulnerable groups to incorporate their adaptation needs. The assessment incorporates local knowledge through a systematic evaluation of the district's climate risks and climate change impacts, emphasizing the integration of hazard, exposure, and vulnerability components as per the AR5 framework adopted from the IPCC. 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 Akatsi North 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 Akatsi North 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 Akatsi North 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. Akatsi North District Profile

2.1 Geography and Climate-Related Profiles

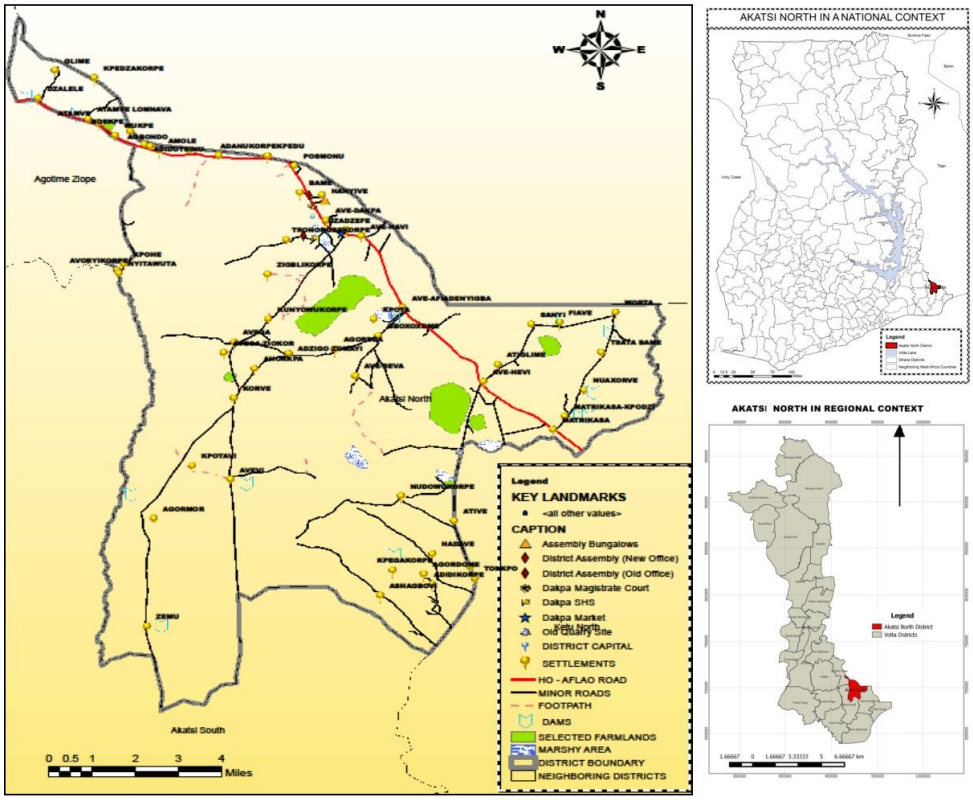
2.1.1 Location and Size

The Akatsi North District, located in the southeastern part of Ghana's Volta Region, is one of 18 administrative districts in the region. Established in 2012 under Legislative Instrument (LI 2161) following its separation from the former Akatsi District Assembly, the district has Ave-Dakpa as its administrative capital, facilitating local governance and development (MTDP 2022-2025). Spanning approximately 324 square kilometres, the district lies between latitudes 6°S–7°N and longitudes 0°W–1°E. It is situated within the coastal savannah equatorial climate zone, bordered by the Agortime Ziope District and the Republic of Togo to the north, Akatsi South and Ketu North Districts to the south, the northern part of Akatsi South District to the east, and the southern portion of the Republic of Togo to the west (ANDA, 2023).

2.1.2 Physical and Environmental Features

The Akatsi North District in Ghana's southeastern Volta Region is predominantly rural, with key population centers in Ave-Dakpa and Xevi. Limited infrastructure, with only one first-class road (connecting Ho-Dakpa-Denu Road), hinders accessibility. The district features diverse water bodies, including the Lotor and Tordzie rivers, supporting its drainage system. Its terrain comprises coastal savannah soils, laterites, and tropical black soils, supporting various agricultural activities (MTDP 2022-2025). Geologically, the district lies primarily within the acidic gneiss belt, with soils ranging from well-drained sandy loams to poorly drained clays. These support diverse land uses, including arable farming, sugarcane production, and livestock grazing. Demographically, the district has a 2.6% annual growth rate, with most settlements remaining rural and reliant on natural resources for livelihoods (GSS, 2014). These physical and environmental features highlight the district's potential for agriculture and its dependence on sustainable resource management for development.

Figure 2: District map of Akatsi North showing national and regional context



Source: Akatsi North District DPU and MTDP (2022-2-25)

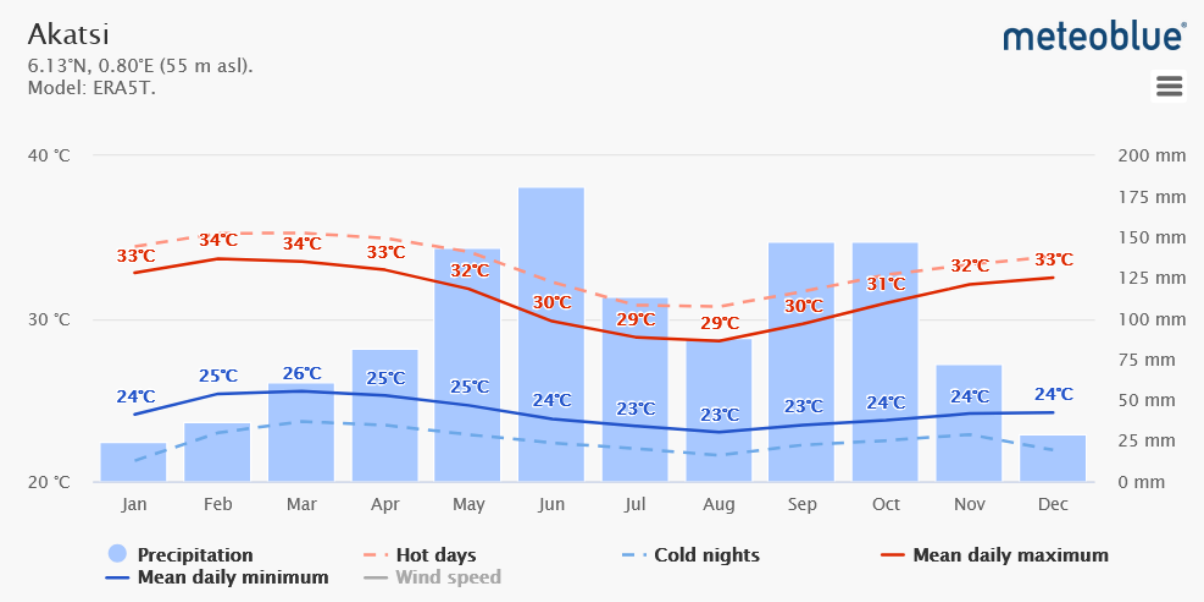
2.1.3 Topography and Climate

According to the district's Climate Change Implementation Report 2022-2023 (ANDA, 2023), Akatsi North District features a gently undulating landscape with elevations ranging from 10 to 50 meters above sea level. Approximately 60% of the district lies below the 100-foot contour line, reflecting a predominance of low-lying areas within the coastal plain. In contrast, the northern regions rise to over 200 feet, introducing variations in landforms and influencing land use, drainage, and socio-economic activities. These topographical differences are integral to the district's environmental and developmental dynamics.

Situated in the coastal savannah equatorial climatic zone, Akatsi North experiences high temperatures ranging from 21°C to 34.5°C, a relative humidity of 85%, and a moderate-to-low annual rainfall of 1,084 millimetres. The district has distinct wet and dry seasons, each lasting approximately seven months. Vegetation transitions from coastal savannah in the south to savannah woodland in the north, featuring grasses interspersed with scattered trees and limited forest grasslands. As highlighted in the district's analytical report, this vegetation supports animal husbandry and forms the basis for many of the district's agricultural and ecological activities (GSS, 2014).

Figure 3 presents historical climate data for Akatsi, detailing temperature patterns, rainfall distribution, and seasonal trends over the past 30 years. This data provides valuable insights into the district's climate dynamics and their implications for livelihoods, particularly in agriculture and water resource management.

Figure 3: Average temperatures and precipitation Akatsi



Source: [Metroblue, Akatsi (2024)]

Temperature trends reveal consistently high temperatures year-round. Mean daily maximum temperatures range from 29°C in August, coinciding with the rainy season, to a peak of 34°C in February and March, the hottest months of the year. Mean daily minimum temperatures show relatively minor fluctuations, ranging from 23°C to 25°C, with the coolest periods occurring in August. Hot days, representing the highest recorded temperatures, align closely with the trend of mean maximum temperatures, peaking at 34°C in February and March. Similarly, cold nights, reflecting the lowest recorded temperatures, remain consistent with the mean minimum, hovering between 23°C and 24°C throughout the year. These temperature variations and seasonal trends are critical for assessing the district's vulnerability to climate-related challenges and guiding the development of targeted adaptation strategies (MTDP 2022-2025).

Precipitation in Akatsi North District exhibits a clear seasonal pattern, with the wettest months occurring between April and October. Rainfall peaks in June, exceeding 175 mm, signalling the height of the rainy season. In contrast, the dry season spans from November to February, during which monthly

precipitation falls below 25 mm. This combination of high temperatures and minimal rainfall during the dry months heightens the risk of heat stress and water scarcity, creating significant challenges for households and agricultural activities reliant on consistent water availability. Seasonal patterns highlight a marked distinction between the district's dry and wet periods. The dry season, characterized by minimal rainfall and elevated temperatures, occurs from November to February, when mean daily maximum temperatures are at their highest. Conversely, the rainy season moderates temperatures, with August standing out as the coolest month due to high rainfall and increased cloud cover. This interplay between temperature and precipitation underscores the critical need for adaptive strategies to address water resource management and agricultural resilience in the district (MTDP 2022-2025).

2.2 Demographics and Gender Characteristics

According to the 2021 Population and Housing Census (GSS, 2021), Akatsi North District has a population of 32,755, with females (53.5%) outnumbering males (46.5%). The district exhibits a youthful demographic, with over 24% of the population in the 0–9 age group. While males dominate younger age brackets, females are more prevalent in older age groups, reflected in a sex ratio of 84.8 males per 100 females. The dependency ratio stands at 56.4, higher among males, emphasizing the economic challenges of a youthful and dependent population.

Literacy levels for those aged 11 and older are 66.8%, with notable gender disparities—68.0% of males are literate compared to 50.9% of females. School attendance patterns also reveal inequities, with females more likely to have never attended school. The district covers 324 km², with a population density of 101 persons per square kilometre (GSS, 2021). The population is predominantly Ewe (94.8%), with Christianity being the primary religion (64%), followed by traditional beliefs (19.2%) and Islam (6%).

Agriculture dominates employment (60.2%), followed by services (28.1%) and industry (11.7%), reflecting the district's reliance on primary economic activities (GSS, 2021). These demographics — educational, and employment, trends underscore the importance of targeted interventions to address gender disparities and support inclusive development.

2.2.1 Key Economic Activities in the District

The Akatsi North District depends predominantly on agriculture, with 67% of the population engaged in farming activities (ANDA, 2014). Among 6,712 farming households, 83.9% focus on crop production, while 36.1% also rear livestock, primarily chickens, goats, cattle, and sheep (GSS, 2014). Tree planting and fish farming remain minimal but present untapped opportunities to combat deforestation and enhance food security. Fish farming, in particular, is identified by the Ghana Statistical Service as a promising economic activity (GSS, 2014).

Agricultural practices are mainly smallholders and subsistence-based, with families producing crops like cassava, sweet potatoes, maize, pineapples, and tomatoes for consumption and local market sales (ANDA, 2023). Beyond agriculture, employment exists in mining, quarrying, construction, manufacturing, and services.

Despite its agrarian economy, multidimensional poverty affects 39.3% of the population, making Akatsi North the poorest district in the Volta Region and ranking it 212th out of 261 districts nationally (GSS, 2021). Employment opportunities are limited, with the district's economy primarily agrarian. However, poverty rates are highest among agricultural workers, with 40.9% of such households affected, compared to 26.2% in industry and 14% in services (GSS, 2021), limited education and health facilities. Market hubs like Dakpa and Xevi facilitate trade in crops such as maize, yams, and vegetables, but these markets lack permanent infrastructure, relying on temporary sheds. Addressing these limitations could improve agricultural productivity, reduce poverty, and bolster the district's economy.

2.2.2 Observed Gender Gaps in the Akatsi North District

The Akatsi North District faces significant gender disparities across key socio-economic, cultural, and political spheres. During in-person engagements at the district level as well as a review of the 2022-2025 Medium Term Development Plan for the district, it was observed that these inequalities are evident

in areas like education, healthcare, agriculture, and participation in Community-Based Organizations (CBOs). This highlights persistent structural and societal barriers that limit opportunities for women and marginalized groups as presented below.

2.2.2.1 Education

The education sector in Akatsi North District faces substantial challenges, particularly in providing access to secondary and vocational education (MTDP 2022-2025). Many young people, especially girls and young persons with disability struggle to continue their studies beyond the basic level. Limited educational opportunities restrict access to higher-paying jobs and essential skills development (Schultheiss et al., 2023). The lack of vocational training centres further exacerbates this issue, leaving youth without the means to engage in sustainable economic activities. Cultural and financial barriers, particularly for girls, contribute to this disparity, reinforcing the gender gap in educational attainment and limiting opportunities for economic empowerment.

2.2.2.2 Health

Healthcare accessibility in Akatsi North is a critical issue, with the absence of a hospital forcing residents to travel to neighbouring districts for medical care (MTDP 2022-2025). A lack of proximity to healthcare services disproportionately impacts women and children, who are more vulnerable to health challenges such as maternal and child health complications. The delayed access to emergency care often results in preventable illnesses and fatalities. Furthermore, the district faces significant healthcare infrastructure challenges, including shortage of trained medical personnel and essential supplies, which exacerbates the health risks and limits the overall well-being of the population. Addressing these gaps is vital for improving health outcomes and supporting community resilience.

2.2.2.3 Water and Sanitation

Access to clean water is one of the most critical issues in Akatsi North (MTDP 2022-2025). Many residents rely on rainwater harvesting, which is often insufficient, or travel long distances to reach dams. However, these dams are frequently overgrown with plants and sand, reducing the availability of clean water for household consumption, crop irrigation, and livestock. Women and girls bear the brunt of this challenge, as they are typically responsible for fetching water, which takes up significant time and effort. The lack of reliable water sources also impacts sanitation and hygiene, contributing to the spread of waterborne diseases.

2.2.2.4 Agriculture and Economic Participation

Agriculture is the primary economic activity in Akatsi North, but systemic barriers, particularly gender-based challenges, hinder many residents, especially women from fully participating and thriving in the sector (MTDP, 2022-2025). Women often face limited access to land, credit, and agricultural inputs, restricting their ability to transition from subsistence farming to more profitable and sustainable ventures. This gender disparity in resource access limits economic opportunities and perpetuates poverty. Furthermore, the lack of modern farming techniques and essential infrastructure, such as irrigation systems and storage facilities, negatively impacts agricultural productivity, income generation, and food security. Addressing these barriers is essential to promote inclusive economic growth and enhance resilience within the district.

2.2.2.5 Sociocultural Norms

Community participation and decision-making processes in Akatsi North are predominantly dominated by men, due to the strong influence of traditional sociocultural norms. Women are frequently excluded from leadership roles and governance structures, which limits their ability to advocate for their needs and priorities. This exclusion not only undermines gender equality but also affects overall development outcomes. Women's perspectives and contributions are crucial to addressing key issues such as education, healthcare, and agriculture. Ensuring women’s active participation in decision-making processes is essential for more inclusive and effective development strategies that address the diverse needs of the communities.

2.3 Critical Climate-Related Hazards in Akatsi North District

This assessment highlights three key climate-related hazards in Akatsi North District: water scarcity, flooding, droughts and wildfires. These hazards are closely linked to the district's socio-economic challenges, highlighting vulnerabilities, especially among marginalized groups such as women and smallholder farmers. The impact of these climate risks exacerbates existing inequalities and poses significant challenges to the district's resilience and development efforts.

2.3.1 Water Resources

The district faces persistent water scarcity, worsened by high temperatures and climate-related hazards (ANDA, 2023). As temperatures rise, evaporation rates increase, reducing the availability of surface water, which is essential for household, agricultural, and livestock use (Keeton et al., 2022). This intensified evaporation, combined with pollutants accumulating in shrinking water bodies, leads to degraded water quality (Williams et al., 2017). This not only affects health but also diminishes the ability of smallholder farmers, particularly women, to use water for crop irrigation and livestock, further impacting food security and livelihoods.

Flooding also introduces pollutants into water sources, compounding the quality issues and posing additional health risks (Ayamga et al., 2021). Women, being the primary water gatherers, are particularly vulnerable to waterborne diseases, which are more likely to spread when sanitation and water infrastructure are inadequate. Furthermore, these compounded water issues negatively impact agricultural productivity, which is a vital source of income for many households, especially for female farmers who face challenges in accessing land and resources for more productive agricultural ventures (Williams et al., 2017).

In Akatsi North, the effective management of water resources is crucial to ensuring the availability and quality of water, particularly given the challenges posed by flooding and climate variability (Keeton et al., 2022). These water-related issues disproportionately affect women, who are primarily responsible for water collection in the district (ANDA, 2023). Inadequate water supplies and poor water quality exacerbate the burden on women, who often must travel long distances to fetch water, leaving them with less time for other critical activities such as education and income generation. These highlight the need to address water challenges in a gender-sensitive approach that ensures women's needs and contributions are considered to improve both water accessibility and quality, easing the burden on women and contributing to the broader goal of sustainable development in the district.

Photo 1: Only engineered dam, in Ave-Afiadenigba partly covered with plants

Source: District Stakeholder Survey, September 2024

2.3.2 Flooding

Flooding is a significant environmental issue in Akatsi North, exacerbated by the increasing intensity and frequency of rainfall linked to climatic variability (ANDA, 2023). Rapid infrastructure development without proper planning has contributed to poor drainage systems, further amplifying the district's vulnerability to flooding. Additionally, factors such as deforestation and agricultural expansion have disrupted natural water flow patterns, making the area even more prone to floods (Awuni et al., 2023).

The impact of flooding in Akatsi North affects various aspects of daily life, with agriculture—one of the largest employment sectors in the district—being particularly vulnerable. Variability in rainfall patterns negatively affects crop production, threatening the livelihoods of many, especially smallholder farmers (Williams et al., 2017), including women, who have limited access to resources like land and agricultural inputs. These disruptions in agriculture can lead to economic insecurity (Amankwaa and Gough, 2023) disproportionately impacting female-headed households that rely more heavily on farming for their income.

In addition to agricultural impacts, the social consequences of flooding include shifts in land tenure and migration patterns (Yiran et al., 2024; Amankwaa and Gough, 2023) which can affect women's access to land and resources, given the gender disparities in land ownership and control. The rising temperatures and frequent droughts also increase the risk of bushfires and environmental degradation, compounding the challenges faced by women, who are often tasked with collecting firewood and managing household resources.

Infrastructure is particularly vulnerable during floods, with roads, bridges, and buildings frequently suffering significant damage. This disruption severely affects access to essential services, transportation, and markets, making it more difficult for women to engage in economic activities or access healthcare and education. Health risks, particularly from waterborne diseases such as cholera and dysentery (Iqbal et al., 2023), are heightened, and women, as primary caregivers, bear the brunt of these health challenges, often managing the care of sick family members under challenging circumstances.

Furthermore, 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 gender-based violence and reduced access to basic necessities (ANDA, 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.

2.3.3 Drought

The Akatsi North District, situated in one of Ghana's drought-sensitive zones, is particularly vulnerable to climate change-induced droughts, which threaten agricultural productivity, the region's economic backbone (Armah & Odoi, 2010). The heavy dependence on agriculture makes the district's economy highly vulnerable to the impacts of drought, as crop yields, loss of livestock, and a decline in agricultural productivity can be severely affected (ANDA, 2023). Droughts disrupt crop yields, livestock, and overall productivity, impacting households reliant on agriculture for survival. Women, as primary caregivers and farmers, face added burdens due to limited access to water for irrigation and household use, which exacerbates their vulnerability during droughts (USAID, 2011). Lack of reliable water sources for both domestic use and irrigation intensifies the impact.

The district's poor access to safe water, with 35.8% relying on unimproved drinking water sources (GSS, 2021), intensifies water scarcity during droughts, disproportionately affecting women and children who are often tasked with water collection. The inadequate infrastructure, with 46.0% of households living in substandard housing (GSS, 2021), further exacerbates vulnerabilities, particularly for women and children, who are more likely to be affected by harsh environmental conditions.

2.3.4 Wildfires

Akatsi North District is highly vulnerable to wildfires, which pose a significant threat to its agrarian economy (ANDA, 2023). Agriculture is the district's primary livelihood, and wildfires caused extensive damage to crops, livestock, and natural resources, increasing food insecurity and economic instability

(Kala 2023). Women, who play a central role in agriculture and household management, are disproportionately impacted as their work in crop cultivation, food processing, and water collection is disrupted. The loss of resources also increases their workload as they must find alternative means of sustenance and income (Kala 2023).

The environmental impacts of wildfires, such as soil erosion and reduced fertility, also affect women more acutely, as they are often responsible for managing household food security. These ecological consequences compound the district's challenges in maintaining sustainable agriculture and protecting natural resources.

