THE GOVERNMENT OF UGANDA

BUSIA MUNICIPAL COUNCIL

Climate Change Action Plan (CCAP) for Busia Municipality

OCTOBER, 2025

CLIMATE CHANGE ACTION PLAN FOR

BUSIA MUNICIPALITY

(2025-2030)

Executive Summary

Uganda's greenhouse gas (GHG) emissions are dominated by the Agriculture, Forestry, and Other Land Use (AFOLU) sector, accounting for about 86% of the total (NDC, 2022). Uganda's greenhouse gas (GHG) emissions are projected to increase from 90.1 MtCO2e in 2015 to 148.8 MtCO2e in 2030 and 235.7 MtCO2e by 2050 under the Business as Usual (BAU) Scenario. This projection is in consideration of Busia Municipality, an urban settling with vibrant sectors (e.g., energy, transport, agriculture, waste and industries) that contribute to this cause with significant amounts of Greenhouse Gases.

The objectives of this climate action plan are:

1. To establish a climate change and vulnerability baseline for Busia Municipality
2. To provide climate actions that address key vulnerabilities, and build adaptive capacities and resilience at all levels
3. To facilitate climate risk decision making processes with guidance related to budgeting, climate action implementation arrangements, resource mobilization and dissemination of climate information
4. To promote a low carbon and climate resilient society by increasing public awareness and integrating climate actions into broader policies

Vision Statement:

"A resilient, sustainable, and climate-smart Busia Municipality where communities thrive in harmony with the environment, leveraging innovative solutions and local knowledge to mitigate climate impacts, adapt to changing conditions, and foster inclusive socio-economic development."

The prioritised climate actions in this plan are meant to reduce the Greenhouse Gas emissions (mitigation) and facilitate climate adaptation in Busia Municipality. These actions target 10 sectors here referred to as result areas. These are: Energy, Transportation, Trade and industry, Agriculture, Water and Environment, ICT, Land and housing, social development (Communities), Education, and Sports and Health. For each result area, an outcome and output statement are provided for envisioning the desired actions for implementation.

The implementation of the climate action plan will be overseen by Busia Municipal Council, with leadership provided by the Town Clerk as the accounting officer and overall coordinator. The Town Clerk will chair the Municipal Climate Action Steering Committee, which will comprise heads of technical departments including Administration, Finance, Trade and Commerce, Environment and Natural Resources, Community Based Services, Works, Production and Marketing, Health, and Education.

The Municipal Climate Change Focal Person (Environment Officer) will act as the secretariat for the plan, ensuring integration of actions into municipal budgets, annual work plans, and procurement plans. This office will also be responsible for consolidating progress reports from divisions, coordinating monitoring and evaluation, and ensuring alignment with national frameworks including the National Climate Change Policy, NDCs, SDGs, and the Parish Development Model.

Development partners, UN agencies, and CSOs working in Busia will engage through formal memoranda of understanding with the Municipality, aligning their projects to community, contingency plan and municipal development priorities. Regular quarterly review meetings will ensure coordination across all stakeholders.

The implementation of the climate action plan will rely on:

1. Municipal budgetary allocations through annual budgets aligned to the Climate Action Plan
2. Central government transfers and sector conditional grants including for environment, health, and infrastructure projects
3. Development partner contributions through project-based and technical support programs
4. Private sector investments in renewable energy, housing, waste management, and urban farming.
5. Community contributions in the form of labor, materials, or voluntary services for local initiatives
6. Innovative financing mechanisms such as climate bonds, carbon credit trading, and green funds

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Acronyms

BAU	Business As Usual
CCAP	Climate Change Action Plan
CHIRPS	Climate Hazards Group InfraRed Precipitation with Station data
CMIP6	Coupled Model Intercomparison Project Phase 6
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
ESGF	Earth Systems Grid Federation
GHG	Greenhouse Gas Emission
MME	Multi-Model Ensemble
NDC	Nationally Determined Contribution
RCP	Representative Concentration Pathway
UNFCCC	United Nations Framework Convention on Climate Change
UNMA	Uganda National Meteorological Authority
WASH	Water Sanitation and Hygiene