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3. Methodological Framework

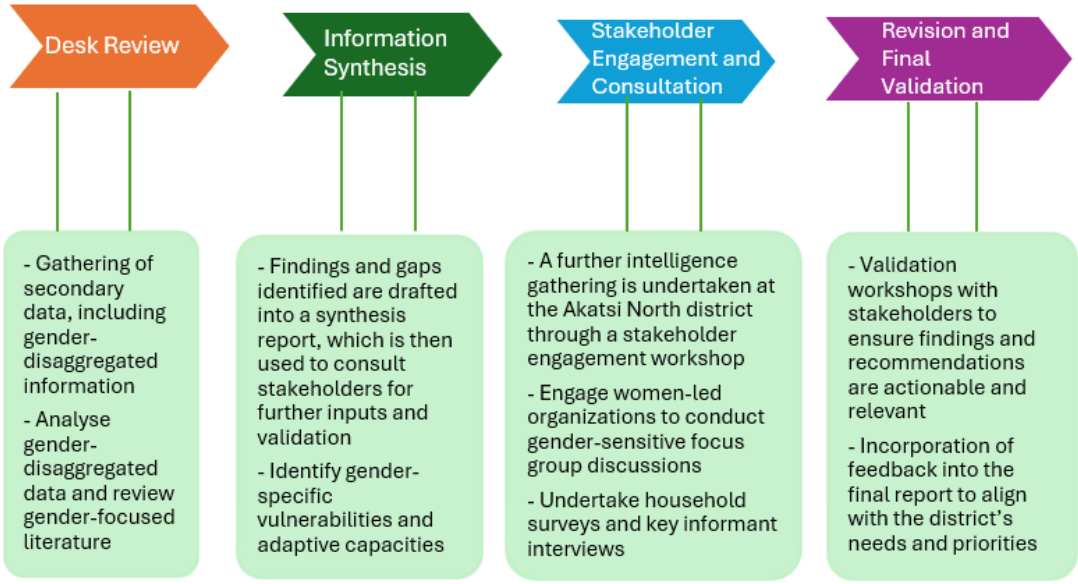
3.1 Introduction

This section outlines the methodological framework used to assess climate vulnerability in Akatsi North District.

3.2 Assessment Process

The methodology employed included a combination of qualitative and quantitative methods to comprehensively identify climate-related risks, vulnerabilities, and adaptive capacities. The assessment followed a structured four-phase process **(Figure 4)**:

Figure 4: Phases for the assessment process



3.2.1 Desktop Review

The methodology was designed to 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 (KII), 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.

3.2.2 Information Synthesis

The synthesis phase consolidated findings from the desktop review with secondary data from national and district sources to refine the assessment approach. It provided a comprehensive view of climate risks and adaptive capacities, with a strong focus on gender and socio-economic factors. A preliminary risk analysis identified key climate threats, vulnerable sectors, and affected populations, highlighting disparities across different groups. This phase also involved preparing a fieldwork strategy to address data gaps and validate early findings, with an emphasis on capturing gender-specific vulnerabilities through inclusive, participatory community engagement.

3.2.3 Stakeholder Consultation

The stakeholder consultation process used a structured participatory approach to ensure inclusivity and responsiveness to those most affected by climate change. It began with a workshop where findings from the desktop review were shared, followed by participatory exercises like resource and hazard mapping, seasonal calendars, and historical timelines. These activities deepened understanding of local challenges and informed gender-focused focus group discussions in ten communities, involving women, youth, migrants, and persons with disabilities. Household surveys gathered quantitative data on vulnerabilities, resource access, and adaptation practices, with attention to gender roles in areas like water, food, and livelihoods. Key informant interviews with local officials and community leaders added expert perspectives on risks, adaptation efforts, and institutional barriers, with gender inclusivity at the core of the process.

3.2.4 Revision and Final Validation

The final phase focuses on validating and refining the findings to ensure they are accurate, relevant, and aligned with the needs of Akatsi North District. A draft report has been 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 will be held to review and provide feedback. This feedback will be integrated into the final report, which will then undergo a final validation to ensure it reflects local realities and supports effective climate adaptation planning in the district.

3.3 Gender-Sensitive Climate Risk Assessment Methodology

The methodology for the Climate Change Risk and Vulnerability Assessment in Akatsi North District, adapted from frameworks such as Norman et al., (2014), follows a comprehensive three-stage process that integrates a gender-responsive approach to effectively assess and address the district's climate vulnerabilities (**Figure 5**). The methodology was designed to 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 first stage focused on gaining a thorough understanding of the climate and socio-economic landscape of Akatsi North District through a comprehensive desktop review. This phase was crucial in identifying the district’s specific environmental, social, and economic factors that contribute to its vulnerability to climate change. Key activities included:

- **Collecting Gender-Sensitive Data:** Secondary data, including climate models, weather patterns, socio-economic reports, and gender-focused studies, were gathered to form a solid base for the assessment. Special attention was given to understanding how climate risks differently affect women, youth, and marginalized groups.

- **Assessing Climate Risks:** The review looked into past and current climate impacts, such as droughts, floods, and heatwaves, and their effects on different groups, particularly focusing on gendered impacts. For instance, it was found that water scarcity places an extra burden on women, who are primarily responsible for collecting water for their households.

- **Understanding Socio-Economic and Gender Factors:** The review examined how factors such as income inequality, limited access to resources, and exclusion from decision-making processes exacerbate the vulnerability of women and marginalized groups to climate change.

- **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 the lived 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

In the second stage, the risks identified were thoroughly evaluated to understand their potential impacts and likelihood. 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:

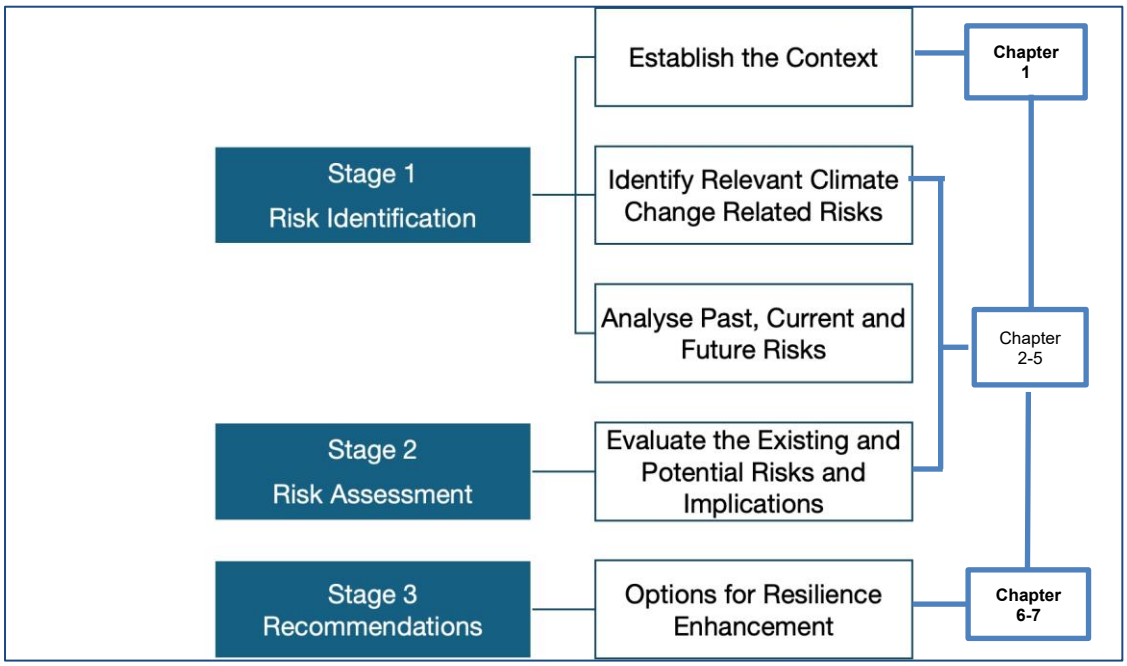
- **Engaging Stakeholders:** Consultations were designed to be inclusive, using tools like focus group discussions (FGDs), and household surveys. Separate sessions were held for women, youth, and other vulnerable groups to ensure their perspectives were heard. For example, women-led FGDs provided valuable insights into how climate risks, such as poor crop yields, affect food security and increase caregiving responsibilities during extreme weather events.
- **Evaluating Gendered Risks:** Risks were assessed based on their severity, likelihood, and impact on different demographic groups. For instance, droughts were found to have a particularly harsh effect on women due to their reliance on rain-fed farming and limited access to alternative income sources.
- **Prioritizing Risks:** Risks were ranked according to their potential for severe outcomes, the costs of adaptation, and the district's ability to address them. Gender-specific vulnerabilities were considered such as reduced mobility during floods.

3.3.3 Stage 3: Adaptation Action Plan

The final stage focused on creating a gender-responsive Adaptation Action Plan specifically designed for Akatsi North District. This plan aimed to reduce climate vulnerabilities, strengthen adaptive capacity, and promote gender equality. Key components included:

- **Strategic Interventions:** The action plan proposed a combination of infrastructure upgrades, community-driven initiatives, and capacity-building programs. Examples included the construction of water systems that cater to women’s needs, promoting climate-resilient farming practices, and offering training programs for women on climate-smart agriculture.
- **Inclusive and Participatory Planning:** The plan was developed using input from the desktop review, stakeholder consultations, and expert analysis to ensure it was balanced. Women and youth were key in shaping proposals, such as the development of early warning systems that address their specific needs.
- **Addressing Gender Inequities:** The plan placed strong emphasis on reducing gender disparities by improving women’s access to financing for climate adaptation, ensuring their inclusion in decision-making processes, and empowering women-led organizations to take the lead on adaptation projects.
- **Aligning with Development Goals:** The action plan aligned with both national and international goals, including SDG 5 (Gender Equality) and SDG 13 (Climate Action), by promoting inclusive strategies that address systemic inequalities and enhance resilience for all community members.

Figure 5: General overview of the risk assessment process



Source: Adapted from Norman et al., 2014

3.4 Data Collection Approaches

3.4.1 Workshop and Participatory Exercises

Stakeholder engagements in 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 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 Akatsi North'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, the media, and other local stakeholders.

Photo 2: Photocall of participation in the first stakeholder engagement workshop at the Akatsi North District Assembly building

To promote interactive learning and active stakeholder engagement, the workshop incorporated several participatory activities. These exercises were designed to enable participants to collectively explore vulnerabilities, assess climate risks, and visualize potential impacts. Activities included mapping of the most vulnerable and at-risk locations, hazard identification and prioritization, resource identification, a historical timeline of climate impacts, seasonality calendars, a matrix of function analysis for climate hazards, and a participatory selection of communities to include in a representative survey for gathering quantitative data on climate hazards and vulnerabilities in the Akatsi North District. A dedicated session on Gender-Responsive Adaptation was also included, highlighting the differential impacts of climate change on men and women. This session emphasized the critical importance of incorporating gender considerations into effective adaptation planning.

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 Akatsi North District Assembly. The session emphasized identifying key climatic hazards and vulnerable areas within the district. Subsequently, participants divided into smaller groups to pinpoint specific climatic risks, map areas and resources at risk, and exchange insights on existing community adaptation strategies.

Following these breakout sessions, participants reconvened in plenary to collectively prioritize hazards based on their severity and potential impact. The stakeholders were broken into groups to map out physical/resource, indicate climate trends, historical timeline and seasonality and opine on hazards or risks identification and prioritization for the district, vulnerability matrix and analysis, livelihood risks and explore coping patterns and adaptation strategies/options.

3.4.1.1 Matrix of Function Analysis

The MoF is a spatial planning tool which describes or signals aspects of adaptive capacity. Applied to climate change, a matrix of function increases understanding of how the current spatial structure of the district enables or inhibits the adaptive capacity and resilience of the area to the changes in climate and associated impacts. The matrix involves identifying various climate hazards – such as droughts, floods, or heatwaves – and mapping them against essential functions that may be affected by these hazards. This process helps in understanding the vulnerability of different sectors and identifying critical areas where adaptation or mitigation strategies are needed. By using the matrix, decision-makers can prioritize actions based on the severity of impacts, the resilience of each sector, and the capacity for response, ensuring a more targeted and effective approach to addressing climate risks.

3.4.1.2 Participatory Expert Selection of Study Communities

The workshop further facilitated the co-identification of communities for both qualitative discussions and the quantitative survey. Qualitative data, obtained through focus group discussions, provided context and deeper insights into community perceptions and experiences, complementing the findings from the quantitative analysis of the district's climate risks. Quantitative data, including statistical records on climate patterns, hazard frequencies, and resource conditions, supported the data-driven approach to assessing vulnerabilities and planning adaptive measures.

The participatory process for selecting communities was based on levels of vulnerability agreed upon by stakeholders in Akatsi North District. Facilitated discussions were held to identify communities most vulnerable to climate hazards, considering factors such as exposure to risks, socio-economic conditions, and existing adaptive capacities. Each community's vulnerability was assessed and categorized into three levels: low, moderate, and high. Based on this assessment, stakeholders assisted in the selection of communities for the survey, prioritizing those with higher levels of vulnerability to ensure that the most at-risk populations are adequately represented. The approach also allowed stakeholders to ensure that the selected communities reflected the diverse climate risks across the district, capturing the perspectives of those most affected by climate change.

Table 1: Communities selected for FGD and survey

No.	Level of Vulnerability	Selected Community for FGD	Selected Community for Survey
1	2 = Moderate	Avevi	Avevi
2	3 = High	Ave Dedzepe	Ashiagborvi
3	2 = Moderate	Ave Afiadenyigba	Ave Afiadenyigba
4	1 = Low	Ave Dakpa	Ave Dakpa
5	2 = Moderate	Ave Xevi	Ave Xevi
6	3 = High	Nyitawuta	Nyitawuta
7	3 = High		Dedzepe
8	2 = Moderate		Kpegbadza
9	3 = High		Hadave
10	3 = High		Zemu

Source: Akatsi North Stakeholder Workshop

3.4.2 Focus Group Discussions

The methodology for conducting Focus Group Discussions (FGDs) in Akatsi North District was 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.

3.4.2.1 Methodology for FGDs

Each FGD aimed to explore community members' perceptions of climate risks, how these risks have impacted their daily lives, and the challenges they face in adapting to climate change. The FGDs were designed to include diverse participants, particularly focusing on adults with equal representation of women, the youth, aged and marginalized groups within communities, to capture a wide range of experiences. The discussions were guided by a set of semi-structured questions which explored:

- The impact of climate change on the district's vulnerable communities, focusing on observed changes,
- Current adaptation practices, needs for future adaptation, and
- The sustainability of adaptation actions.

The FGD methodology was participatory and community-driven (see section 3.4.1.2 for details of communities selected), ensuring the inclusion of diverse groups, including women, youth, and marginalized population.

3.4.2.2 Data Collection Process

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 and men, after general group discussions. This allowed for a more focused discussion on the specific challenges faced by these groups in adapting to climate risks.

3.4.2.3 Data Analysis

After the FGDs, the qualitative data was transcribed, coded, and analysed thematically. Thematic analysis was used to identify common patterns and emerging themes related to the impacts of climate hazards, vulnerabilities, and adaptation strategies. This analysis was then compared with the quantitative data from the surveys to provide a richer understanding of the district's climate risks and the effectiveness of current adaptation measures. The insights gained from the FGDs plays a crucial role in validating the findings from the quantitative survey and in shaping the district's adaptation planning, ensuring that the strategies were informed by the lived experiences of the communities most at risk.

3.4.3 Household Questionnaire Surveys

3.4.3.1 Survey Design

The household survey was designed to capture essential data on climate change impacts, vulnerabilities, and adaptation practices at the household level across Akatsi North District. The questionnaire was structured to collect both demographic and climate-related information. The survey design ensured that the questions were relevant to the local context and that the responses would contribute to understanding the key vulnerabilities and adaptation strategies for Akatsi North District.

3.4.3.2 Sampling Method

The sampling method for the household survey in Akatsi North District was based on probabilistic sampling proportionate to the level of vulnerability. This approach aimed to ensure that the survey included an adequate representation of households from communities with varying levels of vulnerability to climate hazards, as identified through a participatory process. The communities were categorized into three vulnerability levels: low, moderate, and high. Sampling from each of these categories ensured that the survey captured the perspectives of households from areas most affected by climate change, as well as those from less vulnerable regions. Within each selected community, households (head 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.

The population sizes are sourced from the Akatsi North District Assembly Development Planning Unit.

Using Cochran's formula for a finite population (**12, 546**)

- Z value = 1.96 for a 95% confidence level
- Population Proportion= 50%
- Margin of error = 0.05
- **Adjusted sample size** = **373**

Weighted Formula for Sample Size Allocation

Assigning weights to each community to reflect the levels of vulnerability. We'll use a higher weight for the most impacted communities (Nyitawuta, Hadave, Ashiagborvi, and Zemu). For simplicity, assume we categorize vulnerability into three levels (From 1 to 3).

To calculate the sample size per community, we can use the following formula:

$$\textit{Weighted Sample Size or Community} = \left(\frac{Community\ Population\ x\ Vulnerability\ Weight}{\sum(Population\ x\ Vulnerability\ Weight)}\right) x\ Total\ Sample\ Size$$

Table 2: Population sampling for survey

Community	Population	Vulnerability Weight	Weighed Population	Weighted Sample Size
Avevi	585	2	1170	28
Ashiagborvi	415	3	1245	30
Ave Afiadenyigba	1812	2	3624	87
Ave Dakpa	4975	1	4975	118
Ave Xevi	1996	2	3992	95
Nyitawuta	201	3	603	15
Hadave	191	3	573	14
Dzadzepe	1568	2	3136	74
Kpegbadza	401	3	1203	29
Zemu	402	3	1206	30
Total	**12546**		**21727**	**373**

Source: Author's computation

3.4.3.3 Data Collection

The data collection process included face-to-face interviews with the head of each selected household. Trained enumerators administered structured questionnaires that covered topics such as climate change perceptions, vulnerabilities, adaptive practices, and community-based responses to climate risks. Data collection was completed between November 21-28, 2024.

3.4.3.4 Data Analysis

The data analysis focused on understanding the gendered dimensions of climate vulnerability, exposure, sensitivity, and adaptive capacity. Household demographics, including the gender of the household head, composition, and the presence of differently abled individuals, were examined to understand how these factors influenced decision-making and resource access. Economic variables highlighted gender-based disparities in resilience strategies. Additionally, perceptions of climate change impacts were explored, revealing gender differences in how men and women experienced climate risks.

The analysis also assessed gender differences in household vulnerability, exposure to climate hazards, and sensitivity to sectors like agriculture, health, and infrastructure. Social roles were examined to understand the gendered impacts of climate change, particularly how women faced increased workloads and income loss. Women's involvement in decision-making and adaptation strategies was compared to that of men, shedding light on gender inequalities in response to climate risks.

Finally, the analysis explored gender disparities in access to resources for adaptation. It also looked at gender differences in adaptive capacity and the role of local organizations in supporting women's adaptation to climate change.

3.5 Climate Projections Methodology

Assessing the historical climate projections for Akatsi North District in this study involved analysing datasets and employing local stakeholder contributions to present projections particularly to the context of Akatsi North.

3.5.1 Projection Data Sources

The study relied on three key datasets to analyse historical and projected climate conditions in Akatsi North District

1. **CHIRPS (Climate Hazards Group InfraRed Precipitation with Station data):** Daily precipitation data from CHIRPS, with a spatial resolution of 0.05°, was used to examine variability in rainfall patterns across the district.
2. **ERA5 Reanalysis:** Hourly temperature records from ERA5, available at a spatial resolution of 0.25°, facilitated the assessment of temperature extremes over time.
3. **CMIP6 (Coupled Model Intercomparison Project Phase 6):** This dataset provided multi-model climate projections necessary for evaluating future scenarios of rainfall and temperature extremes under various Shared Socio-Economic Pathways (SSPs).

3.5.2 Projection Period

The historical analysis focused on the period 1991-2020, aligning with IPCC's framework for climate studies. This timeframe enabled a comprehensive examination of past trends in precipitation and temperature extremes. Projections were carried out for near-term (2021-2040), mid-century (2041-2060), and end century (2081-2100) intervals, offering insights into anticipated climatic changes across different time scales.

3.5.3 Projection Analysis

The analysis aimed to investigate patterns and changes in climate extremes, focusing on rainfall and temperature variations over time and evaluating potential shifts under different climate scenarios, while integrating stakeholder inputs to ensure the findings were locally relevant and actionable for decision-making.

To examine climate extremes, specific indices were used to measure variability in rainfall and temperature. Rainfall metrics included indicators like the most intense one-day rainfall (Rx1day), total rainfall over five consecutive days (Rx5day), prolonged dry spells (CDD), and extended wet periods (CWD), as well as rainfall exceeding the 95th percentile (R95p). For temperature, metrics captured extremes such as the highest and lowest daytime and nighttime temperatures (TXx, TNx, TXn, TNn), which shed light on heatwaves, cold snaps, and other extreme events. The analysis followed a structured six-step approach.

1. First, data on rainfall and temperature was sourced from CHIRPS and ERA5 for past records, while CMIP6 data informed projections.
2. Second, rigorous quality checks ensured accuracy, and daily data was summarized into seasonal and annual formats to compute indices.
3. Third, extreme climate indices were derived using tools like ClimPACT2.
4. Fourth, trend analyses employed statistical methods such as the Mann-Kendall test and Sen's slope estimator to detect significant changes.
5. Fifth, future projections under different SSPs were analysed to anticipate shifts in climate indices.
6. Lastly, 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

4. Findings and Implications

4.1 Stakeholder Engagement

4.1.1 Mapping of Most Vulnerable and At-Risk Locations and Hazard Identification and Prioritization

During the stakeholder engagement workshop groups were tasked to map out physical resources, identify hazard risk areas and present the main climate hazards and their impacts in the district. The groups looked at how people in the district currently adapt to the impacts of the specific hazards and the perceived effectiveness of these adaptation strategies.

Vulnerable and Disaster-Prone Areas

The assessment identified several areas within Akatsi North District as highly vulnerable to environmental hazards highlighting the need for targeted interventions to address the district's varied environmental challenges with a particular emphasis on gender-sensitive solutions to mitigate impacts on vulnerable populations. Identified vulnerable areas include:

Flood-Prone Zones

- Communities such as Ave Dzadzepe, Ave Havi, Nyitawuta, and the vicinity of the chief's palace in Ave-Dakpa experience frequent flooding.
- Other areas, including Ashiagborvi and Atsata Bame, also face recurring flood events that disrupt agricultural activities and threaten livelihoods.

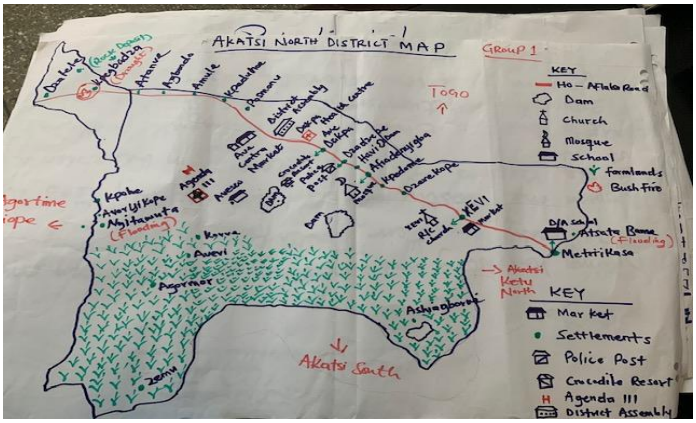
Bushfire Risks

- Farmlands across the district, particularly in the lower-lying areas, are at high risk of bushfires during the dry season, typically from January to April.
- Forested zones such as Zemu, Agormor, and Ashiamgborvi are especially prone to bushfires.
- The practice of burning vegetation by Fulani herdsmen to encourage fresh grass growth exacerbates the bushfire risks, increasing the vulnerability of these areas to both fire and drought.

Drought-Prone Areas

- Communities like Kpegbedza suffer from severe water scarcity, which affects both agricultural productivity and domestic water supply.
- The drought impacts are particularly significant for women, who bear the primary responsibility for water collection, compounding their vulnerabilities and workloads.

Figure 6: Maps (up and down) – Visualization of critical infrastructure, key resources and vulnerable areas, Akatsi North District



Source: District Stakeholder Survey, September 2024

Addressing the district's susceptibility to droughts, infrastructure failures, and erratic weather patterns requires targeted interventions to build systemic resilience. Women's critical roles in agriculture, caregiving, and water management necessitate adaptive strategies that address their unique challenges and enhance their capacity to cope with climatic changes. Strengthening the district's infrastructure, such as dams and public buildings, and ensuring sustainable water resource management are pivotal to mitigating future risks.

Key Landmarks and Community Resources

The assessment identified critical infrastructure and community resources in Akatsi North 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. They include:

Water Infrastructure

- Ave Dakpa Dam: Serves as a vital resource for water supply and irrigation but is situated in a flood-prone area.
- Other Dams: Most communities rely on a few non-engineered dams and one engineered dam in Ave-Afiadenigba. These dams are heavily impacted by water hyacinths and debris, reducing their functionality.

Tourism and Recreation

- Dakpa Crocodile Resort: A significant state-owned tourist attraction near the Ave Dakpa Dam, which is also vulnerable to flooding.

Educational Institutions

- TVET School in Ave-Dakpa: Frequent flooding in the area has necessitated its relocation, underscoring the infrastructural challenges posed by flood risks.

Healthcare Facilities

- Dakpa Health Centre and St. Anthony's Catholic Hospital (located in the adjoining Ketu North District) are key healthcare providers.
- Agenda 111 Hospital: Currently under construction in Avevi, with an estimated completion rate of 70%.

Social and Security Infrastructure

- Churches, mosques, and a police post play a critical role in community cohesion and security.

Markets

- The district hosts several markets essential for trade, supporting the livelihoods of local farmers and traders.

Agricultural Farmlands

- Predominantly located in the southern part of the district, these farmlands are the backbone of the local economy. However, they are under constant threat from bushfires and drought, jeopardizing agricultural productivity.

Photo 3: Image of stakeholders mapping resources and hazard-prone areas in Akatsi North

Source: District Stakeholder Survey, September 2024

Matrix of Function Analysis

In further assessing the key landmarks and community resources, the stakeholders completed a Matrix of Function (MoF) questionnaire, a spatial planning tool that signals aspects of adaptive capacity. When applied to climate change, the MoF enhances understanding of how the district's spatial structure enables or limits its adaptive capacity and resilience to climate impacts. The findings highlight critical gaps in infrastructure, services, and economic opportunities that affect the district's adaptive capacity. Addressing these issues through targeted investments and policy interventions will be essential. The key findings include:

Public Utilities and Facilities: The MoF revealed limited access to essential utilities, such as pipe-borne water and wells, in most communities, including Ave Dakpa, Avevi, Ave Dzadzepe, and Nyitawuta. This scarcity 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.

Transportation Infrastructure: Road connectivity is inconsistent, with a mix of paved and unpaved roads. However, critical transportation amenities such as bus stations and petrol stations are sparse, and many roads are in poor condition. These limitations hinder accessibility and economic activity, particularly the ability to access markets and essential services. Improved road infrastructure could significantly enhance equitable access and regional economic opportunities.

Market and Financial Services: Communities like Ave Dakpa and Ave-Dzadzepe benefit from livestock and fish markets, but 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.

Ecosystem Services and Agriculture: Ecosystem services supporting agriculture are broadly available, with communities cultivating crops like rice, maize, and cassava and engaging in livestock farming. These activities are vital for food security but require ongoing support to enhance productivity and resilience to climate variability.

Healthcare Access: While CHIP compounds and clinics are relatively common, public hospitals are rare, limiting access to advanced healthcare services. Specialized care, such as midwifery, pharmacies, and eye specialists, is available in some areas but is insufficient for the population's needs. Communities often face long travel distances to access critical healthcare, affecting timely treatment and overall health resilience.

Educational Facilities: Basic educational institutions are available but widely dispersed, with only one Senior Secondary and Technical Vocational School located in Ave-Dakpa. This limits access for students in distant communities, posing barriers to higher education and skill development.

Emergency Services: Security services, such as police checkpoints, are present at strategic points, but only one fire station serves the entire district. This limited capacity affects disaster preparedness and response, particularly in areas prone to fires and floods.

Community Organizations and NGOs: Religious institutions, cooperative unions, and NGOs play a crucial role in social cohesion, community development, and resilience building. However, these organizations are more concentrated in larger communities, leaving smaller towns with fewer resources.

Traditional Trades: Small-scale self-employed workers, including carpenters, fishermen, and weavers, are prevalent. However, challenges such as limited access to capital, markets, and training reduce their capacity to adapt to climate impacts.

4.1.2 Historical Timeline of Major Climate Induced Events

The historical timeline of Akatsi North District, as recounted by stakeholders, reveals several significant events impacting its agricultural, water, and economic sectors (Figure 10). These events underscore the district's exposure to extreme weather conditions and their disruptive impacts. Learning from these historical events could prioritize the district’s investment in infrastructure, adaptive capacity, and inclusive planning to safeguard its communities against recurring environmental challenges. Below are some highlights events:

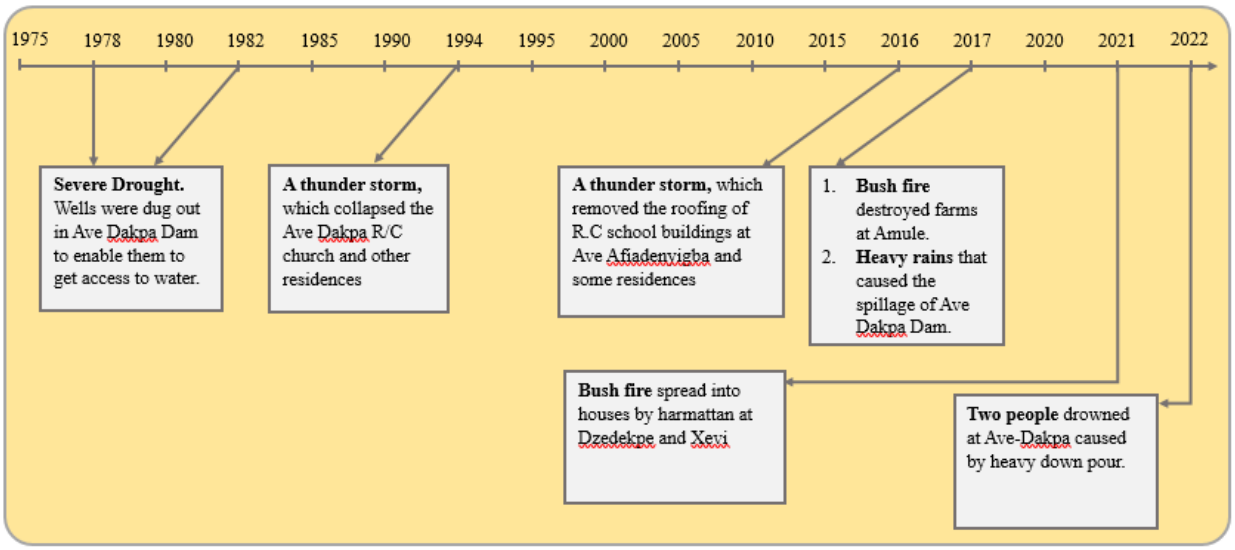
1983 Drought
The 1983 drought in Ghana marked a critical period of food insecurity in Akatsi North. Widespread food scarcity and increased mortality rates, particularly among vulnerable populations such as women, children, and the elderly, were reported. The drought significantly disrupted agriculture and transportation, leading to long-lasting economic difficulties and reduced access to essential resources.

2008 Dam Structural Failure
Failure of the Ave-Dakpa Dam in 2008 caused extensive damage, particularly to farmlands, with crops destroyed and water supplies disrupted. Women, who bear the primary responsibility for water collection and agricultural tasks, faced heightened challenges in securing water for household and farming needs. This event highlighted the district’s vulnerability to infrastructure failures and the need for improved maintenance and resilience planning.

Thunderstorms (1994-2016)
Recurring thunderstorms during this period caused significant destruction to community infrastructure, including church buildings and schools.

2024 Rainfall Pattern Changes
Recent shifts in rainfall patterns, attributed to climate change, have caused considerable disruptions in agricultural activities. Erratic weather has delayed planting seasons and affected transportation, straining the local economy. Women, as key agricultural workers and caregivers, have been disproportionately affected by these disruptions, further emphasizing the district’s vulnerability and the urgent need for adaptive strategies.

Figure 7: Historical timeline of major events in Akatsi North

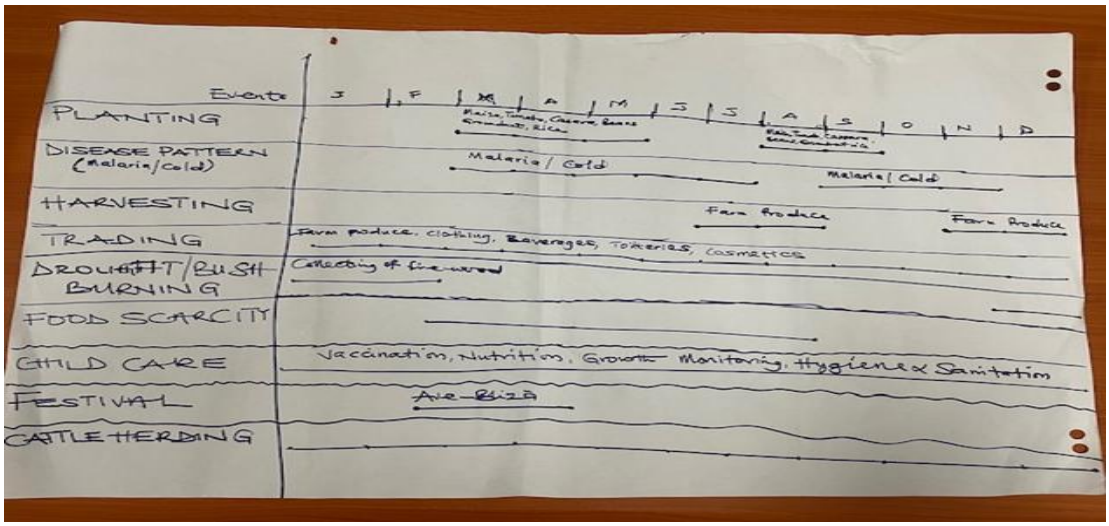


Source: District Stakeholder Survey, September 2024

4.1.3 Seasonality Calendars of Climate Hazards

The stakeholders followed the developed of the historical timeline with an illustrative adaptation of the trends of seasonal events in Akatsi North District. The presentation of the seasonal calendar focused on periods of stress and vulnerability, livelihood and coping strategies and evaluated how men and women utilize climate information.

Figure 8: Stakeholders adaptation of the climate seasonal calendar of Akatsi North districts



Source: District Stakeholder Survey, September 2024

Periods of Stress and Vulnerability

The group emphasized that the district's seasonal calendar highlights critical periods of heightened stress and vulnerability, driven by climate factors, resource scarcity, and labour demands. These factors collectively impact livelihoods and food security across the district.

Dry Season (December - March)
Risks: The dry season is marked by drought and bush burning, referred to as "twin events," which exacerbate bushfire risks and reduce agricultural productivity. December through February sees increased firewood collection, requiring significant labour contributions from both men and women.

Water Scarcity: Limited rainfall during this period intensifies water scarcity, affecting both domestic use and cattle grazing, which is a year-round activity but faces increased challenges in dry months.

Agricultural Cycle (March - May; August - September)
Primary Planting Season: From March to May, men and women are engaged in land preparation and planting of staple crops such as maize, tomato, cassava, beans, groundnut, and rice.

Minor Planting Season: A similar pattern is observed in August and September.
Vulnerability: Erratic rainfall patterns during these planting periods disrupt schedules, threatening food security.

Health Challenges: Disease incidence, particularly malaria and colds, peaks during these times (March–May and August–November), further reducing labour availability and productivity.

Harvest and Post-Harvest (July - August; December - January)
Main Harvest Season: Spanning July to August, this period involves intensive labour demands for tasks such as shelling, dehusking, drying, bagging, and transporting produce.

Minor Harvest Season: Occurring in December and January, these months also require significant labour for post-harvest activities.

Post-harvest periods are vulnerable to climatic fluctuations and pest infestations, which can jeopardize food storage and income from farm produce.

The seasonal calendar underscores the targeted need for interventions during the dry season, planting periods, and harvest cycles to mitigate risks and ensure food security. Strategies to reduce labour burdens, particularly for women, and improve resource availability, such as water and firewood, are crucial. Measures to address erratic rainfall, pest management, and health risks during vulnerable periods could enhance the district's resilience to seasonal stresses.

Table 4: Seasonal calendar of climate induced activities

Events	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Planting			maize, tomato, cassava, beans, groundnut, rice					maize, tomato, cassava, beans, groundnut, rice				
Disease pattern (malaria/cold)			Malaria/cold						Malaria/cold			
Harvesting							Farm produce				Farm produce	
Trading	Farm produce, clothing, beverages, toiletries, cosmetics											
Drought/ bush burning	Collecting of firewood											Collecting of firewood
Food scarcity												
Childcare	Vaccination, Nutrition, Growth monitoring, hygiene &sanitation											
Festival		Ave-Bliza										
Cattle herding	All year round											

Source: District Stakeholder Survey, September 2024

4.1.4 Vulnerability Matrix and Analysis of Hazards on Livelihoods

The stakeholders used a vulnerability matrix to assess and rate the levels of impact and vulnerabilities caused by climate hazards, drawing on their lived experiences in the Akatsi North District. Ratings were assigned to indicate the differing levels of impact on male and female members of the district, ensuring that gender-specific vulnerabilities were captured in the analysis. The findings emphasize the need for targeted, gender-sensitive interventions to address these vulnerabilities and promote equitable resilience strategies for both men and women.

Table 5: Vulnerability matrix of climate impact of activities

Event	Erratic Rains	Flood	Drought	Bush Fires	Pest Outbreak	Diseases
Crop production	1 3	2 3	3 2	3 3	3 3	3 2
Post-harvest activities	3 1	3 2	3 1	3 2		
Livestock	1 3	2 3	3 3	1 3	1 3	3 3
Agro-processing	3 1	3 2	1 2			
Marketing	3 1	3 1	2 2			3 1
Domestic water	3 1	2 2	3 2			2 1
Food security	*3 2*	*3 2*	*3 3*	*3 3*	*2 2*	*2 2*

Key: -Women Men
Source: District Stakeholder Engagement, September 2024
Level of Vulnerability: 1 – Low, 2 – Medium, 3 - High

The analysis conducted using a vulnerability matrix based on stakeholder perceptions and ratings, revealed distinct gendered impacts of climate-related hazards—such as erratic rainfall, drought, floods, and pest outbreaks – in Akatsi North District. After developing the vulnerability matrix, the following gender differences were identified from discussions on gender-related vulnerabilities, roles, responsibilities, and activities.

Differential Gender Vulnerabilities

Men's Vulnerability: Men, who are primarily involved in rain-dependent crop farming, are particularly susceptible to erratic rainfall and drought. Reduced water availability during droughts directly impacts their farming activities, diminishing crop yields and household incomes.

Women's Vulnerability: Women, engaged in small gardens and food crop production, face compounded challenges during droughts, as they bear the dual responsibility of household food provision and water collection. Drought conditions require women to travel longer distances to fetch water, increasing their workload and physical strain. Additionally, variability in crop yields disproportionately affects women, who depend on these crops for household consumption. Poor harvests exacerbate food insecurity, further straining women's ability to sustain their families.

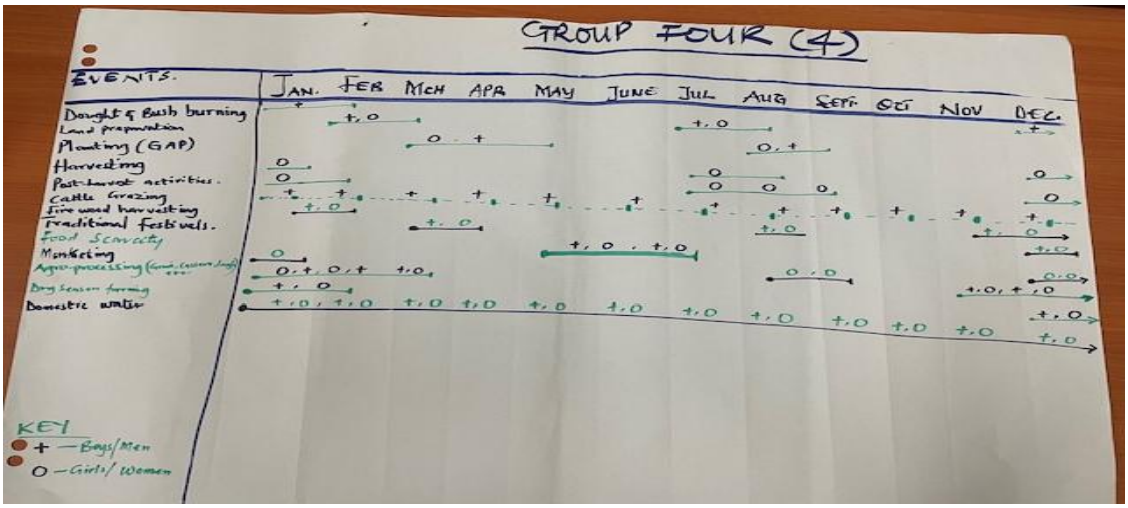
The burden of water scarcity and food insecurity during droughts highlights the uneven impacts of climate stressors on women. Women's daily responsibilities, including caregiving and food preparation, are amplified during these periods, adding to their overall vulnerability.

Although both men and women participate in decision-making on livelihood strategies, women face heightened labour demands during harvest and marketing seasons. This reflects a pronounced seasonal labour burden for women, particularly in agriculture and trade-related activities, compared to men. Persons with disabilities face even more pronounce vulnerabilities as they often have to rely on or pay others to perform such activities such as fetching water for household use or preparing lands for crop production.

Gender Specific Roles, Responsibilities and Activities

Stakeholders further employed the vulnerability matrix to evaluate gender-differentiated participation in climate-induced activities, emphasizing distinct roles of men and women in responding to drought, bush burning, and resource management throughout the year.

Figure 9: Gender-differentiated annual climate induced activities



Source: District Stakeholder Engagement, September 2024

The analysis revealed that certain tasks, such as domestic water collection, require continuous year-round effort from both genders. However, other activities like land preparation, harvesting, cattle keeping, and marketing are more seasonal and exhibit clear gender-based distinctions. These gender-based distinctions in responsibilities underscore the need for tailored interventions that address the unique vulnerabilities and strengths of both men and women in responding to climate-induced challenges. Highlighted gender differences are presented below:

Gender Roles
Men's responsibilities are often tied to physically demanding tasks, such as cattle grazing**,** land clearing, and bushfire management, which require strength and mobility.
Women, however, bear the dual burden of agricultural labour and household management. Their roles in food crop planting, harvesting, post-harvest activities, and marketing emphasize their critical contribution to food security and family well-being.

Drought and Bush Burning (January & December)
Men are primarily responsible for managing drought and bush burning events, aligning with their role in resource-intensive activities such as year-round cattle grazing. This task requires mobility and physical labour, which are traditionally male-dominated roles.
Women are less involved in these activities but are indirectly affected as household water and food security depend on resource availability during these periods.

Land Preparation (February & July)
Both men and women actively participate in land preparation, reflecting a shared responsibility for ensuring agricultural readiness. While men typically focus on labour-intensive tasks like clearing large tracts of land, women contribute by clearing smaller garden spaces and assisting with planting preparations.

Planting (March & August)
Women play a significant role during these periods, particularly in planting food crops crucial for household sustenance.
Men, on the other hand, often focus on cash crop planting, reflecting a gendered division of labour.

Harvesting (January, July & December)
Men assist with heavy-lifting tasks, such as transporting produce from farms to storage facilities, but *women* remain the primary actors in this stage.

Harvesting is a pivotal period during which women play a central role. Their contributions are critical for food security, as they oversee the collection, sorting, and initial processing of crops.

Post-Harvest Activities (July–September & December–January)
Men are typically involved in transporting goods to market, but women take the lead in handling and selling produce.
Women dominate post-harvest tasks, including crop drying, storage, processing, and preservation. These activities ensure food availability and income stability for households.

Marketing
Men's involvement in marketing is generally limited to larger-scale transactions or cash crops.
Women are heavily involved in marketing produce, often travelling to local markets to sell surplus crops. Their role in trade highlights their dual responsibilities in income generation and household sustenance.

Agro-Processing
Moreover, agro-processing activities, an essential component of food production, occur from January through to March, with *men and women both engaged*, though involvement shifts by the end of the year.
Men take on more responsibility in agro-processing tasks in November and December.
Women contribute primarily to value-adding activities that support household income.

Dry Season Farming
Both men and women see a collaborative effort in January and December for dry season farming which provides alternative food sources. This seasonal adaptation allows communities to diversify food sources and maintain food security despite the dry months.

Domestic Water Collection
Involves *both men and women* throughout the year as a daily necessity. This task reflects a shared responsibility crucial to sustaining household needs, particularly in managing water scarcity during drier months.

Overall, the matrix underscores the distinct yet interdependent roles of men and women in managing climate-induced events, with each gender playing specific parts across various agricultural and household activities. The year-round responsibilities, especially in tasks like domestic water collection and cattle grazing, highlight the continuous strain on resources and labour as climate pressures increase.