CHAPTER ONE: INTRODUCTION

1.1 Background

Uganda's greenhouse gas (GHG) emissions are dominated by the Agriculture, Forestry, and Other Land Use (AFOLU) sector, accounting for about 86% of the total (NDC, 2022). Uganda's greenhouse gas (GHG) emissions are projected to increase from 90.1 MtCO2e in 2015 to 148.8 MtCO2e in 2030 and 235.7 MtCO2e by 2050 under the Business as Usual (BAU) Scenario (Figure 1). This projection is in consideration of Busia Municipality, an urban settling with vibrant sectors (energy, transport, agriculture, waste and industries among others) that contribute to this cause with significant amounts of Greenhouse Gases.

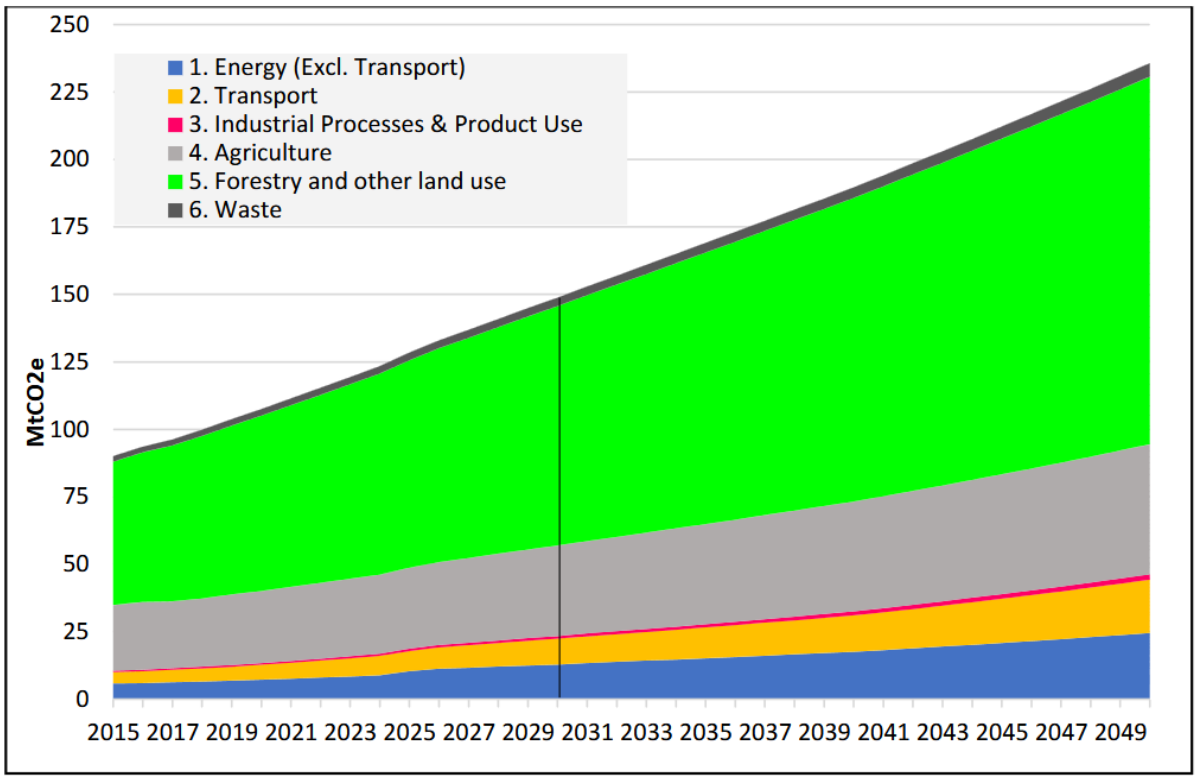

Figure 1: Uganda's BAU GHG emissions trajectory (Source: NDC, 2022)

It is against this backdrop, that Busia Municipal Climate Action Plan has been developed to inform decision making processes geared towards the planning and implementation of enhanced climate mitigation and adaptation actions in the short, medium and long term up to 2030 across the different sectors, aimed at improving their resilience.