Table 6: Vulnerability matrix of annual climate induced activities

Events	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Drought & bush burning	+											+
Land preparation		+ o					+ o					
Planting (GAP)			o	+				o +				
Harvesting	o						o					o
Post-harvest activities	o						o	o	o			o
Cattle grazing	+	+	+	+	+	+	+	+	+	+	+	+
Firewood harvesting											+	o
Traditional festivals			+ o	+ o								
Food security	+ o	+ o							+ o	+ o		
Marketing	o							o	o			o
Agro-processing	o +	o +	o +								+ o	+ o
Dry season farming	+ o											+ o
Domestic water	+ o	+ o	+ o	+ o	+ o	+ o	+ o	+ o	+ o	+ o	+ o	+ o

Key: **o =** Women **+ =** Men
Source: District Stakeholder Engagement, September 2024

Coping Strategies

The group identified various adaptive practices employed by communities in Akatsi North to navigate seasonal challenges and enhance resilience to climate variability and economic hardships. These strategies highlight the district's efforts to address vulnerabilities while emphasizing the need for further support and intervention to strengthen resilience against climate variability and economic hardships.

- **Agricultural Practices:** To combat erratic rainfall and soil degradation, communities adopt good agricultural practices such as soil management and strategic fertilizer application, particularly during the primary (March–May) and minor (August–September) planting seasons. These practices aim to boost crop yields and mitigate the adverse effects of climate variability on agriculture. Developing infrastructure for water storage and distribution could further mitigate the effects of drought, irregular rainfall, and water scarcity, significantly enhancing resilience.
- **Alternative Livelihoods:** Year-round trading of farm produce, clothing, beverages, toiletries, and cosmetics provides additional income streams for households. Economic activities peak during festival periods like the Ave-Bliza in April, cushioning households against income losses during low agricultural productivity months.
- **Health and Nutrition Programs:** Vulnerable periods (March–May and September–November) see increased focus on vaccination, nutrition programs, growth monitoring, and hygiene and sanitation efforts. These measures help safeguard children's health and enhance community resilience to diseases such as malaria and colds.
- **Other Environmental Activities:** Dry season activities such as firewood harvesting, predominantly undertaken during the dry season, serve as a critical energy and income source. Others include year-round activities include cattle grazing which provides additional economic support, with men typically managing livestock movement. However, without careful management, these activities contribute to environmental degradation, including deforestation and soil erosion.
- **Climate Information Measures:** Recent disruptions in the agricultural calendar due to irregular rainfall, linked to climate change have made reliable climate information critical. Stakeholders emphasized the need for localized and timely weather information to guide planting and harvesting schedules.
- **Institutional Interventions:** Organizations like the National Disaster Management Organization (NADMO) play a pivotal role during severe crises by providing relief through food, water, and temporary shelter. NGOs complement these efforts by delivering critical recovery resources.
- **Livelihood Empowerment Against Poverty (LEAP):** Financial support from the LEAP program helps vulnerable households buffer against climate-induced stresses, offering economic relief to manage erratic rainfall and drought.
- **District Assembly Initiatives:** Adaptive measures include promotion of short-duration and disease-resistant crops. These crop varieties are aligned with altered seasonal patterns to mitigate the impacts of erratic rainfall. Afforestation Projects and initiatives are also promoted to aim at restoring degraded lands and improve environmental resilience.
- **Livelihood Diversification:** Programs supporting "*okada*" (motorcycle taxi) operations, gari processing, and cassava-based products like "kokonte" flour and chips provide alternative livelihoods, especially for those heavily affected by climate variability.
- **Some Gender-Differentiated Coping Strategies:** Men often migrate or pursue alternative livelihoods to mitigate economic losses, particularly in livestock farming. Women actively engage in agro-processing activities such as palm oil and alcohol distillation, diversifying income sources alongside taking care of household responsibilities.

Stakeholders highlighted the importance of strengthening climate adaptation measures and providing technical and financial support to scale up existing practices. Addressing the district's environmental and economic challenges through targeted interventions and improved access to resources could significantly reduce vulnerability and promote sustainable development.

4.2 Quantitative and Qualitative Analysis

4.2.1 Demographics of Households Engaged

The survey targeted randomly selected household heads in Akatsi North District, interviewing a total of 380 respondents from 10 selected communities (**Table 7**). Among these, 52% of the household heads were female. Households in Akatsi North are relatively small, with an average of 3.7 persons per household, which is below the national average of 4.4 persons (GSS, 2021). A significant proportion of respondents (58%) were married. The remaining respondents were widowed (13%), single (11%), cohabiting (10%), or divorced/separated (8%). Education levels among respondents varied widely. 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 7: Distribution of respondents interviewed in each community

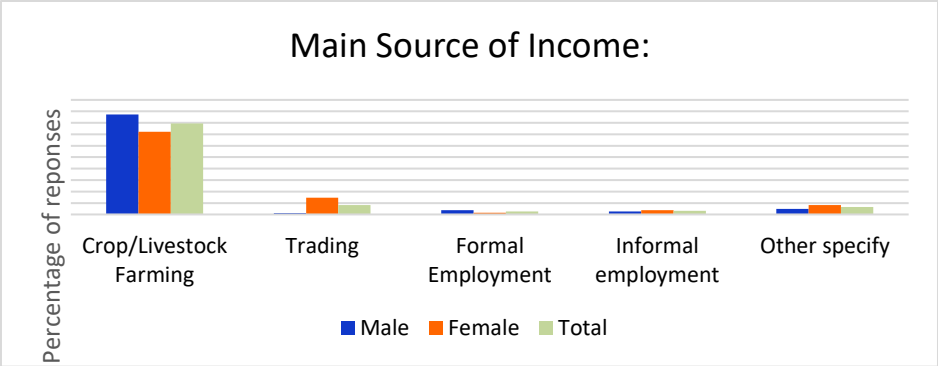
Town	No. of respondents	Percentage (%)
Nyitawuta	25	6.6
Avevi	24	6.3
Xevi	40	10.5
Dzadzepe	60	15.8
Ave Dapka	70	18.4
Ave Afiadenyigba	60	15.8
Kpegbadza	25	6.6
Zemu	25	6.6
Ashiagborvi	26	6.8
Hadave	25	6.6
Total	**380**	**100.0**

Source: Akatsi North Household survey

4.2.2 Economic Vulnerabilities

In Akatsi North District, agriculture forms the bedrock of the district's economy (ANDA, 2023). The survey results reaffirm this, with 80% of the community primarily engaged in crop/livestock farming. However, in relative terms, agricultural activities are more commonly managed by male household heads than females. The focus group discussions showed that, while crop farming was largely done by community members, livestock farming was kept largely by migrant male community members. On the other hand, trading is the second most prevalent source of income, with more females engaged in it than males, although it accounts for less than 10% of total household income. In contrast, formal employment in both public and private sectors is minimal, with fewer than 3% of respondents employed in such establishments (**Figure 10**). This highlights the district's heavy reliance on agriculture and informal sector activities, with limited opportunities in the formal labour market.

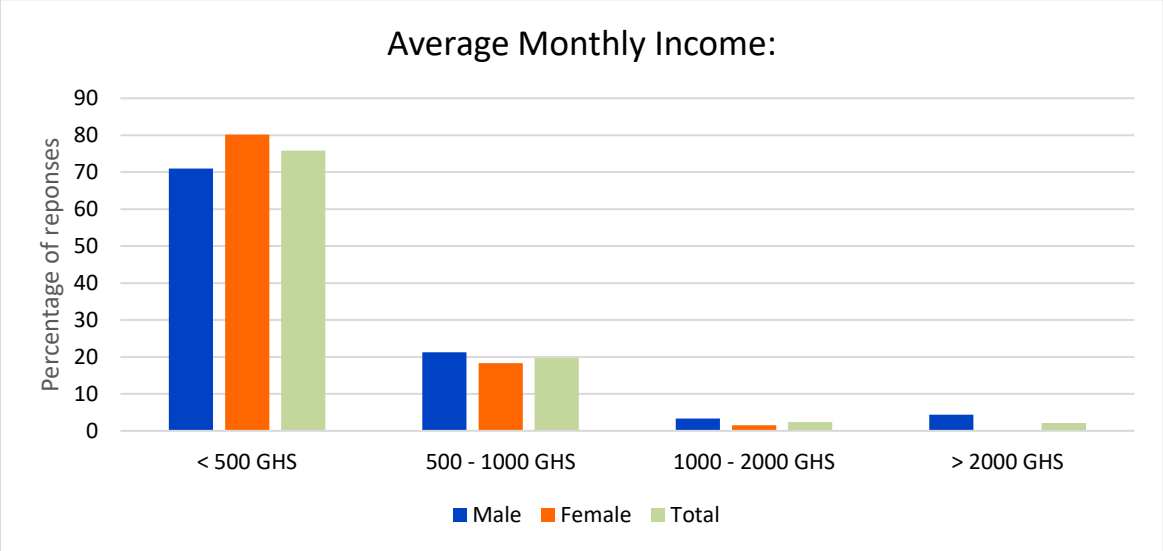
Figure 10: Main source of income for residents in Akatsi North District



Source: Akatsi North Household survey

The survey results reveal distinct gendered patterns in secondary income sources. 38% of men reported engaging in secondary employment, compared to 28% of women. Among those in secondary employment, a significant portion of men (47%) are involved in informal work such as okada (motorcycle taxis) driving and artisanal work, while 49% of women are engaged in trading as a secondary source of income. The income distribution shows a significant economic disparity, with a majority (76%) of respondents earning less than 500 GHS per month, nearly equal to Ghana's minimum wage of 490.05 GHS per month. This large proportion highlights widespread economic vulnerability and limited purchasing power. A smaller portion (20%) earns between 500 and 1000 GHS, which is consistent with regional averages. However, only 2% earn between 1000 and 2000 GHS, far below national trends where this income group typically represents a larger share of the workforce (GSS, 2017). Moreover, only 2% of respondents earn above 2000 GHS, none of whom are female household heads, emphasizing the economic vulnerability of female-headed households. These income dynamics reflect a limited presence of higher earners in the district, implying restricted upward economic mobility. Further, focus group discussions show that persons with disability and youth, aged 27 years and lower, are among the lowest-earning members of the community. For PWDs in particular, the discussions showed that their disability often affected their productivity, often needing to close shop for days, further affecting their monthly income. The findings underscore the need for targeted development strategies aimed at raising income levels and enhancing financial resilience across all households.

Figure 11: Average monthly income



Source: Akatsi North Household survey

The ownership of assets among respondents reveals varied patterns, with land being the most common asset, owned by 36% of the respondents, significantly higher than other forms of property. The results do not show significant difference between the percentages of land ownership between males and females. 38% of male respondents noted that they own lands, compared to 35% of the female respondents. Livestock ownership followed a similar pattern as the second most owned asset (9%). With 11% of male respondents owning livestock compared to 9% of females. Observations from focus group discussions showed that while men owned relatively larger in size livestock such as cattle, women mostly owned smaller sized livestock such as goats. Poultry ownership is also higher in female respondents than in male respondents. With 8% of males and 11% of females respectively, owning poultry. Also, house ownership, held by 14% of the respondents.

Land, livestock and poultry being the top assets owned by respondents in Akatsi North, indicate the importance of both small and large-scale agriculture to the district, where land serves as a key asset for livelihoods and economic activity. Further demonstrating the district's reliance on agriculture for wealth accumulation.

Vehicle ownership is minimal, with only one male respondent out of the 380 owning a vehicle. Motorbikes (4%) and bicycles (1%) are slightly more common. Both are largely owned by males.

Motorbikes are observed to be the preferred means of transportation due to the cost of ownership and economic accessibility between communities which are often long kilometres apart.

4.2.3 Climate Awareness and Perception

Perceptions of climate change are shaped largely by the direct effects individuals experience and the frequency of extreme weather events. These local impacts serve as a primary source of knowledge, leading communities to develop their understanding of climate change based on tangible, observed consequences rather than scientific projections (Sambrook, 2021).

The majority of respondents (95%) report having noticed changes in weather patterns over the past 10 years. Focus group participants from Nyitawuta, Ave Dakpa, and Hadave highlighted the shifts in climate patterns:

> *"There has been a change in the rain pattern. 5-10 years ago, you wouldn't have been able to come to this place at this time due to flooding, but that has changed." – Adult male, Nyitawuta*
>
> *"We used to experience cold during Harmattan, but lately, the cold has disappeared, and there's much more heat than before." – Adult female, Ave Dakpa*
>
> *"We used to have two rainy seasons, with the minor season starting in September. But over the years, it hasn't been like that." – Adult male, Ave Dakpa*
>
> *"There have been a lot of storms recently. You see clouds in the sky, then suddenly, the wind picks up, but the rain doesn't follow." – Adult female, Avevi*
>
> *"Right now, we should have planted weeks ago, but we haven't been able to because of the delayed rainfall." – Adult Male, Ave Afiadenyigba*

Participants' observation of changes in weather patterns were attributed to their perceived experiences on rainfall variability, seasonal calendars of climate events and climate impacts.

The survey reveals that the perceived impacts of climate change have significantly affected the agricultural sector. Respondents indicated that climate change has generally increased food insecurity (33%), reduced crop yields (33%), made accessing water more difficult (17%), and caused property damage (11%), among other effects. Focus group discussions (FGDs) revealed similar concerns, with participants sharing their experiences of climate impacts on various aspects of household welfare and community life. Some relevant quotations include:

Water Resources
"They used to harvest water when it rained. They dug a small dam along the stretch of the road to fetch water from there." – Adult female, Ave Dzadzepe
"The river is far, but since it hasn't been raining much, there's no water there anymore." – Youth female, Avevi

Agriculture
"Due to the change in the weather pattern, crop yields have been affected, and when there's excess rain, it floods our farms." – Adult male, Ave Dakpa
"Because of the drought, whenever we plant, the crops don't grow well, and the yield is not as much as before." – Youth female. Ave Dakpa

Livestock
"We used to engage in cattle farming, but since the rainfall pattern has changed, we no longer keep cattle. Now, we focus on sheep, goats, and a few chickens." – Adult male, Ave Afiadenigba

Human Health
"Because our income has been reduced, it affects our livelihood. We don't eat a balanced diet, and the food isn't as nutritious." – Female PWD, Ave Dakpa

Infrastructure
"The main road that we used to use becomes flooded and cuts us off when it rains heavily. It also damages the buildings and farmlands." – Adult female, Nyitawuta
"The excess heat has caused some of the buildings to crack." – Adult Male, Avevi

The survey also reveals that extreme weather events often lead to significant impacts such as displacements (30%), psychological distress (28%), loss of livelihood (23%), and damage to homes and infrastructure (16%), along with other consequences like increased conflict. In response, households have implemented various strategies to address these challenges.

The strategies adopted highlight a strong reliance on agricultural innovations and water management practices. Improved crop varieties emerge as the most common approach, adopted by 27.8% of respondents. This underscores the crucial role of climate-resilient crops in sustaining livelihoods under changing environmental conditions. Following closely are soil conservation techniques (24%) and crop diversification (10.9%), which focus on integrated agricultural practices to enhance productivity and mitigate risks. For PWDs, dependence on sponsors and family relatives remained high as adopted strategy. In times of general fall in food availability, induced by climate impacts, PWDs stand greater vulnerability in the face of communal food insecurity.

Water-related strategies, such as rainwater harvesting (10.7%) and irrigation (9%), are also widely used, demonstrating efforts to combat water scarcity. Collective action, involving community collaboration to address challenges, as reported by 1.6%, indicate the role of social networks in building resilience, while community-based early warning systems (2.5%) highlight the importance of disaster preparedness in enhancing resilience.

Notably, men and women have similar preferences for improved crop varieties, but women slightly lead in adopting rainwater harvesting practices, likely due to their primary role in household water management. Conversely, only men (a small number, 2 respondents) reported using irrigation as an adaptation strategy. Migration (6.2%) and livelihood diversification (10.7%) are also seen as adaptive measures to cope with more severe impacts. Observations from group discussions with the youth showed that, due to lack of alternative ventures other than agriculture, youth have now turned to migrating to close by communities and far away cities and towns for “greener pastures” in menial jobs, as farm hands and for education.

4.2.4 Household Physical Vulnerability

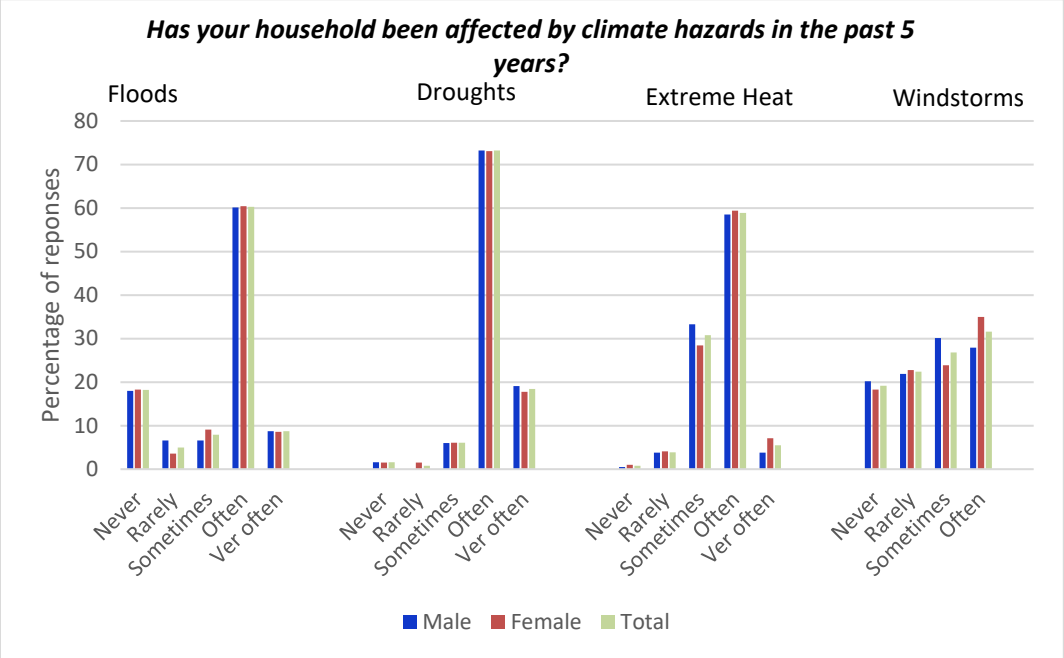
The vulnerability of households was identified by analysing respondents’ exposure and sensitivity to climate hazards. According to the IPCC (2022), the vulnerability of household, community or an area to climate change is a function of the area’s propensity or predisposition to be adversely affected, encompassing a variety of concepts and elements, including sensitivity or susceptibility to harm and lack of capacity to cope and adapt. Therefore, analysing exposure and sensitivity provides a critical understanding of the extent to which households are at risk, as these factors determine the degree to which a system or community is likely to experience harm due to climatic stressors.

4.2.4.1 Exposure to Hazards

The survey data reveals household exposure to climate hazards over the past five years, highlighting varying levels of impact across different hazards. Flooding was reported as a frequent occurrence by 60% of respondents, with 9% experiencing it very often. Droughts were noted as the most consistently severe hazard, affecting 73% of respondents often, with an additional 18% experiencing them very often. Extreme heat was also reported frequently, with 59% of respondents indicating it occurred often, though only 6% experienced it very often. Windstorms showed more variation, with 32% of households facing them often and 27% sometimes, suggesting a moderate prevalence compared to droughts and extreme heat.

The data also highlights gender parity in the perception of most hazards, though slight variations exist. For instance, women reported higher exposure to extreme heat very often (7%) compared to men (4%), suggesting potential gendered differences in vulnerability or perception. Overall, these findings indicate that floods and droughts are the most significant and persistent hazards, impacting both genders almost equally.

Figure 12: Household exposure to climate hazards



Source: Akatsi North Household survey

Respondents further identified differentiated impacts of climate hazards, with floods typically experienced with either high or low impacts for both men and women. However, droughts were generally felt with high to very high impacts, suggesting that, unlike floods, which may affect certain areas more than others, droughts have a widespread effect throughout the community. This is particularly significant as droughts heavily influence agriculture, the district's economic backbone. Extreme heat was reported to have medium to high impacts, while bush fires were noted to cause low to very low impacts.

Overall, the results show that climate hazards occur with varying frequency across communities, with the majority of respondents experiencing them occasionally or frequently. About 58% reported that these hazards occur sometimes, while 33% indicated they occur often, pointing to a substantial frequency of exposure. Rarely and very often were less common responses, accounting for 7% and 2%, respectively, while only 2% reported never experiencing such hazards. Notably, women were more likely to report hazards occurring often (39%) compared to men (26%), suggesting possible gendered differences in perception or exposure.

However, nearly all respondents (98%) indicated they never receive any warnings before climate events occur, highlighting a significant gap in early warning systems within Akatsi North District.

4.2.4.2 Sensitivity to Hazards

The study further analysed the sensitivity of key sectors in Akatsi North District to climate impacts, focusing on climate-induced hazards such as floods, droughts, soil erosion, bushfires, windstorms, sea level rise, pests, diseases, and both low and excessive rainfall. Using word clouds to visually represent the extent of sensitivity, the results show that the health sector is the most sensitive to climate impacts, followed by water resources and agriculture. Biodiversity and infrastructure were perceived as relatively less sensitive to climate change.

In the health sector, two thirds of respondents reported having access to healthcare facilities. However, stakeholder engagements highlighted that healthcare services in the district are at a basic level, with no hospital available and only Community-based Health Planning Services (CHPS) compounds in place. This underscores the district's vulnerability to higher-level and emergency health needs in the face of climate-related stresses.

Water resources are also critical to the district's sensitivity to climate hazards. While 54% of respondents rely on standpipes and boreholes, and 17% use sachet water as their primary drinking source, 22% use dams for drinking water. These dams play a vital role in residents' livelihoods. However, many are poorly maintained, with plants and sand covering much of the water, limiting its availability for consumption, crops, and livestock. Stakeholder engagements and FGDs revealed that the water quality and quantity are insufficient to meet the needs of the community.

Agriculture is another sector highly sensitive to climate change impacts. The significant livelihood dependence on agriculture means that a bad season of yields directly translates to a bad year of livelihood. Although men, reported higher sensitivity to climate change's impacts on agriculture than women, the study finds that both male and female are highly sensitive to climate impacts on agriculture.

Figure 13: Word cloud with size should the level of sensitivity in the sector to climate hazard in Akatsi North District. Total (Green), Women (Red), Men (Blue).

Source: Author's own computation from Survey

4.2.4.3 Health and Well-Being

The data reveals notable differences in health-related issues and healthcare access between male and female-headed households. While healthcare is technically available, barriers—particularly cost—pose a significant challenge to households, with female-headed households experiencing greater difficulties in obtaining services.

In terms of health issues related to climate change, heatstroke and heat exhaustion are reported more frequently in male-headed households (32.1%) than in female-headed households (29.2%). However, respiratory problems are more prevalent in female-headed households, with a marked difference: 66.7% of female-headed households report respiratory issues, compared to 36.4% of male-headed households. This suggests that climate-related health risks, especially respiratory problems, may disproportionately affect women.

Waterborne diseases are reported in both male and female-headed households, though male-headed households (14.8%) report them slightly more than female-headed households (8.3%). Malnutrition is a significant concern, with 70.8% of female-headed households reporting it, compared to just 23.5% of

male-headed households. This indicates that women in these households may be more vulnerable to food insecurity or poor nutrition due to climate change effects.

Mental health issues are reported by a very small percentage of respondents, with only 2.5% of male-headed households and no female-headed households reporting climate-related mental health problems. This suggests that mental health challenges may either be underreported or less often linked to climate impacts. Similarly, injuries related to climate change are reported by a small percentage of both groups – 2.2% of male-headed households and 4.2% of female-headed households – indicating that physical injuries are a concern, but not as widespread as other climate-related health impacts.

When it comes to healthcare access, the majority of households report difficulties, particularly among female-headed households. While 22.8% of male-headed households report easy access to healthcare, only 4.2% of female-headed households report the same. A significant portion, 74.1% of male-headed households and 91.7% of female-headed households, report that healthcare is available but difficult to access, likely due to factors such as distance, cost, or other barriers. Only a small percentage (3.1% of male-headed households and 4.2% of female-headed households) report having no access to healthcare at all.

Cost is the dominant barrier to accessing healthcare, with nearly half of respondents from both male and female-headed households citing it as the primary challenge – 48.5% of male-headed households and 49.2% of female-headed households. Other common barriers include the availability and quality of care: 19.1% of male-headed households and 15.1% of female-headed households report availability issues, while 19.6% of male-headed households and 20.2% of female-headed households identify the quality of care as a concern. Distance and transportation are less significant barriers, with 8.1% of male-headed households and 10% of female-headed households mentioning distance as an issue, and 4.8% of male-headed households and 5.6% of female-headed households citing transportation. Notably, no respondent reported "other" challenges, suggesting that the main barriers are widely recognized and understood.

4.2.5 Household Adaptive Capacity

4.2.5.1 Social and Decision-Making Roles

The data reveals how gender dynamics influence decision-making related to climate exposure and sensitivity, with significant differences between male and female-headed households. The survey explored responses regarding household decisions related to finances, income-generating activities, and children's education.

In male-headed households, 69% of decisions about finances are made by the male head, with joint decision-making accounting for 30%, leaving just 1% for women in financial decisions. In contrast, in female-headed households, 68% of financial decisions are made by women, with 24% made jointly. Similarly, for income-generating activities, decisions in male-headed households are largely made by the male head (57%) or jointly (41%). In female-headed households, the female head typically makes 65% of these decisions, with 33% made jointly. These findings suggest that both male and female-headed households tend to share similar financial roles within their respective households, emphasizing the need for equity in resource access and income distribution.

In decisions about children's education, 35.5% of male-headed households make decisions alone, while 61% of decisions are made jointly. In female-headed households, 59.4% of educational decisions are made by the female head alone, and 39.1% are made jointly. This difference indicates that in male-headed households, education decisions are a more collaborative priority, whereas in female-headed households, women take a dominant role, reflecting their greater focus on children's education.

The study also highlights differing responsibilities in farming and other domestic tasks. In male-headed households, 38% of males are primarily responsible for farming, while 57% of females in female-headed households bear the primary responsibility. However, shared farming tasks are more common in male-headed households (61%) compared to female-headed households (42%). This suggests that farming in male-headed households tends to be more collaborative, while women in female-headed households predominantly take on farming duties. Water collection, however, is predominantly the responsibility of

females in both household types, with 54% of males in male-headed households and 72% in female-headed households reporting this. Shared water collection is more common in male-headed households (30%) compared to female-headed households (28%), demonstrating that while women bear the primary responsibility for water collection, the burden is significantly higher in female-headed households. In households of migrant communities, especially Fulani community, this vulnerability is exacerbated as, such social amenities such as well and damns are not present, and their communities are removed from the district. Implying that women in these households must travel long distances into other communities to access potable water for household use.

Similarly, childcare largely falls to females, with 33% of male-headed households and 71% of female-headed households reporting that women are the primary caregivers. Shared childcare responsibilities are more common in male-headed households (47%) compared to female-headed households (29%), indicating that in female-headed households, women almost exclusively bear the caregiving role.

Regarding the impact of climate change on women, both male and female-headed households report that the increased workload is the primary effect, with 31.7% of females in female-headed households reporting this compared to 28.4% in male-headed households. Other impacts, such as reduced income, health problems, and limited access to resources, are reported similarly across both male and female heads, with no significant differences between the groups.

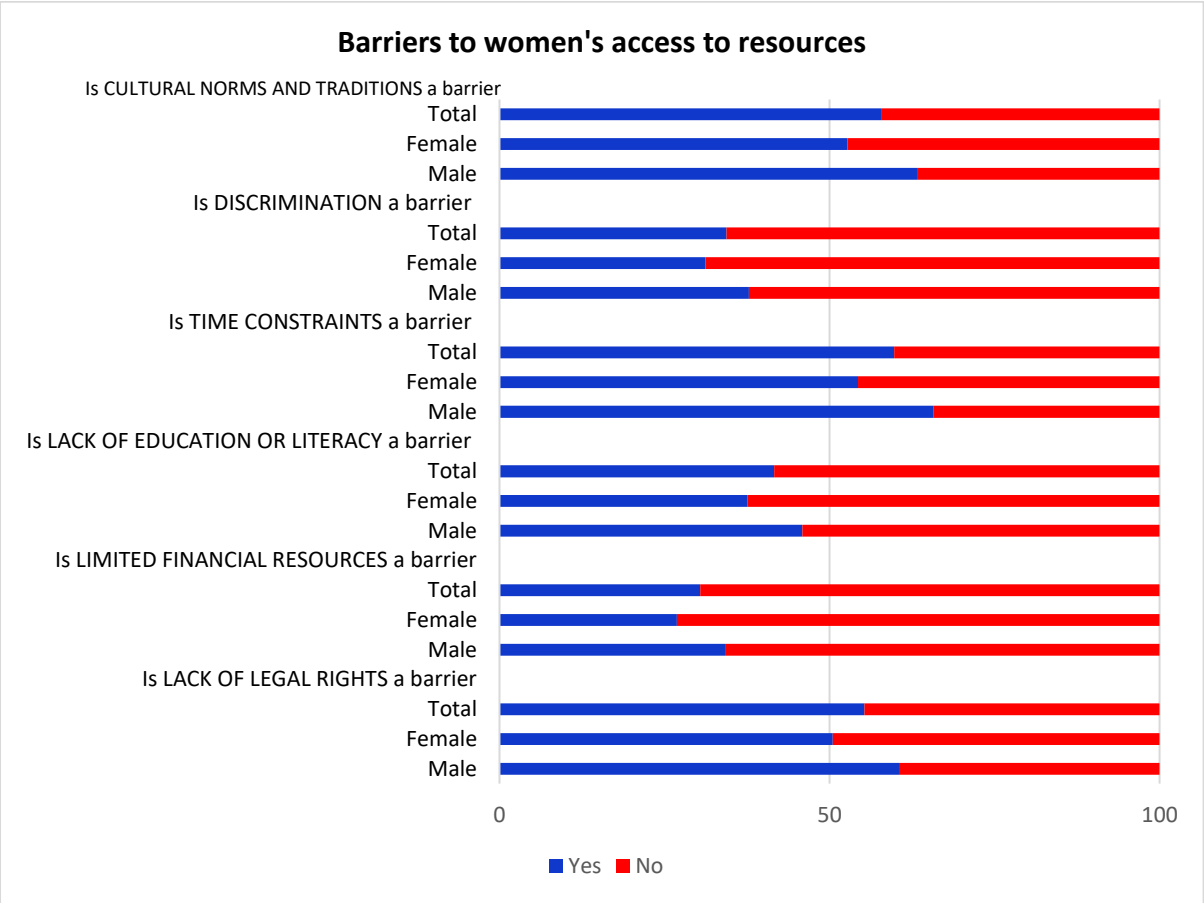
4.2.5.2 Access to Resources

Regarding access to resources, the study shows that women have slightly less access to land. Although 66% of male-headed households and 68% of female-headed households reported a disparity. Both groups also agree that women have limited access to credit (92%), information and training (89%), and agricultural inputs (88% of male-headed households and 90% of female-headed households). These barriers significantly contribute to women's vulnerability to climate change, as limited access to essential resources hinders their ability to adapt to changing environmental conditions.

The study also assesses both male and female household heads' perspectives on the barriers that hinder women's access to resources. Cultural norms and traditions, time constraints, and lack of legal rights are seen as the primary barriers to women's access to resources. More than half of respondents agree on the significant impact of these barriers. Cultural norms are widely viewed as limiting women's access to resources, while time constraints, due to household and caregiving responsibilities, further hinder women's participation in economic activities. The lack of legal rights is also recognized as a key barrier, as inadequate legal protections restrict women's access to resources.

In contrast, barriers such as limited financial resources, lack of education or literacy, and discrimination are perceived as less impactful by less than half of the respondents. While financial limitations are acknowledged, they are not seen as universally impactful. Similarly, although lack of education or literacy and discrimination are important issues, they are recognized by a smaller proportion of respondents, indicating that these challenges, while significant, are less widely acknowledged than the other barriers.

Figure 14: Barriers to women's access to resources



Source: Akatsi North Household survey

4.2.5.3 Support and Empowerment

The data reveals that local organizations or groups supporting women in adapting to climate change are limited, with only a small proportion of households reporting their existence. Among male-headed households, just 5.9% acknowledge the presence of such organizations, while 16.7% of female-headed households report similar access. This disparity suggests that female heads may be more aware of or better connected to these support networks. However, the vast majority – 94.1% of male-headed households and 83.3% of female-headed households – indicate that they have no access to local organizations or groups offering support. For persons with disability, support and empowerment from family and friends remain a crucial part of their livelihoods. Although this is not always adequate or present. This highlights a significant gap in localized resources and networks to assist women in coping with climate-related challenges, underscoring the need for enhanced outreach and the development of community-based support systems tailored to the unique needs of women.

4.3 Projected Climate Trends and Implications

This section presents analysis of projected climate trends in Akatsi North, focusing on how these changes affect gendered vulnerabilities and communal resilience.

4.3.1 Projected Climate Trends

4.3.1.1 Precipitation

The analysis of annual total precipitation in Akatsi North reveals notable trends and potential climate-related challenges under both historical and future climate scenarios. Historical data shows significant interannual variability in precipitation (1000 mm - 1800 mm), reflecting the region's dynamic hydrological

nature. However, future projections indicate a reduction in this variability, likely due to the smoothing effect of long-term model simulations, though extreme events remain a possibility.

In the near future (~2020–2040), the SSP 5-8.5 scenario, representing high emissions, projects higher precipitation amounts compared to the SSP 2-4.5 scenario, which assumes moderate emissions. This divergence suggests complex and nonlinear responses to increased greenhouse gases. However, by the far future (~2060–2100), SSP 5-8.5 predicts a sharp decline in precipitation, signaling drier conditions and increased risks for water availability and ecosystems. In contrast, SSP 2-4.5 indicates more stable precipitation patterns with lower variability, emphasizing the benefits of climate action to maintain water resources and reduce vulnerabilities.

Additionally, climate indices for Akatsi North show declines in extreme rainfall events (Rx1 and Rx5), dry days, moderate rainfall days (R10mm), and very wet days' contribution to total precipitation (R95pTOT). These changes suggest a reduction in the intensity and frequency of extreme rainfall, with longer dry periods. While low-intensity rainfall events are expected to increase (as shown by higher wet and consecutive wet days), the overall trend indicates heightened risks of water stress and altered hydrological patterns.

The findings underscore the need for targeted adaptation and mitigation strategies. In the near term, the increased precipitation under SSP 5-8.5 could create water management challenges, such as flooding or inefficient use. However, the long-term decline highlights the importance of proactive planning to prevent water shortages, including investments in water conservation, sustainable agriculture, and climate resilience efforts in vulnerable communities.

Figure 15 presents historical and projected mean precipitation patterns under SSP 5-8.5 and SSP 2-4.5 scenarios for Akatsi North, segmented into four periods: Historical (1990-2020), Near Future (NF, 2026-2050), Mid Future (MF, 2051-2075), and Far Future (FF, 2076-2100). The SSP 5-8.5 scenario (red) shows higher precipitation amounts compared to SSP 2-4.5 (green) within the NF period, with notable and significant declines towards the far future. Historical mean and future scenario means are marked with horizontal, continuous lines along with the standard deviations (dashed lines) for comparative analysis across different timeframes and regions.

Figure 15: Historical and projected annual mean precipitation for Akatsi North

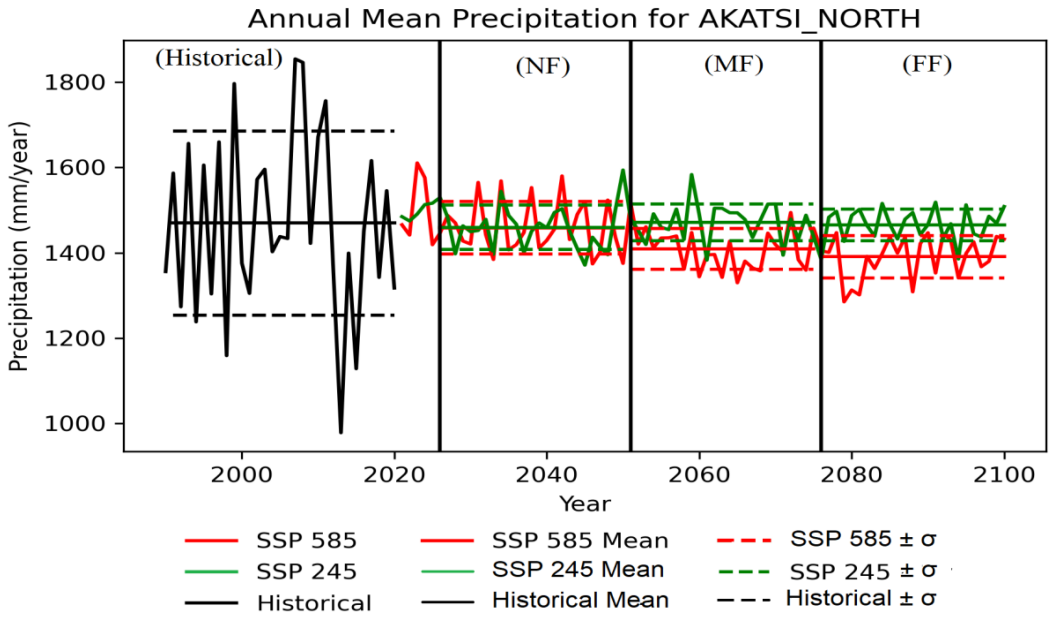
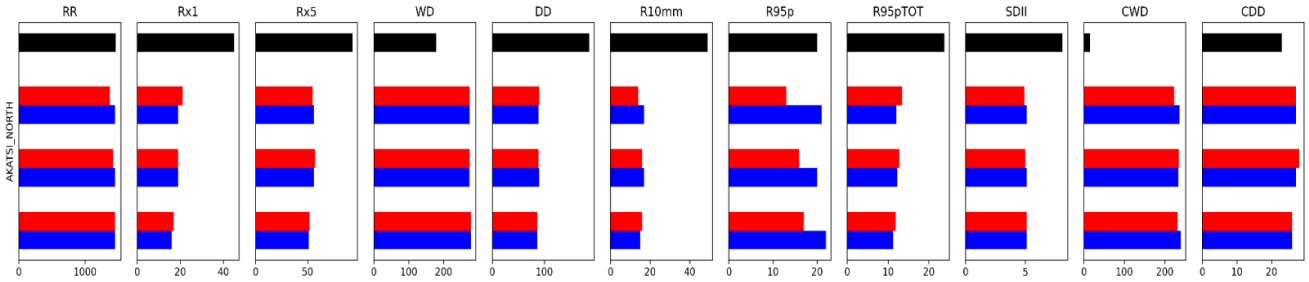


Figure 16 shows historical and projected climate extreme metrics across the Akatsi North District. Black bars denote the historical pattern, and the red and blue boxes denote SSP 2-4.5 and SSP 5-8.5 respectively for the projection periods.

Figure 16: Historical and projected climate extreme metrics across Akatsi North District



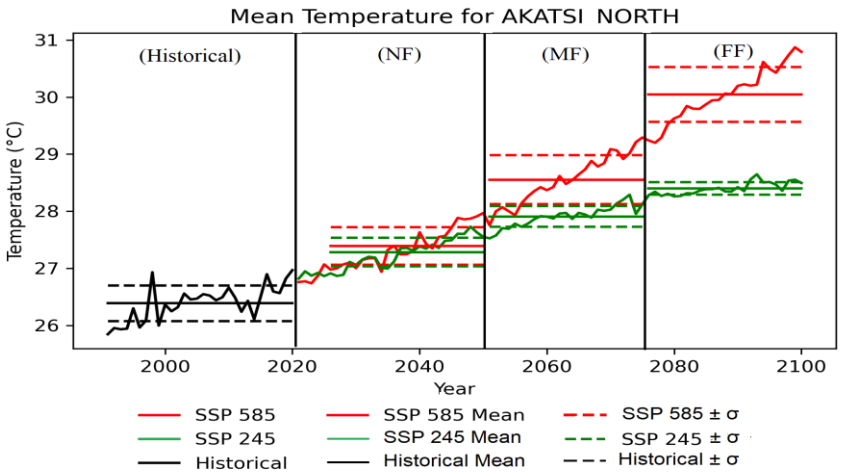
4.3.1.2 Temperature

The temperature projections for Akatsi North reveal a consistent and steep rise throughout the 21st century, with accelerated warming anticipated by the century's end. Under the high emissions SSP 5-8.5 scenario, temperatures are projected to peak around 31°C, significantly exceeding those estimated under the moderate SSP 2-4.5 scenario. The approximately 3°C difference between these scenarios highlights the substantial influence of greenhouse gas emissions on regional temperature trends.

The pronounced temperature increase under SSP 5-8.5 carries severe implications, including intensified heat stress, elevated evapotranspiration rates, and potential reductions in agricultural productivity. In contrast, the more moderate warming under SSP 2-4.5 underscores the benefits of climate mitigation, demonstrating that emissions reduction efforts can significantly curb these adverse effects. This highlights the urgency of adopting sustainable development practices and effective climate policies to protect livelihoods and ecosystems in Akatsi North.

Figure 17 presents historical and projected mean temperature patterns under SSP 5-8.5 and SSP 2-4.5 scenarios for Akatsi North, segmented into four periods: Historical (1990-2020), Near Future (NF, 2026-2050), Mid Future (MF, 2051-2075), and Far Future (FF, 2076-2100). The SSP 5-8.5 scenario (red) consistently shows higher temperatures compared to SSP 2-4.5 (green) across all locations, with notable and significant increases in the far future. Historical mean and future scenario means are marked with horizontal, continuous lines along with the standard deviations (dashed lines) for comparative analysis across different timeframes and regions.

Figure 17: Historical and projected mean temperature for Akatsi North (four periods)



4.3.1.3 Summary of Projected Climate Trends and Implications for Akatsi North District

The analysis of the projected climate trends for Akatsi North District shows that in general:

- **Rainy Days Projections for Akatsi North:** For rainy days, projections indicate that Akatsi North, as part of the southern regions, is expected to maintain levels comparable to historical data, with more than 1000 rainy days under both SSP scenarios. This is consistent with historical trends for the area.
- **Wet Days (WD) and Dry Days Projections for Akatsi North:** Akatsi North is projected to experience an increase in wet days (WD), with future projections exceeding 200 wet days for both SSP scenarios, compared to approximately 100 wet days historically. Additionally, the region is expected to see a significant reduction in dry days, with the number of dry days decreasing to around 80, compared to over 150 days historically.
- **R10mm Days (Rainfall Days Over 10mm) in Akatsi North:** In Akatsi North, significant decreases in R10mm days (days with rainfall over 10mm) are projected. While southern regions, including Akatsi North, will see a reduction, the area's future values may drop to around 3 days, compared to over 30 days historically. This reflects a shift toward fewer intense rainfall events.
- **Consecutive Dry Days (CDD) in Akatsi North:** Consecutive dry days (CDD) are expected to increase in Akatsi North under both future SSP scenarios. The region is anticipated to experience the most substantial increase in consecutive dry days, with values rising to more than 40 days, compared to approximately 30 days historically.
- **Simple Daily Intensity Index (SDII) in Akatsi North:** Rainfall intensity, measured by the Simple Daily Intensity Index (SDII), is projected to drop significantly, with southern regions like Akatsi North experiencing reductions to about 3–5 mm/day from historical levels exceeding 10 mm/day. These changes emphasize a trend toward fewer but less intense rainfall events, coupled with prolonged dry periods.

Table 8: Summary of projected climate trends in Akatsi North District

Climate Variable	Key Findings	Implications
Rainfall Patterns	• Rainy days remain stable at over 1000 days under both SSP scenarios. • Wet days (WD) increase to over 200 days, while dry days decline to about 80 days compared to over 150 historically.	Stable rainy days and increased wet days can support farming activities but may elevate risks of floods and waterlogging.
Annual Precipitation	• Historical variability of 1000–1800 mm reduces under future projections. • SSP 5-8.5 shows a significant decline in precipitation in the far future (~2060–2100). • SSP 2-4.5 indicates stable precipitation with fewer signs of long-term decline.	Reduced variability under SSP 2-4.5 could benefit agricultural planning, while long-term declines under SSP 5-8.5 may exacerbate heightened risks of water stress.
Rainfall Extremes	• Heavy rain days (R95p) and intensity (SDII) are projected to decrease significantly. • Consecutive wet days (CWD) increase, while consecutive dry days (CDD) rise 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 prolonged dry spells and decreased water availability 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.

4.3.2 Projected Climate Change Trends and Gender Vulnerability

4.3.2.1 Livelihoods and Economic Changes

The climate projections for Akatsi North highlight significant challenges for local livelihoods, particularly in agriculture, which is the primary economic activity in the region. Climate hazards such as erratic rainfall, flooding, droughts, and rising temperatures are expected to disrupt crop and livestock production.