1.2 Specific Objectives

The objectives of this climate action plan are:

a) To establish a climate change and vulnerability baseline for Busia Municipality
b) To provide climate actions that address key vulnerabilities, and build adaptive capacities and resilience at all levels
c) To facilitate climate risk decision making processes with guidance related to budgeting, climate action implementation arrangements, resource mobilization and dissemination of climate information
d) To promote a low carbon and climate resilient society by increasing public awareness and integrating climate actions into broader policies

1.3 Vision of the plan

Vision Statement:

"A resilient, sustainable, and climate-smart Busia Municipality where communities thrive in harmony with the environment, leveraging innovative solutions and local knowledge to mitigate climate impacts, adapt to changing conditions, and foster inclusive socio-economic development."

1.4 Purpose of the plan

The purpose of this plan is to:

1. Strengthen the resilience of communities and infrastructure to withstand and recover from climate-related stocks such as floods, heat waves, and drought.
2. Increase community awareness of human-induced climate change impacts and promote responsible environmental practices.
3. Implement sustainable waste management, water conservation, and energy efficiency measures to reduce carbon emissions and protect natural ecosystems.
4. Promote climate-smart agriculture and adaptive livelihood strategies to improve food security and reduce vulnerability to climate variability.
5. Invest in green, eco-friendly urban planning and infrastructure to minimize risks like flooding, heat stress, and environmental degradation.
6. Foster inclusive, community-driven climate action by engaging local residents, leaders, and organizations in adaptation and mitigation initiatives.
7. Create sustainable green jobs and livelihoods that support economic development while safeguarding the environment.
8. Leverage technology and indigenous knowledge for climate monitoring, adaptation, and emissions reduction.
9. Develop robust municipal policies and frameworks that integrate climate resilience, sustainability, and urban development.

1.5 Planning Process

The preparation of the Busia Municipality Climate Change Action Plan (2025–2030) followed a structured, participatory, and evidence-driven process that integrated climate data analysis, stakeholder engagement, and participatory planning approaches. A consultative and participatory process emphasized inclusivity, gender balance, and social equity. Stakeholder consultations were conducted at multiple levels including municipal, division, and ward to identify key climate hazards, vulnerabilities, and feasible adaptation and mitigation actions. Participants included technical officers from key municipal departments, community representatives, and civil society organizations. These engagements formed the foundation for defining the vision, objectives, and priority climate actions for the municipality.

A Climate Risk and Vulnerability Assessment (CRVA) formed the analytical backbone of the plan. It applied a mixed-methods design, integrating quantitative climate analysis with qualitative community insights. The CRVA followed the IPCC risk framework, conceptualizing risk as the interaction between hazard, exposure, and vulnerability. A structured literature review established the analytical framework and aligned the CAP with existing policy and scientific evidence. Sources spanned national policies including the National Climate Change Policy (2015), National Adaptation Plans (NAPs), Vision 2040, and the Third National Communication (2022) as well as regional references from EAC and IGAD. Municipal-level documents, including the Busia Physical Development Plan and Multi-Hazard Risk Profile, were also reviewed to contextualize local climate challenges.

Stakeholder engagement involved 10 key informant interviews (KIIs) and 5 focus group discussions (FGDs) with officials in natural resources, agriculture, planning, health, education, and community development, as well as representatives from CSOs and communities. These interactions captured local perceptions of climate hazards, adaptive capacities, and priority needs. Consultations were conducted in the local Samia language, ensuring inclusivity, and data collection was guided by ethical considerations such as informed consent and confidentiality.