Table 9: Projected impacts of changing climate on changes in livelihoods and economic changes by gender from the participatory stakeholder engagement and FGDs

Community	Climate Change	Women	Men	Youth	PWD
Avevi	Erratic rainfall, prolonged dry spells	Increased burden in farming, reduced earnings from crops.	Lower crop yields affect income; pressure to adopt resilient methods.	Disrupted education due to increased farm work.	Greater reliance on family for support.
Ashiagborvi	Deforestation, erratic rainfall, increased bush burning, temperature changes	Challenges in preserving food security; reduced economic options.	Increased difficulty in maintaining farms; higher costs for irrigation.	Limited entrepreneurial opportunities.	Increased vulnerability to food shortages.
Ave Afiadenyigba	Flooding and waterlogging	Loss of farmland affects income; strain on household resources.	Higher costs for flood recovery; reduced farming output.	Migration in search of stable work; interrupted studies. Cutoff from other communities	Mobility challenges worsen during floods.
Ave Dakpa	Droughts and reduced rainfall	More time spent on water collection; reduced productivity in subsistence farming.	Difficulty sustaining livestock; increased investment pressures.	Fewer alternatives to traditional livelihoods.	Exacerbated isolation and dependency.
Ave Xevi	Heatwaves, water scarcity	Increased health risks and reduced energy for daily tasks.	Stress from providing irrigation; lower income from cash crops.	Limited ability to adapt to heat-related challenges.	Difficulty accessing medical care.
Nyitawuta	Prolonged dry periods, drying of water bodies, irregular rainfall	Higher workloads to secure water for households.	Struggles to maintain agricultural income. Cutoff from other communities.	Disrupted education due to inadequate infrastructure.	Difficulty adapting infrastructure for disabilities.
Hadave	Heavy rains, inconsistent patterns	Strain on maintaining crops during extreme rains.	Damage to farm equipment and facilities.	Risk of job displacement due to economic instability.	Infrastructure damage increases dependency.
Dzadzepe	Soil erosion, flooding	Efforts to maintain food crops with diminished soil quality.	Investment challenges in soil improvement methods.	Reduced farming engagement opportunities.	Loss of productive engagement capacity.

Community	Climate Change	Women	Men	Youth	PWD
Kpegbadza	Flash flooding, drought risks	Increased effort to secure household safety and stability.	Financial losses from infrastructure damage.	Pressure to relocate for safety or economic reasons.	Risk of neglect during community crises.
Zemu	Deforestation, erratic rainfall, increased bush burning, temperature changes	Limited ability to ensure food sufficiency.	Increased debt due to unstable agricultural returns.	Economic migration in search of better opportunities.	Reduced capacity for mobility-related tasks.

4.3.2.2 Projected Impacts on Access to Resources

Climate change is projected to affect access to key resources such as water, land, and agricultural inputs in Akatsi North. Women, who are largely responsible for collecting water and managing household resources, will bear the brunt of increased water scarcity and the additional demand for water during droughts. Men will face challenges in securing adequate water for agricultural use, which is critical for both food production and livestock. Youth, often helping with agricultural work, will encounter barriers to accessing resources that are vital for maintaining family farms. People with disabilities may experience significant difficulty accessing water and land, potentially exacerbating their vulnerability due to limited mobility. Access to resources such as irrigation systems and agricultural tools will also be affected by flooding and soil erosion, heightening the competition for resources and leaving the most vulnerable groups struggling to meet basic needs.

Table 10: Projected impacts of changing climate on access to resources by gender from the participatory stakeholder engagement and FGDs

Community	Climate Change	Women	Men	Youth	PWD
Avevi	Erratic rainfall, prolonged dry spells	Increased time collecting water and managing household shortages.	Difficulty accessing irrigation and fertilizers.	Challenges finding affordable resources.	Reliance on others for water and mobility.
Ashiagborvi	Deforestation, erratic rainfall, increased bush burning, temperature changes	Competing needs for shared water resources.	Difficulty managing water for livestock and irrigation.	Limited access to climate-adaptive tools.	Reduced mobility to collect essentials.
Ave Afiadenyigba	Flooding and waterlogging	Limited access to clean drinking water.	Resources diverted to rebuilding efforts.	Reduced involvement in education due to infrastructure impacts.	Dependence on family for mobility.
Ave Dakpa	Droughts and reduced rainfall	Struggles to secure consistent water for households.	Difficulty maintaining irrigation and crop systems.	Limited economic diversification.	Heightened vulnerability to resource scarcity.
Ave Xevi	Heatwaves, water scarcity	Compromised access to health and agricultural resources.	Difficulty sustaining irrigation during heat waves.	Reduced ability to find alternative livelihoods.	Challenges accessing health and water.
Nyitawuta	Prolonged dry periods, drying of water bodies,	More effort spent accessing communal water points.	Difficulty ensuring consistent water for farming.	Limited opportunity for personal and economic growth.	Dependency increases in water-scarce conditions.

Community	Climate Change	Women	Men	Youth	PWD
	irregular rainfall				
Hadave	Heavy rains, inconsistent patterns	Difficulty securing access to clean water and transport.	Damage to community water systems affects irrigation.	Reduced job and education prospects.	Difficulty navigating damaged infrastructure.
Dzadzepe	Flooding Soil erosion	Competition for declining natural resources.	Difficulty stabilizing farming resources.	Reduced opportunity for resource engagement.	Increased reliance on family members.
Kpegbadza	Flooding and river overflows	Restricted access to household and community water.	Loss of agricultural access routes.	Limited ability to access educational facilities.	Barriers to accessing public infrastructure.
Zemu	Seasonal variability, crop failures	Strain accessing adaptive farming inputs.	Resource access becomes less predictable.	Less engagement in resource-based activities.	Dependency on adaptive infrastructure.

4.3.2.3 Responsibilities within Households

The impacts of climate change in Akatsi North will shift the roles and responsibilities of all gender groups within households and communities. The climate-induced shifts in responsibilities will place additional stress on women and marginalized groups, requiring targeted adaptation strategies to address their specific needs and ensure their continued involvement in community resilience efforts.

Table 11: Projected impacts of climate change on responsibilities within households and communities from the participatory stakeholder engagement and FGDs

Community	Climate Change	Women	Men	Youth	PWD
Avevi	Erratic rainfall, prolonged dry spells	Increased responsibility in household water collection and food security.	Focus on rebuilding infrastructure and securing income.	Increased involvement in agricultural labour, especially in family-owned farms.	Dependence on others for mobility and support.
Ashiagborvi	Deforestation, erratic rainfall, increased bush burning, temperature changes	Responsible for food preservation and managing household resources during heat stress.	Role in ensuring farm irrigation systems function.	Increased pressure to support family livelihoods.	Increased reliance on family for mobility and tasks.
Ave Afiadenyigba	Flooding and waterlogging	Increased responsibility in managing household safety and flood recovery.	Managing financial resources for flood recovery and infrastructure repair.	Increased responsibilities in rebuilding community assets and resources.	Difficulty with mobility and independence during recovery.

Community	Climate Change	Women	Men	Youth	PWD
Ave Dakpa	Droughts and reduced rainfall	Increased role in collecting water and ensuring food sufficiency.	Managing livestock and crop adaptation strategies.	Pressure to contribute to family welfare.	Difficulty engaging in agricultural and household tasks.
Ave Xevi	Heatwaves, water scarcity	Handling daily chores with increased strain from heat and water scarcity.	Pressure to provide for family's water needs and food security.	Increased community responsibilities due to strained resources.	Strain in managing mobility and independence.
Nyitawuta	Prolonged dry periods, drying of water bodies, irregular rainfall	Increased responsibility for water collection and food management during droughts.	Efforts to secure water for agriculture and livestock.	Increased responsibilities in terms of livelihood support.	Increased reliance on family for water and assistance.
Hadave	Heavy rains, inconsistent patterns	Managing household safety and ensuring the upkeep of home during floods.	Repairing damages to household infrastructure and securing water for irrigation.	Increased pressure to help with farm work or migrate for better opportunities.	Strained responsibilities due to mobility and accessibility issues.
Dzadzepe	Flooding Soil erosion	Increased efforts to protect household and community resources from soil erosion.	Greater pressure to maintain farmland and livestock.	Increased involvement in soil restoration activities.	Reduced engagement in soil restoration activities due to mobility constraints.
Kpegbadza	Flooding and river overflows	Taking on added responsibility for flood management and household safety.	Maintaining farm resources and infrastructure during floods.	Increased need to assist in rebuilding efforts or seek alternative livelihoods.	Increased isolation and reliance on others for community rebuilding.
Zemu	Seasonal variability, crop failures	Managing food storage and family resources during seasonal variations.	Increased role in securing livelihoods through alternative methods.	Increased pressure to support family and community efforts in resource management.	Difficulty in carrying out responsibilities due to reduced mobility and access.

4.3.3 Projected Climate Implications on Community Vulnerability

Akatsi North District is becoming increasingly vulnerable due to projected changes in climate patterns, such as rising temperatures, erratic rainfall, and prolonged dry spells. These climatic shifts present significant threats to the district's predominantly agrarian economy, as farmers heavily rely on rain-fed agriculture, making them highly susceptible to droughts, floods, and unpredictable growing seasons. With key crops like maize, cassava, and tomatoes dependent on stable rainfall, changing patterns could lead to reduced yields and food insecurity. Extreme weather events, including heavy rains and storms, are expected to exacerbate flooding, soil erosion, and pest outbreaks, further undermining agricultural productivity and household livelihoods.

The district's vulnerabilities are further compounded by weak infrastructure and limited access to essential services. Poorly maintained roads hinder market access and emergency response during floods, while the lack of reliable water sources increases dependence on rainwater collection, leaving households highly vulnerable to water scarcity during dry seasons. In communities like Nyitawuta and

Xevi, where water sources are either insufficient or unreliable, climate impacts on water availability could exacerbate health and sanitation risks. Additionally, limited healthcare access and inadequate educational infrastructure across the district reduce resilience to climate-induced challenges. Without targeted interventions, these factors could deepen poverty, increase inequality, spur migration, and undermine the district's overall adaptive capacity.

Through focus group discussions (FGDs) with community members from Avevi, Ave Dzadzepe, Ave Afiadenyigba, Ave Dakpa, Ave Xevi, and Nyitawuta, the study gathered firsthand accounts of the challenges they face, along with their concerns for the future. These insights offered valuable context for understanding the vulnerabilities and adaptive capacities within each community.

- **Nyitawuta**

Nyitawuta is particularly vulnerable to further marginalization due to its isolated and underdeveloped infrastructure. The lack of motorable roads, coupled with the absence of mobile phone networks and internet connectivity, creates substantial barriers to accessing essential services and opportunities. Despite having a newly constructed clinic, frequent absenteeism of health workers due to poor road conditions limits healthcare access for residents. The community's only primary school, a fragile structure made from straw and bamboo, reflects the neglect in educational investment. Water sources are restricted to rainfall collection and community streams, exacerbating vulnerability during dry seasons. Additionally, the community's reliance on rain-fed agriculture makes it highly susceptible to delayed or insufficient rainfall, intensifying fears of food insecurity. Health concerns also persist, as extreme weather events and inadequate healthcare expose residents to climate-related illnesses. These compounded vulnerabilities underscore the community's precarious position and growing anxiety about an increasingly unstable future. As resources become scarcer and economic pressures intensify, residents foresee an increase in migration and the disintegration of traditional support systems. They are also concerned about their inability to adapt to worsening conditions, which could lead to long-term poverty and further marginalization.

Key future vulnerability trends for the community include:

- ***Migration Trends:*** Rising economic pressures and resource scarcity may drive increased migration as residents seek more stable living conditions.
- ***Breakdown of Support Systems:*** As climate impacts worsen, traditional community support structures could weaken, further isolating vulnerable groups.
- ***Adaptation Challenges:*** The inability to effectively adapt to escalating climate risks may lead to long-term poverty, exacerbating existing inequalities.
- ***Increased Vulnerability:*** Without significant investments in infrastructure and services, Nyitawuta's vulnerabilities will likely intensify, particularly in agriculture, health, and education.
- ***Need for Targeted Interventions:*** The community's precarious situation highlights the urgent need for targeted interventions to strengthen resilience and adaptive capacity.

Photo 4: Focus group discussions in Nyitawuta

- **Avevi**

Avevi is facing significant challenges due to the impacts of climate change, particularly erratic rainfall patterns and declining soil fertility. Farmers in the community are experiencing a consistent decrease

in crop yields, which raises concerns about future hunger and poverty. The loss of agricultural productivity has a ripple effect on local trade, especially for women who rely on farming outputs for their businesses. Additionally, environmental degradation, including deforestation and soil erosion, exacerbates the situation, threatening biodiversity and weakening the community's resilience. The community of Avevi is deeply concerned about the worsening food insecurity and hunger caused by the unpredictable rainfall and the increasing frequency of extreme weather events. These climate-induced challenges jeopardize agricultural livelihoods, potentially leading to economic hardship and deepened poverty. Residents express anxiety about their ability to sustain their families, particularly as subsistence farming becomes increasingly unfeasible.

Key future vulnerability trends for the community include:

- ***Increased Vulnerability to Climate Change:*** The community will face intensified challenges due to erratic rainfall patterns, declining soil fertility, and more frequent extreme weather events, potentially deepening food insecurity and poverty.
- ***Declining Agricultural Productivity:*** As climate change continues to affect rainfall and soil health, Avevi's farming community will struggle with reduced crop yields, undermining both subsistence farming and the local economy.
- ***Economic Strain on Women Traders:*** Women, who depend on farming outputs for their businesses, may experience economic difficulties as agricultural productivity declines, further reinforcing gender disparities and economic vulnerability.
- ***Environmental Degradation:*** Deforestation and soil erosion will likely worsen, leading to a loss of biodiversity and diminished natural resources, exacerbating both agricultural challenges and the community's overall resilience.
- ***Food Insecurity and Hunger:*** With the unpredictable climate and declining agricultural outputs, Avevi will face an increasing risk of food insecurity, potentially leading to long-term socio-economic consequences, including poverty, malnutrition, and migration.
- ***Resource Scarcity and Migration:*** The scarcity of essential resources, particularly water, could trigger migration as people seek more stable livelihoods, which may strain other communities and further marginalize Avevi.
- ***Climate Adaptation Needs:*** The community will need innovative solutions for climate resilience, including sustainable farming practices, improved water management, and strengthened infrastructure to help mitigate the future impacts of climate change.

Photo 5: Focus group discussions in Avevi

➢ **Ave Dzadzepe**

Ave Dzadzepe, residents are deeply concerned about food insecurity driven by unpredictable weather patterns. The decreasing reliability of rainfall and prolonged dry spells have disrupted farming cycles, reducing crop yields and jeopardizing household food supplies. The community fears that these climate challenges could lead to increased migration as people seek alternative livelihoods outside the area. Additionally, the already fragile infrastructure, including roads and water systems, is particularly vulnerable to extreme weather events, which could isolate the community and further limit access to essential resources and markets. With the continuing decline in agricultural yields due to erratic rainfall and deteriorating soil fertility, the community anticipates a future marked by significant financial instability and widespread unemployment. This fear is compounded by the potential for long-term environmental degradation, making recovery from climate impacts increasingly difficult.

Key future vulnerability trends for the community include:

- ***Rising Food Insecurity:*** As erratic weather patterns continue to disrupt farming cycles, the community of Ave Dzadzepe faces an increased risk of food insecurity, threatening household food supplies and agricultural livelihoods.
- ***Migration Pressures:*** The growing challenges of unreliable rainfall and diminishing agricultural productivity are expected to drive migration, with residents seeking alternative livelihoods outside the community due to economic instability.
- ***Vulnerable Infrastructure:*** The already strained infrastructure in Ave Dzadzepe, including roads and water systems, remains highly vulnerable to extreme weather events, risking further isolation and reduced access to essential services and markets.
- ***Financial Instability and Unemployment:*** The decline in crop yields and agricultural viability could lead to widespread financial instability, with significant impacts on employment opportunities and economic hardship for residents.
- ***Long-term Environmental Degradation:*** Prolonged climate impacts are expected to exacerbate environmental degradation, including soil erosion and reduced fertility, making it increasingly difficult for the community to recover and adapt to changing conditions.

Photo 6: Focus group discussions in Ave Dzadzepe

➢ **Ave Afiadenyigba**

Ave Afiadenyigba is facing severe challenges as hunger and extreme poverty worsen due to the impacts of climate change on farming and trade, which are the community's main economic pillars. Women, in particular, carry a disproportionate burden, as they are primarily responsible for ensuring household food security and generating income. The unpredictable rainfall and declining agricultural productivity have exacerbated their economic disempowerment, making it increasingly difficult for many to provide for their families or afford education for their children. Limited access to quality healthcare further compounds the community's vulnerability, as climate-related illnesses become more common. Residents of Ave Afiadenyigba fear that the intensifying climate conditions, including erratic weather patterns and heavy rains, will lead to recurring flooding, which could destroy farmlands, homes, and essential infrastructure. This would deepen the community's vulnerability and could perpetuate cycles of poverty, hunger, and displacement, making it harder for families to recover and adapt to these worsening conditions.

Key future vulnerability trends for the community include:

- ***Increased Vulnerability to Food Insecurity***: Ave Afiadenyigba's dependence on farming and trade makes it highly vulnerable to erratic weather patterns, leading to reduced crop yields and heightened food insecurity. Women, who are central to food security and income generation, face growing economic disempowerment.
- ***Risk of Worsening Flooding:*** Climate change-related extreme weather, including heavy rains, is expected to increase the frequency and severity of flooding. This poses a threat to agricultural productivity, infrastructure, and housing, further deepening the community's vulnerability.
- ***Deteriorating Health Outcomes:*** Limited access to quality healthcare, coupled with the rise of climate-related illnesses, will continue to impact the well-being of residents, further straining the community's capacity to cope with climate change.
- ***Economic Instability:*** With declining yields and limited access to markets and resources, Ave Afiadenyigba faces a future of persistent financial instability. This may lead to higher levels of unemployment, especially among women, and perpetuate cycles of poverty.

- ***Migration and Displacement:*** As climate impacts worsen, migration in search of better livelihoods is likely to increase, potentially leading to the displacement of families and the breakdown of traditional support systems.

Photo 7: Focus group discussions in Ave Afiadenyigba

➢ **Ave Dakpa**

Ave Dakpa's residents face growing concerns about the future as declining rainfall patterns and increasing water scarcity threaten their farming activities. The community, heavily reliant on rain-fed agriculture, has already experienced food shortages due to delayed and insufficient rainfall. The situation is further compounded by pests and diseases, such as fall army worms and termites, which are damaging crops, reducing farmers' incomes, and exacerbating food insecurity. During dry seasons, water scarcity becomes a critical challenge, as residents depend on limited water sources for both farming and household needs. The community's fears revolve around the broader impact of climate change on their social and economic stability. Ave Dakpa residents worry that persistent water scarcity, coupled with inadequate infrastructure, will lead to intense competition for resources, further increasing hardships. The inability to irrigate farms could make agricultural productivity nearly impossible, threatening the collapse of water-dependent livelihoods and deepening their vulnerability.

Key future vulnerability trends for the community include:

- ***Declining Rainfall and Water Scarcity:*** The community anticipates continued challenges from erratic rainfall patterns and growing water scarcity, which threaten their rain-fed agricultural practices and overall food security.
- ***Impact of Pests and Diseases:*** Increased threats from pests and diseases, like fall army worms and termites, are expected to further diminish crop yields, exacerbating income loss and food shortages.
- ***Social and Economic Stability:*** The ongoing water scarcity and limited infrastructure are predicted to intensify resource competition, pushing the community into deeper economic instability and hardship.
- ***Decrease in Agricultural Productivity:*** With inadequate irrigation options, Ave Dakpa faces the possibility of agricultural productivity decrease, further jeopardizing livelihoods and increasing vulnerability to climate impacts.
- ***Migration and Displacement:*** As conditions worsen, residents fear an increase in migration as families seek alternative livelihoods, potentially leading to the displacement of community members and further exacerbating poverty.

Photo 8: Focus group discussions in Ave Dakpa

- **Ave Xevi**

The unpredictability of rainfall in Ave Xevi is a major concern, disrupting farming schedules and affecting crop yields. The community is increasingly worried that worsening water security will make it difficult to sustain both agricultural activities and basic household needs. Limited infrastructure, such as the absence of effective irrigation systems, further weakens their capacity to adapt to the changing climate. These vulnerabilities leave Ave Xevi highly susceptible to food insecurity and economic hardship. Moreover, residents fear the complete collapse of their water resources, which are already on the brink of failure. The only dam in the area, located far from most households, is nearly completely covered with plants, making it unreliable. Additionally, the community's borehole is frequently nonfunctional, forcing residents to rely heavily on rainwater collection for household use. As climate change exacerbates water scarcity, the community fears it will struggle to meet basic needs and sustain livelihoods. This anxiety is compounded by concerns over worsening health and sanitation conditions, agricultural losses, and deepening economic challenges.

Key future climate vulnerability trends for the community include:

- ***Water Scarcity and Agriculture Impact:*** The ongoing and worsening water security challenges will continue to strain agricultural activities, making it harder for residents to maintain food production and livelihoods. Efforts to ensure reliable water resources will become critical in securing the community's future.
- ***Health and Sanitation Risks:*** The inadequate water supply and poor sanitation conditions pose serious health risks, particularly as waterborne diseases may rise due to contamination from unreliable water sources. Addressing water and sanitation infrastructure will be key to improving health outcomes.
- ***Infrastructure Needs:*** Limited infrastructure, such as functional irrigation systems and reliable water points, remains a critical vulnerability. There is an urgent need to develop resilient infrastructure to enable the community to adapt to climate changes and increase agricultural productivity.
- ***Economic Hardship and Food Insecurity:*** The unpredictability of rainfall and crop failures could deepen food insecurity, threatening the economic stability of the community. Economic diversification, such as promoting alternative livelihoods and strengthening food security measures, will be crucial to mitigating long-term impacts.
- ***Community Vulnerability to Climate Change:*** With already fragile systems in place, the community faces the risk of exacerbated vulnerabilities due to climate change. A coordinated effort to build adaptive capacity, such as increasing access to climate-resilient agricultural practices and expanding local resource management strategies, will be necessary to protect Ave Xevi from future climate-related challenges.

Photo 9: Focus group discussions in Ave Xevi

5. Implications for Gender-Responsive Climate Adaptation Planning and Resilience Building

While we acknowledge the limitation of the scope of this work to climate risk and vulnerability assessment, the implications of our findings to the logical step of adaptation planning make it imperative that we provide some early guidance and intervention suggestions for gender-responsive adaptation planning and resilience building. Such guidance, we believe, will inform the conceptualization of adaptation planning processes while also providing early insights into what specific interventions will look like both in the near and longer terms. Again, while these suggested measures are inexhaustive, not screened nor prioritized, we are of the view that as efforts advance to use current findings as the basis for district-specific adaptation planning, some if not all of suggested measures will give early indications of what should go into the very important process of gender-responsive adaptation planning and resilience building at the subnational level/district.

Thus, from our findings, there is no doubt that Akatsi North District faces significant climate vulnerabilities that undermine its social, economic, and physical resilience. Erratic rainfall, prolonged droughts, flooding, rising temperatures, and soil erosion disrupt livelihoods, strain social systems, and damage critical infrastructure. Additionally, poor access to clean water, lack of critical infrastructure such as hospitals and vocational training centres and rising youth unemployment exacerbate the district's fragility. These vulnerabilities are expected to worsen under future climate scenarios, disproportionately affecting marginalized groups like women, youth, and the elderly.

Gender-responsive strategies are crucial in addressing the challenges faced by Akatsi North, where women, who are primarily responsible for securing water and food for their households, disproportionately suffer from water shortages and declining agricultural yields. Additionally, youth face barriers such as limited educational and economic opportunities, which hinder their ability to adapt to changing conditions. To address these disparities, it is essential to adopt gender-inclusive approaches that ensure equitable access to resources, foster inclusive governance, and promote participation in decision-making processes.

The suggested adaptation measures demonstrate how intentional processes of adaptation planning should align with broader national development goals, the Nationally Determined Contributions (NDCs), as well as existing national sustainable development and resilience-building frameworks and policies. In their different forms, the suggested measures support overarching national sustainable development aspirations such as the promotion of food security, inclusive economic growth, and the provision of climate-resilient infrastructure. More, importantly, perhaps, it is also our desire that the suggested adaptation measures and the eventual district adaptation plans will respond and contribute to existing global commitments such as the Sustainable Development Goals (SDGs), particularly those that foreground the elimination of poverty (SGD 1), gender equality (SDG 5), reducing inequalities (SDG 10) and climate action (SDG 13).

5.1 Economic Adaptation Strategies

The economic adaptation strategies in Akatsi North District are designed to enhance the resilience of vulnerable groups, including women, youth, and marginalized communities, to the impacts of climate change. These strategies focus on diversifying income sources, improving access to financial services, promoting climate-smart agricultural practices, and fostering economic empowerment. Key interventions include providing training on sustainable livelihoods, facilitating access to climate-resilient agricultural inputs, supporting women entrepreneurs, and increasing access to technology and markets. Additionally, the development of climate-resilient infrastructure, vocational training, and community-based enterprises are essential to ensuring long-term economic stability and resilience in the face of climate change. These efforts aim to reduce economic vulnerabilities, promote self-reliance, and ensure equitable growth for all communities in the district.

Table 12: Strategies to address economic vulnerabilities in Akatsi North District

Recommendation	Adaptation Options	Expected Impact	Potential Partners
Enhance access to climate-resilient livelihoods	1. Provide training on climate-smart agricultural practices 2. Promote alternative livelihoods (*e.g.,* eco-tourism, handicrafts) for vulnerable groups	Increased resilience to climate impacts on agriculture, diversified income sources for vulnerable groups	Ministry of Agriculture, local cooperatives, NGOs focused on livelihoods
Strengthen access to financial services	1. Facilitate microfinance opportunities for women and youth 2. Establish community savings and loan schemes for marginalized groups	Improved financial inclusion, enhanced capacity for investment in climate-resilient businesses	Local banks, microfinance institutions, NGOs, community leaders
Promote sustainable agricultural practices	1. Introduce climate-resilient crop varieties to farmers 2. Facilitate access to irrigation systems for smallholder farmers	Increased agricultural productivity, reduced dependence on rain-fed agriculture	Ministry of Agriculture, local agricultural extension services, NGOs
Support economic empowerment for women, PWDs and migrant groups	1. Provide training and access to markets for women entrepreneurs 2. Promote tools and programmes that enhance economic participation for PWDs and marginalized groups 3. Facilitate women's access to land and agricultural inputs	Empowered women entrepreneurs, empowered PWD, improved economic independence for women and PWDs	Women's groups, PWD groups, local government, agricultural input suppliers
Increase access to technology and information	1. Provide access to mobile technology for farmers to access market information 2. Train women and youth in digital literacy and online entrepreneurship	Improved market access, increased economic opportunities through digital platforms	Telecommunications companies, NGOs focused on digital literacy, local government
Promote climate-resilient infrastructure	1. Develop climate-resilient infrastructure (*e.g.,* roads, irrigation, storage facilities) 2. Improve access to rural infrastructure for markets	Increased economic activity, enhanced market access, and reduced post-harvest losses	Ministry of Works and Housing, local government, development partners
Diversify income sources through skills training	1. Organize vocational training programs for youth in non-agricultural sectors (*e.g.,* carpentry, tailoring, masonry) 2. Promote agricultural value-added enterprises (*e.g.,* processing, packaging)	Increased job opportunities for youth, diversification of income sources	Technical training centers, local businesses, NGOs focused on skill development

Recommendation	Adaptation Options	Expected Impact	Potential Partners
Support community-based enterprises	1. Support the development of local cooperatives for agricultural or small-scale industrial production	Strengthened local economies, increased local ownership of economic activities	Local cooperatives, agricultural value chain actors, development organizations
	2. Promote value chain development for local products (*e.g.,* palm oil, cassava)		

Source: Stakeholder engagement and FGDs

5.2 Physical Adaptation Strategies

The physical adaptation strategies in Akatsi North District aim to strengthen the resilience of communities to climate-induced challenges such as flooding, drought, and temperature extremes. These strategies focus on improving essential infrastructure, including the construction and rehabilitation of roads, water supply systems, and drainage networks. Key interventions include the construction of dams and boreholes for reliable water access, particularly for agriculture, and the enhancement of irrigation systems to support year-round farming. Additionally, the development of climate-resilient housing and the installation of culverts to manage flood risks are critical to reducing physical vulnerabilities. These efforts also involve upgrading healthcare facilities, enhancing energy access, and ensuring that infrastructure can withstand future climate impacts, thus contributing to the overall resilience and sustainability of the district's physical environment.

Table 13: Strategies to address physical vulnerabilities in Akatsi North District

Recommendation	Adaptation Options	Expected Impact	Potential Partners
Improve water accessibility and availability	1. Construction of dug-out wells and dams for water storage and irrigation 2. Installation of mechanized boreholes at strategic points	Increased water availability for domestic and agricultural use during dry periods Reliable water supply, particularly in areas with insufficient rainfall	Water Resources Commission, AKDA, Ghana Water Company, Local Communities, NGOs, GIDA, Development Partners, MLGRD
Improve road infrastructure to enhance accessibility	1. Rehabilitation of road networks, including the provision of culverts and drains 2. Construction of roads to farm sites with proper drainage systems 3. Improve road network across communities	Reduced flooding and improved access to markets, services, and neighbouring regions Easier access to farmlands, reducing transportation challenges during rainy seasons	District Assembly, Ghana Highway Authority, Local Communities, Local Farmers, Ministry of Roads and Highways, Contractors
Enhance climate-resilient housing and infrastructure	1. Building of climate-resilient homes, focusing on flood and wind resistance 2. Use of alternative roofing materials for homes to withstand heavy rains	Improved shelter for vulnerable populations, particularly in flood-prone areas Increased durability and protection for homes against storm damage	Ministry of Works and Housing, Local Builders, ANDA, Ministry of Works and Housing, Local Communities

Recommendation	Adaptation Options	Expected Impact	Potential Partners
Strengthen flood management infrastructure	1. Construction of flood barriers and embankments in flood-prone areas 2. Implementation of erosion control measures along key roads and water bodies	Reduced flood damage to homes, farmlands, and critical infrastructure Mitigated soil erosion and reduced flooding risks	District Assembly, Ghana National Disaster Management Organization (NADMO), Local Communities, Ministry of Environment, Local Communities, EPA
Improve healthcare infrastructure for climate-related risks	1. Upgrading health centres with reliable water and energy systems 2. Installation of solar-powered systems for health centres	Enhanced healthcare services during extreme weather events and power outages Reliable healthcare services, especially during energy disruptions	Ministry of Health, District Health Services, Local Communities, Ministry of Energy, Solar Providers, Health Facilities
Improve drainage systems and flood control measures	1. Constructing proper drainage systems in low-lying areas 2. Planting trees and vegetation around water bodies to reduce runoff	Reduced flooding and waterlogging, improving public health and farm productivity Improved water retention and reduced flooding in surrounding areas	Local Communities, District Assembly, Ministry of Works and Housing, Forestry Commission, Local Communities, NGOs
Promote sustainable land management practices	1. Implement agroforestry practices to reduce soil erosion 2. Tree planting along roads and around water bodies	Reduced land degradation and enhanced agricultural productivity Enhanced water retention and reduction of soil erosion	Forestry Commission, Farmers, Ministry of Agriculture, Forestry Commission, Local Communities, NGOs

Source: Stakeholder engagement and FGDs

5.3 Social Adaptation Strategies

The social adaptations across the communities in Akatsi North District reflect a range of strategies aimed at addressing climate-related challenges and building resilience. These adaptations focus on strengthening community structures, promoting livelihood diversification, improving education, and ensuring more equitable access to resources.

Table 14: Strategies to address social vulnerabilities in Akatsi North District

Recommendation	Adaptation Options	Expected Impact	Potential Partners
Encourage women's participation in decision-making	1. Facilitate women's participation in local governance and community decision-making 2. Organize gender-responsive workshops for local governance	Empowerment of women, increased gender equality, and inclusive decision-making	Gender-focused NGOs, local government, women's groups, ANDA, MLGRD
Access to resources like seeds and farming tools	1. Provide subsidies for agricultural inputs like seeds and tools 2. Organize community-based seed banks for smallholder farmers	Increased agricultural productivity, enhanced food security, improved access to resources	Agricultural extension services, NGOs, local government

Recommendation	Adaptation Options	Expected Impact	Potential Partners
	3. Involve PWDs and migrant groups in local agricultural discussions to ensure their needs are prioritized in government programs.		
Community-based groups for collective action	1. Strengthen women's and youth groups for joint action on climate resilience 2. Establish climate adaptation taskforces to address community challenges	Improved social cohesion, collective efforts in addressing climate change, enhanced community resilience	Community organizations, local leaders, youth groups
Education and awareness on climate adaptation	1. Conduct workshops on sustainable farming, water management, and climate change impacts 2. Integrate climate change education into school curricula	Increased climate change awareness, adoption of sustainable practices, better preparedness	ANDA, Local environmental NGOs, CSOs, Ministry of Education, local schools, NGOs, GES
Strengthening healthcare services	1. Improve local healthcare infrastructure and access to climate-resilient health services 2. Implement community health programs to address climate-related health risks	Better health outcomes for vulnerable groups, reduced climate-induced health risks, improved access to healthcare	Ministry of Health, local health services, NGOs
Strengthen community social safety nets	1. Establish support networks for vulnerable families (families with PWDs, aged, etc.) 2. Organize community-based health and well-being programs	Improved community support systems, enhanced social safety nets	Local government, community groups, social welfare organizations
Promote health awareness and access to healthcare	1. Organize health education campaigns focused on climate-related health risks 2. Provide mobile health clinics to remote areas	Increased awareness of climate-related health risks, improved health access in remote areas	Ministry of Health, local health services, community health organizations
Foster social cohesion and conflict resolution	1. Facilitate community dialogue sessions to address social issues and climate impacts 2. Train community leaders in conflict mediation and resolution	Stronger social bonds, reduced conflicts over resources, improved community resilience	Local government, peacebuilding organizations, community leaders
Increase youth engagement in community development	1. Organize youth-led community development projects 2. Create platforms for youth to voice concerns and contribute to climate adaptation plans	Increased youth involvement in community resilience, empowerment through active participation	Local youth groups, local government, NGOs focused on youth empowerment

Source: Stakeholder engagement and FGDs

6. Community Specific Recommendations

Based on the adaptation needs identified by focus group discussants, several recommendations can enhance resilience and livelihoods in the community. To address the community's adaptation needs, a focus on water access and infrastructure improvement is essential. By focusing on these strategies, the community can build resilience against climate variability, improve agricultural productivity, and enhance overall well-being.

6.1 Ave Xevi: Enhancing Livelihoods, Resilience, and Sustainability

The Xevi community faces vulnerabilities related to economic dependency on subsistence farming, limited diversification of livelihoods, and challenges with environmental sustainability. Women, who play a critical role in the community's economy, face barriers to accessing resources and skills to diversify their income. Additionally, the community is impacted by environmental degradation, particularly due to deforestation and unsustainable practices like charcoal production, which exacerbate climate change effects. Infrastructure limitations further hinder access to markets and processing facilities, reducing productivity and income opportunities.

Photo 10: Main community dam at Xevi, almost fully covered with plants

The adaptation options revealed from the study are summarised in the table below.

Table 15: Adaptation strategies for enhancing livelihoods, resilience, and sustainability in Ave Xevi

Adaptation Options	Expected Impact	Potential Collaborators
Provide financial assistance for petty trading	Increased household income and reduced dependency on farming	ANDA, Department of Social Welfare, Microfinance and Small Loans Centre (MASLOC), Private Microfinance Institutions
Support women in animal rearing	Enhanced food security and diversified livelihoods	Ministry of Food and Agriculture (MoFA), NGOs, Veterinary Services Department
Promote Kente weaving	Sustainable income generation and preservation of cultural heritage	Rural Enterprise Programme (REP), ANDA
Training in gari processing, catering, soap-making	Expanded income opportunities and improved skill sets	National Board for Small Scale Industries, ANDA, NGOs
Business management training	Improved sustainability and profitability of enterprises	Ghana Enterprise Agency, ANDA
Initial support for Women's group associations formation	Strengthened trust and sustainability of women's networks	NGOs, ANDA, National Board for Small Scale Industries (GHANA ENTERPRISES AGENCY)

Adaptation Options	Expected Impact	Potential Collaborators
Steady supply of soap-making ingredients	Improved production and income consistency	ANDA, Local suppliers, Ghana Trade Fair Company
Funding for palm oil production	Increased productivity and profitability	MoFA, Rural Enterprise Programme (REP), ANDA
Climate education on deforestation	Increased awareness and adoption of sustainable practices	Environmental Protection Agency (EPA), Forestry Commission (FC), NGOs like Friends of the Earth (FoE)
Promotion of agroforestry	Enhanced environmental sustainability and agricultural productivity	MoFA, Forestry Commission, Agricultural Extension Services
Community-based processing facilities	Reduced labour intensity and increased productivity	Physical Planning Unit; District Works Department, ANDA
Transport and market access improvements	Enhanced market reach and economic growth	Ministry of Roads and Highways (MRH), ANDA, Ghana Private Road Transport Union (GPRTU)
Complete and staff the community clinic	Improved healthcare access and reduced travel for medical emergencies	Ghana Health Service (GHS), ANDA, donor partners
Set committees to monitor dams and healthcare services	Improved resource maintenance, security, and community accountability	ANDA, local leaders, community-based organizations
Dredge and replicate dams across the community	Enhanced irrigation, livestock farming, and access to water for households	Ministry of Water Resources and Sanitation (MWRS), ANDA, External Development Partners
Provide and rehabilitate boreholes for households	Improved access to clean water for domestic use	MWRS, ANDA, Community Water and Sanitation Agency (CWSA)

6.2 Nyitawuta: Strategies for Addressing Critical Resource Challenges and Enhancing Sustainable Development

Nyitawuta faces critical challenges in water resource management, infrastructure, and livelihood diversification, compounded by inadequate connectivity and environmental degradation. Addressing these challenges requires a focus on sustainable resource management, community capacity building, and strategic investments in infrastructure. Promoting communal ownership and financial contributions can further enhance the sustainability of proposed interventions.

Photo 11: Only community primary school (top left), newly constructed community clinic (top right), household water from community stream (down center)

The adaptation options revealed from the study are summarised in the table below.

Table 16: Adaptation strategies for addressing critical resource challenges and enhancing sustainable development in Nyitawuta

Adaptation Options	Expected Impact	Potential Collaborators
Connect water pipes to the community	Improved access to clean and reliable water for households	Community Water and Sanitation Agency (CWSA), ANDA
Repair and strategically position dams	Increased water availability for farming and household use	Ministry of Water Resources, ANDA, donor agencies and Development Partners
Repair boreholes and ensure depth for sustainability	Long-term water access for community needs	CWSA, ANDA, local contractors
Provide capital for animal rearing	Diversified income sources and increased resilience to crop failures	Ministry of Food and Agriculture (MoFA), NGOs, MASLOC
Promote vegetable farming and provide inputs	Improved food security and nutritional outcomes	MoFA, NGOs, ANDA
Support alternate income-generation activities	Reduced dependency on farming and enhanced household income	ANDA, NGOs
Offer youth vocational training and startup capital	Increased youth employment and reduced rural-urban migration	NVTI, Plan International, ANDA
Improve road access to Nyitawuta	Reduced transportation costs and enhanced market access for local produce	Ghana Highway Authority, ANDA
Facilitate communal labour for road maintenance	Cost-effective infrastructure improvement	ANDA, community associations
Promote sustainable charcoal production	Balanced economic activities with environmental conservation	Forestry Commission (FC), EPA, ANDA
Enforce rules against unauthorized tree cutting	Preservation of local forests and prevention of deforestation	Community Chiefs, Forestry Commission, ANDA
Support vegetable farming for nutritious diets	Increased household income and access to balanced nutrition	MoFA, local agricultural groups
Improve phone network connectivity	Enhanced communication and support for youth-led entrepreneurial activities	ANDA, telecom companies (MTN, Vodafone)
Support electricity expansion for business ventures	Boosted opportunities for processing, storage, and marketing	Energy Commission, ANDA

6.3 Avevi: Community-Led Adaptation Options to Address Water Scarcity, Economic Instability, and Environmental Challenges

Avevi is a community facing multiple challenges related to climate change, economic instability, and limited access to essential services. Water scarcity is a significant issue, with reliance on a single borehole, while unpredictable rainfall patterns impact agricultural productivity. There is a strong dependence on subsistence farming and petty trade, with limited employment opportunities for youth and women. The community's recommendations focus on enhancing agricultural practices, supporting small businesses, and addressing environmental degradation through sustainable farming and grazing practices.

Photo 12: Avevi only community mechanized borehole (left). Community waste dump (right)

By engaging local and national collaborators, these adaptations aim to improve resilience, food security, and economic stability in the face of ongoing climate challenges.

Table 17: Community-led adaptation options to address water scarcity and environmental challenges in Avevi

Adaptation Options	Expected Impact	Potential Collaborators
Establish mechanized boreholes for improved water quality and quantity	Improved access to clean and sufficient water, reducing waterborne diseases and enhancing daily livelihoods	Ghana Water Company, GIZ, USAID
Implement small-scale irrigation systems *(e.g.,* using dams or water storage systems)	Enhanced crop production even during dry seasons, leading to food security and increased farmer income	Ministry of Food and Agriculture, IFAD, GIZ
Diversify economic activities by supporting skill development and vocational training programs	Increased economic opportunities for youth and women, reducing unemployment and poverty	Youth Employment Agency, Ghana Skills Development Fund
Introduce livestock management programs to address environmental pressures and improve animal health	Improved sustainability of livestock farming, reducing environmental degradation and increasing livestock productivity	Ministry of Environment, Science, Technology and Innovation, Agricultural Development Bank
Develop local markets for agricultural and livestock produce	Enhanced market access, increasing income and economic opportunities for farmers and traders	Ministry of Trade and Industry, Local District Assembly
Introduce sustainable grazing practices to reduce land degradation	Reduced environmental damage and improved soil health, ensuring long-term agricultural productivity	Ministry of Environment, Environmental Protection Agency
Promote sustainable building practices to address rising heat and environmental pressures on infrastructure	Reduced building damage, increased comfort for residents, and lowered costs due to improved resilience to climate change	Ministry of Works and Housing, UNDP, GIZ
Establish local cooling systems to counteract extreme heat affecting livelihoods	Improved living conditions and protection of livestock and crops from extreme heat	Ghana Meteorological Agency, Energy Commission
Improve access to refrigeration for storing animal products to ensure better marketability	Increased product shelf life, higher market value, and reduced losses from spoilage	ANDA, MoFA, Ghana National Chamber of Commerce, Agricultural Development Bank

6.4 Ave Dzadzepe: Strategies to Improve Climate Vulnerabilities and Agricultural Challenges

The Ave Dzadzepe community faces pressing challenges in infrastructure, agricultural productivity, and sustainable resource management. Poor road networks, inadequate irrigation systems, and limited access to fruit tree seedlings hinder development. Additionally, the community struggles with erosion, flooding, and inequitable distribution of resources. To address these issues, targeted recommendations emphasize infrastructure improvement, sustainable farming practices, capacity building, and equitable resource allocation to boost livelihoods and resilience.

Table 18: Adaptation strategies to improve climate vulnerabilities and agricultural challenges in Ave Dzadzepe

Adaptation Options	Expected Impact	Potential Collaborators
Improved inner community road network	Enhanced access to markets, schools, and health services	District Assembly, Road and Highways Department, ANDA
Provision of tree/seedlings by the Forestry Commission	Increased biodiversity, reduced erosion, and enhanced livelihoods	Forestry Commission, MoFA, Department of Agriculture, WIAD, ANDA, Community Groups
Capacitating farmers with irrigation for all-year farming	Improved agricultural productivity and food security	Ministry of Agriculture, Development Partners
Planting fruit trees to supplement food crop production	Diversified income and enhanced food security	Forestry Commission, Agricultural Extension Services
Construction of four dams at strategic locations	Year-round irrigation and reduced reliance on rain-fed agriculture	Ministry of Water Resources, Technical Experts
Construction of durable dams by experts	Reduced flooding and enhanced sustainability of irrigation systems	Ministry of Water Resources, Technical Experts
Skills training for youth	Reduced unemployment and dependence on agriculture	NGOs, Vocational Training Institutes, ANDA, Development Partners
Factory/venue for processing tomatoes	Value addition and increased income for farmers	Private Sector, Development Partners
Improved drainage and creation of drains	Increased road durability and reduced erosion	Road and Highways Department, Local Contractors, Physical Planning Unit
Provision of security for dams and tree crops	Reduced misuse of resources and improved management	District Assembly, Community Leaders, Community groups
Creation of fire belts around tree crops	Protection of tree crops from wildfires	Forestry Commission, Community Groups, ANDA, District Fire Service Department
Use of uniform seeds for tomato production	Improved quality and demand for produce	Agricultural Extension Services, Farmer Groups, MoFA, ANDA

6.5 Ave Afiadenyigba: Climate Variability and Economic Challenges

Ave Afiadenyigba, which traditionally is dependent on farming and trading activities such as petty retail trading, palm oil processing, and carpentry. Residents identify declining rainfall patterns, poor soil fertility, pest infestations, and periodic flooding as significant barriers to agricultural productivity, their primary livelihood source. The lack of adequate water supply, poor road networks, and limited healthcare facilities further exacerbate the community's vulnerability. Despite these challenges, the community demonstrates resilience by leveraging local resources and knowledge while emphasizing the need for strategic interventions such as improved water infrastructure, better healthcare services, and skill-based training.

Photo 13: Only engineered dam in ANDA partially covered with water plants in Ave Afiadenyigba

These adaptation options aim to enhance food security, economic stability, and overall community well-being.

Table 19: Climate variability and economic challenges in Ave Afiadenyigba

Adaptation Options	Expected Impact	Potential Collaborators
Dredging of the dam	Improved water availability for irrigation and household use, especially during dry seasons	Ghana Irrigation Development Authority (GIDA), NGOs, ANDA
Rehabilitating boreholes	Enhanced access to clean and reliable water sources for the community	Community Water and Sanitation Agency (CWSA), ANDA
Refurbishing the health centre	Better healthcare delivery with improved infrastructure, reducing referrals for minor health issues	Ghana Health Service, District Health Directorate; ANDA
Improving conditions of the marketplace	Enhanced economic activities with a better trading environment	Local Government, Market Women Associations; ANDA
Providing startup capital for youth and skills training	Increased employment opportunities and sustainable livelihoods through capacity building	National Youth Authority, NGOs, Microfinance Institutions; Ghana Enterprise Authority
Improving the inner road network	Enhanced transportation and accessibility within the community	Ghana Highway Authority, MLGRD, ANDA
Regularly rotating waste and water committees	Improved accountability and efficiency in water and waste management	ANDA, Community Leaders; District Environmental and Health Unit
Ensuring culverts for all roads	Mitigated road destruction caused by poor drainage, improving mobility	Ghana Highway Authority, Local Government
Supporting health professionals with better conditions	Increased retention of healthcare workers, ensuring continuous service delivery	Ghana Health Service, NGOs
Volunteering for road repairs	Strengthened community ownership and cost-effective maintenance of road infrastructure	Community Members, Local Government

6.6 Ave Dakpa: Community Livelihood Options and Access to Water

The Ave Dakpa community faces significant challenges in adapting to climate variability and improving their livelihood options. Limited access to reliable water sources, inadequate infrastructure, and challenges with agricultural productivity hinder sustainable development. Additionally, the community struggles with transparency and maintenance issues regarding shared resources.

To address these challenges, recommendations have been proposed that focus on water resource management, skill-based training, infrastructure development, and promoting accountability in resource distribution.

Table 20: Strategies to improve community livelihood options and access to water

Adaptation Options	Expected Impact	Potential Collaborators
Dugout wells/dams constructed	Improved water availability for farming and domestic use	District Assembly, NGOs, Ministry of Water Resources
Mechanized boreholes	Reliable water supply for irrigation and household needs	Development Partners, Community Water and Sanitation Agency
Alternative livelihood/skill-based training	Enhanced income and reduced reliance on climate-dependent farming	NGOs, Ministry of Employment, Vocational Training Institutes
Palm oil production/trading for women	Empowered women with better economic opportunities	Women's Groups, Agricultural Extension Services
Mechanized boreholes/dams for farm irrigation	Increased agricultural productivity and reduced crop losses	Agricultural Development Fund, District Assembly
Road network to farms	Easier transportation of produce, boosting market access	Road and Highways Department, Local Contractors
Agricultural input support/tractor services	Improved farm yields through timely access to inputs and machinery	Ministry of Agriculture, Private Sector
Provision of harvester for rice farmers	Reduced post-harvest losses and increased rice production	Farmer-Based Organizations, NGOs
Planting trees around dams	Reduced water loss from evaporation and improved microclimate	Forestry Commission, Community Groups
Training community representatives for dam maintenance	Increased capacity for sustainable use and management of resources	NGOs, Technical Training Institutions
Building culverts in waterlogged/low-lying areas	Improved road durability and year-round accessibility	Road and Highways Department, Community Members
Skill/artisanal training (*e.g.*, tailoring, masonry)	Diversified income sources and enhanced resilience to shocks	Vocational Training Institutes, NGOs
Transparent input disbursement processes	Equitable access to agricultural inputs, reducing conflicts	Ministry of Agriculture, District Assembly

7. Institutional Capacity Building and Adaptation Policy Implications

7.1 Introduction

Adaptation governance requires intentional efforts and adequate capacity at all levels both human and institutional. 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 this. 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 the district staff, as well as other critical stakeholders in adaptation planning and in areas such as climate risk and vulnerability assessments, and climate-informed decision making.

Despite efforts put in, there is still a capacity gap at the institutional level which needs to be addressed. We proceeded from the premise that the Akatsi North District Assembly 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. 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 through the use of 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.

In this chapter, we underscore the critical importance of the Assembly in providing the requisite climate change governance leadership and how capacity at multi-levels also become 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 that responds to the vertical integration approach adopted by the Ghana NAP process. By aligning district level planning processes to national level aspirations, we clearly 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.

The Akatsi North District Assembly is actively addressing the district's distinct climate vulnerabilities, including flooding, prolonged droughts, soil erosion, and water resource scarcity. Through comprehensive capacity-building initiatives such as targeted workshops, stakeholder interviews, and practical training sessions on climate adaptation, Assembly staff have gained critical knowledge to design and implement locally relevant, gender-responsive adaptation strategies. These initiatives have empowered the Assembly to prioritize inclusive approaches that reflect the district's specific challenges.

Collaborative engagements with civil society organizations (CSOs), local stakeholders, and community representatives have further enhanced this process by fostering participatory dialogue. These discussions have highlighted the most pressing needs of vulnerable groups, including women, youth, and marginalized populations, ensuring that their voices inform the planning and prioritization of adaptation strategies.

This approach underscores the importance of institutional capacity in driving sustainable and equitable climate adaptation. By creating an enabling environment to access climate finance and aligning with Ghana's National Adaptation Plan (NAP), the Akatsi North District Assembly can improve the execution of projects focused on food security, water management, and infrastructure resilience. Leveraging local knowledge and integrating national policies, the Assembly is well positioned to address the district's climate vulnerabilities effectively.

7.1.1 Strengthening the Enabling Environment for Climate Finance

The Akatsi North District faces challenges in accessing adequate climate finance to address its vulnerabilities, including flooding, water scarcity, drought and soil degradation. Strengthening institutional capacity to attract and manage climate funds is essential. However, limited technical capacity, unclear financial frameworks, and inadequate partnerships with funding agencies hinder progress. Accessing climate finance is pivotal for implementing transformative adaptation strategies. This involves creating clear financial frameworks, fostering partnerships with national and international donors, and building the technical expertise of local authorities to design bankable projects. Establishing an enabling environment for climate finance will empower the district to implement impactful adaptation measures that align with both local priorities and national climate goals.

Strengthening the enabling environment involves building institutional capacity through targeted training for Assembly staff on climate finance mechanisms, developing bankable proposals, and establishing partnerships with national and international climate financing bodies. Furthermore, the district must focus on creating transparent financial management systems to ensure accountability and long-term trust from donors. By improving its readiness for climate finance, Akatsi North District can implement large-scale interventions to enhance community resilience.

Table 21: 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
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

7.1.2 Implementing a Gender-Responsive National Adaptation Plan

Climate impacts in Akatsi North disproportionately affect women, youth, and marginalized groups, who are often at the forefront of managing resources like water and food. Systemic barriers, including restricted access to land, credit, and decision-making platforms, exacerbate their vulnerabilities. A gender-responsive National Adaptation Plan tailored to Akatsi North's context must address these disparities by promoting equitable participation and leadership in climate adaptation efforts. This includes initiatives such as capacity-building programs for women in agriculture and entrepreneurship, youth-oriented skills training in climate-resilient livelihoods, and inclusive governance structures that reflect diverse community needs. Prioritizing gender responsiveness not only improves the district's adaptation outcomes but also strengthens social cohesion and equity.

Table 22: 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

7.1.3 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 23: Key actions, expected outcomes, and collaborators for enhancing planning and Execution 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
Organize capacity-building sessions for Assembly staff on inclusive governance frameworks	Improved design and implementation of equitable adaptation projects	Governance Experts, Ghana 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

Key Actions	Expected Outcomes	Key Collaborators
Create gender-responsive monitoring indicators to assess project impact	Improved accountability and ability to measure progress in reducing gender inequalities	MoGCSP, Local NGOs, UNDP
Develop tools and resources for transparent project monitoring and evaluation	Better tracking of project outcomes and continuous improvement of adaptation strategies	Ministry of Planning, Research Institutions

7.1.4 Collaboration Between Key Institutions and Stakeholders

Achieving resilience in Akatsi North requires collaboration between the District Assembly, civil society organizations (CSOs), traditional leaders, and private sector actors. Coordinated efforts can enhance resource mobilization, policy alignment, and the integration of local knowledge into adaptation strategies. Strengthening partnerships with research institutions and technical experts will further ensure evidence-based decision-making and the successful implementation of climate-resilient infrastructure and social interventions.

7.2 Policy Implications

7.2.1 Strengthening Climate-Resilient Infrastructure and Natural Resource Management

Akatsi North District faces critical challenges related to infrastructure and natural resource management, exacerbating the impact of climate change on local communities. The district's poor road networks hinder access to markets and farms, limiting economic activities and increasing transportation costs. Additionally, inadequate water infrastructure leaves communities vulnerable to prolonged droughts and water scarcity, particularly during the dry season. Deforestation, bush burning, and soil degradation further undermine the district's environmental resilience, contributing to declining agricultural productivity and biodiversity loss. Addressing these issues requires a holistic approach to climate-resilient infrastructure development, including constructing durable roads, mechanized boreholes, and small dams while integrating sustainable practices such as afforestation and community-led natural resource management.

Table 24: Strengthening climate-resilient infrastructure and natural resource management

Recommendation	Action	Expected Outcome	Practical Example
Improve water access through dams and boreholes	Construct mechanized boreholes and small dams in strategic locations	Reliable year-round water supply for farming and households	Boreholes installed in Ave-Dzadzepe for irrigation and drinking water
Enhance road networks to improve access to farms	Rehabilitate roads with proper drainage and culverts	Reduced transportation challenges for farmers and traders	Construction of farm-access roads with culverts in low-lying areas
Promote reforestation and sustainable land management	Provide tree seedlings and train communities in afforestation	Reduced deforestation and improved soil health	Establishment of community-managed woodlots in Ave-Dakpa

7.2.2 Integrating Gender-Responsive Approaches into Adaptation Policies

Climate adaptation efforts in Akatsi North District must recognize and address the disproportionate impacts of climate change on women, youth, and marginalized groups. These groups often face systemic barriers, including limited access to resources, decision-making spaces, and education, which undermine their ability to adapt effectively. Gender-responsive policies are crucial to creating equitable adaptation strategies that empower vulnerable populations by enhancing their participation in

governance, promoting equitable resource allocation, and building capacity for resilience. Integrating gender perspectives into adaptation frameworks ensures inclusivity and fosters community-driven solutions to climate challenges.

Table 25: Integrating gender-responsive approaches into adaptation policies

Recommendation	Action	Expected Outcome	Practical Example
Ensure 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 drought-resistant farming for women in ANDA, Ave-Dakpa
Promote equitable resource distribution	Prioritize women and marginalized groups in accessing farming inputs and equipment	Improved resource access for disadvantaged groups	Provide subsidized irrigation kits to women farmers

7.2.3 Promoting Inclusive Economic Adaptation Strategies

Economic vulnerabilities in Akatsi North District are closely tied to the reliance on climate-sensitive livelihoods, limited access to markets, and resource inequities. Women, youth, and marginalized groups face systemic barriers to economic participation, leaving them particularly vulnerable to the adverse effects of climate change. Economic adaptation strategies must focus on empowering these groups by promoting alternative livelihoods, improving agricultural productivity through value chain enhancements, and fostering entrepreneurship. By targeting inclusive resource distribution and capacity building, the district can create sustainable income opportunities that are resilient to climate shocks, thereby enhancing overall economic stability and community well-being.

Table 26: Promoting inclusive economic adaptation strategies

Recommendation	Action	Expected Outcome	Practical Example
Support women with alternative livelihoods	Train women in palm oil production and other trades	Improved income generation and economic independence	Establish women-led palm oil processing cooperatives
Build agricultural value chains	Facilitate access to processing equipment for tomatoes and rice	Reduced post-harvest losses and increased profits.	Set up tomato processing factories in Ave-Afiadenyigba
Encourage youth entrepreneurship	Provide artisanal training in tailoring, carpentry, and masonry	Diversified income sources for youth and reduced reliance on agriculture.	Launch vocational training hubs in the capital town, Ave-Dakpa and across other communities

7.2.4 Addressing Systemic Barriers to Resource Access

Systemic barriers, such as inequitable resource distribution, lack of transparency, and inadequate infrastructure, hinder adaptation efforts in Akatsi North District. Marginalized groups, including women, youth, and smallholder farmers, are disproportionately affected due to limited access to water, land, inputs, and market opportunities. Addressing these barriers involves creating transparent mechanisms for resource allocation, improving physical infrastructure, and fostering collaboration among stakeholders to ensure fair access. By tackling these systemic issues, the district can enhance social equity, improve livelihoods, and build community resilience to climate impacts.

Table 27: Policy recommendations for addressing systematic barriers to resource access

Barrier	Action	Expected Outcome	Practical Example
Inequitable distribution of farming resources	Provide land tenure certificates to women farmers to secure credit	Reduced corruption and improved access for all	Pilot land tenure programs in Ave Dakpa
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
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 palm oil processing groups
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 Ashiamgborvi

7.2.5 Aligning Local Adaptation Efforts with National and International Frameworks

Akatsi North District's adaptation strategies must align with Ghana's National Adaptation Plan (NAP) and international frameworks, such as the Sustainable Development Goals (SDGs), to access resources and ensure scalability. Local efforts should integrate global best practices while addressing district-specific vulnerabilities. Building institutional capacity to access climate finance and fostering partnerships with national and international entities are critical for sustained adaptation. This alignment ensures that local adaptation projects not only meet community needs but also contribute to broader climate resilience and sustainable development objectives.

Table 28: 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 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 SDG 6 (Clean Water)
Climate finance mechanisms (*e.g.,* GCF)	Train Assembly staff on proposal writing and fund management	Increased funding and financial sustainability	Conduct workshops for Akatsi North Assembly on climate finance

8. Conclusions, Recommendations and Ways Forward

8.1 Conclusion

Effective adaptation in Akatsi North requires integrating local knowledge with global frameworks to develop sustainable and gender-responsive solutions. Approaches like the IPCC's risk framework, CARE International's participatory tools, and GIZ's gender-inclusive methodologies offer valuable pathways to enhance community resilience. By aligning adaptation strategies with international development goals like SDGs 5 and 13, Akatsi North can foster resilience, equity, and sustainable growth, ensuring that all community members can thrive in the face of climate change.

The methodological framework employed for the climate vulnerability assessment in Akatsi North District was both comprehensive and inclusive, ensuring that the process addressed the diverse needs and perspectives of the district's population. By combining qualitative and quantitative approaches, the framework provided a robust foundation for identifying localized climate risks, vulnerabilities, and adaptive capacities. The process entailed participatory stakeholder consultations, focus group discussions and household head survey, which have provided valuable data on the differential impacts of climate change and adaptation practices across demographic groups.

The findings from the study highlight the profound impacts of climate change on the Akatsi North District. These impacts are compounded by social, economic, and infrastructural vulnerabilities, requiring urgent and comprehensive responses.

- **Vulnerability and Risk Exposure**

The district faces recurrent floods, droughts, erratic rainfall, and extreme heat, all of which significantly disrupt agricultural activities—the district's primary economic activity. These hazards also affect water resources, agriculture, health services and infrastructure, creating cycles of stress that undermine the district's overall resilience. Climate hazards have varied impacts on households depending on their location and livelihood. Flood-prone zones like Ave Dzadzepe and drought-prone areas such as Kpegbedza are particularly at risk, underscoring the uneven distribution of vulnerabilities across the district. Also, the absence of early warning systems in the district exacerbates household sensitivity to climate hazards. Nearly all respondents reported receiving no prior warning before hazard events, leaving communities unprepared and increasing their vulnerability to sudden impacts.

- **Sectorial Sensitivity**

Key sectors such as agriculture, water resources, and health are highly sensitive to climate hazards. Agriculture, the economic backbone of the district, is particularly vulnerable to erratic rainfall and droughts, leading to reduced crop yields and food insecurity. Water resources are strained by poor dam maintenance and increasing demand, while the health sector struggles with limited infrastructure and a high incidence of climate-related illnesses such as malnutrition and respiratory diseases.

- **Economic and Social Inequities**

Economic disparities in Akatsi North District intensify vulnerabilities to climate change. Most households earn less than 500 GHS per month, below the national average, limiting their capacity to invest in adaptive measures. Female-headed households are particularly vulnerable, often lacking access to financial resources and income diversification opportunities. Social inequities, such as the underrepresentation of women in decision-making roles and the influence of cultural norms, further compound these challenges.

- **Gender-Differentiated Impacts**

The effects of climate change in the district are deeply gendered. Women face disproportionate challenges due to their roles in water collection, food management, and caregiving. Droughts intensify their burdens as they must travel farther for water and manage reduced household food supplies. Men are more directly impacted by crop failures and resource-heavy tasks like livestock management. Despite their critical roles in climate adaptation, women's limited access to resources, such as credit, and agricultural inputs, significantly constrains their ability to respond effectively to climate challenges.

- **Adaptive Capacity and Resource Limitations**

Adaptive capacity in Akatsi North District is constrained by limited access to essential resources. Women, in particular, face barriers to credit, and agricultural inputs, which restrict their ability to implement effective adaptation strategies. Cultural norms, time constraints, and legal challenges further limit their capacity to respond to climate impacts. Households employ various strategies to adapt to climate variability, including improved crop varieties, soil conservation, and rainwater harvesting. However, these measures are often insufficient to address systemic challenges such as erratic rainfall and prolonged droughts. Livelihood diversification, such as engaging in trading or agro-processing, provides an additional buffer but is not accessible to all households.

The district has limited access to community-based and institutional support systems for adaptation. While organizations like NADMO and NGOs provide occasional assistance, their reach is insufficient to meet the widespread needs of vulnerable households. Female-headed households, in particular, report a lack of support networks tailored to their specific challenges.

- **Infrastructural Deficiencies**

The district's infrastructure is ill-equipped to withstand climate impacts. Poor road conditions and limited transportation options hinder market access and disaster response efforts. Health services are basic and unevenly distributed, leaving many communities without access to advanced medical care. Similarly, the reliance on non-engineered dams for water and irrigation creates additional vulnerabilities, as these structures are often dry up, are filled with debris or are in unsanitary conditions

8.2 Recommendation

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

1. Strengthening Infrastructure

Invest in climate-resilient water infrastructure and water access, such as engineered dams, community potable water sources and irrigation systems, to mitigate the impacts of droughts and irregular rainfall. Expand healthcare facilities, including mobile health units, to ensure all communities have access to basic and emergency medical services. Also, improving road networks to enhance connectivity and market access, particularly in remote communities such as Nyitawuta.

2. Promoting Gender Equity in Resource Access

Address systemic barriers that limit women's access to resources such as credit, and agricultural inputs. Implement legal reforms and 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.

3. Diversifying Livelihoods

Encourage alternative income-generating activities such as agro-processing, artisanal crafts, and ecotourism to reduce dependence on climate-sensitive sectors. Expand vocational training programs to equip residents with skills for emerging industries. Strengthen initiatives like the Livelihood Empowerment Against Poverty (LEAP) program to include components focused on climate-resilient entrepreneurship.

4. Improving Agricultural Practices

Promote the adoption of climate-resilient crops and integrated farming systems. Provide training on soil conservation techniques and pest management to improve productivity and sustainability. Enhance access to high-quality seeds, fertilizers, and modern farming equipment through subsidies or cooperative purchasing schemes.

5. Addressing Health and Education Needs

Expand health outreach programs to address climate-related illnesses such as respiratory problems, malnutrition, and heat-related conditions. Introduce school-based programs to educate children on climate change and adaptation strategies, fostering a culture of resilience from a young age. Invest in expanding educational facilities, including vocational and technical schools, to build local capacities and improve future economic prospects.

6. Building Community Resilience

Establish community-based disaster management committees to oversee local adaptation efforts and coordinate responses to climate events. Strengthen the presence of NGOs and civil society organizations to deliver targeted interventions and build local capacities. Foster partnerships between government agencies, private sector actors, and local communities to co-create sustainable solutions.

7. Integrating Findings into Policy and Planning

Incorporate these findings into district-level planning frameworks and Ghana's National Adaptation Plan. Develop a gender-sensitive climate action plan that addresses the specific needs of men and women, ensuring equitable resource allocation and representation in decision-making processes. Align local initiatives with national and international climate goals to secure funding and technical support.

Adaptation Need

Constructing a dam and extending water systems can support irrigation and vegetable farming, providing sustainable income opportunities, especially for women. Repairing or adding boreholes and improving water access for household use and farming are critical priorities. Diversifying livelihoods through a shift from maize farming to activities like animal rearing, poultry, and vegetable cultivation can enhance resilience to climate impacts. Additionally, upgrading the road network will lower transportation costs and improve market access for produce, boosting economic opportunities and community development.

- *"Their priority is irrigation. A constructed dam will allow them to do irrigation and earn daily income." – Adult male, Ave Xevi*
- *"They suggest adding more boreholes or fixing the broken one, and strategically positioning dams for vegetable farming." – Youth female, Avevi*
- *"If they could shift from maize crops to animal rearing, poultry, and vegetable farming." - Adult female, Ave Dzadzepe*
- *"Extending water from the pipe to this area for household consumption and farming." – Female PWD, Ave Dakpa*
- *"Improving the road network to reduce transportation costs for their produce." – Adult male, Avevi.*
- *"The road network is very bad, so when transporting produce, they pay a lot of money to take it to the market centre." – Youth male, Ave Xevi*
- *"Extending water systems to support vegetable farming can provide income for women." – Youth male, Nyitawuta*

Climate change presents an urgent and multifaceted challenge for the Akatsi North District, exacerbating existing vulnerabilities and disproportionately affecting marginalized groups, including women, youth, and the elderly. These impacts disrupt food security, livelihoods, and essential services, deepening poverty and social inequalities. The interplay of socio-economic and environmental vulnerabilities underscores the need for holistic, inclusive approaches to resilience building that address both immediate risks and the structural barriers that hinder adaptive capacity.

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