The climate analysis utilized historical datasets (1994-2024) from the Uganda National Meteorological Authority (UNMA) and NASA POWER data to examine rainfall and temperature variability. Future projections (2025-2040) were generated using a multi-model ensemble (MME) from six CMIP6 models under SSP2-4.5 and SSP8.5 scenarios. The models were validated against observed data, and trend analyses employed the Modified Mann-Kendall test and Theil-Sen slope estimator to determine the magnitude and direction of change.

Climate Hazard Profiling involved multiple climate hazards (floods, dry spells, heatwaves, lightning, windstorms, and air pollution) analysis using spatial and statistical tools that is;

a. Flooding was modelled using HEC-GeoRAS based on rainfall, elevation, and land cover data.
b. Dry spells were assessed using the Standardized Precipitation Index (SPI).
c. Heatwaves were identified following WMO and ETCCDI guidelines, using temperature percentiles for local thresholds.
d. Lightning was mapped using data from NASA's SEVIRI satellite and thunder-day records.
e. Windstorms were analyzed through kriging interpolation of UNMA wind data, applying the Beaufort scale.
f. Air quality was monitored using a Casella microdust device, with 123 samples collected across wards and mapped via kriging interpolation.

Vulnerability was analysed as a function of exposure, sensitivity, and adaptive capacity, where:
*Vulnerability = (Exposure * Sensitivity) – Adaptive Capacity*

Exposure was determined by identifying physical and socio-economic assets located in hazard-prone areas while sensitivity indicators included dependence on climate-sensitive sectors, housing quality, and health access. Adaptive capacity indicators captured aspects such as livelihood diversification, education, access to credit, renewable energy, and social networks.

The indices were computed and spatially analysed in a GIS environment to produce ward-level maps of vulnerability and composite climate risk. The results of the CRVA informed stakeholder-led planning sessions, during which the participants prioritized actions across ten thematic result areas: Energy; Transportation; Trade and Industry; Agriculture; Environment; ICT; Land and Housing; Social Development; Education and Sports; and Health. These participatory sessions produced a set of adaptation actions tailored to local capacities and socio-economic contexts. A validation workshop was held to refine and confirm the proposed interventions.

The CCAP spans 2025-2030, aligning with Uganda's Updated NDC target of 24.7% emission reduction by 2030 and other national policy frameworks. This alignment will ensure that municipal actions contribute to broader national climate commitments while addressing localized vulnerabilities and opportunities.

6.1 Policy, Regulatory and Planning Frameworks

This plan has been developed to integrate multiple objectives, sectoral, catchment, and local planning for climate-resilient adaptation, in alignment with international, national, and strategic commitments. The frameworks aim to reduce emissions, build resilience to climate impacts, enhance climate-resilient infrastructure and services, and strengthen the knowledge base. Table 1 outlines the policy, regulatory, and planning frameworks that guide the planning and implementation of climate-resilient mitigation and adaptation strategies.

Table 1: Strategies, International, and national policy and regulatory frameworks

Frameworks, Policies, Plans and Acts	Relevance to Climate actions
International Frameworks	
United Nations Framework Convention on Climate Change (UNFCCC) 1992	Uganda signed and ratified the UNFCCC in 1992. The UNFCCC primarily focuses on developing NDCs, promotes integration of climate change into national planning, and enables access to international climate finance, capacity building and technology to align actions with global climate goals and strengthens institutional frameworks for coordinated climate action.
The Sendai Framework for Disaster Risk Reduction (2015-2030)	The **Sendai Framework** emphasize the need to **reduce disaster risks** that are exacerbated by climate change, including dry spells, floods, and extreme weather events; encourage the integration of DRR into **climate change policies and plans**. With an aim of building **climate resilience**, improving EWS, and ensuring that climate adaptation efforts contribute to reducing vulnerability to climate-related disasters.
The United Nations Convention to Combat Desertification (1994)	The **UNCCD** focus on promoting sustainable land management practices that prevent desertification, land degradation, and dry spell; implementing climate-resilient agricultural practices, improve soil health and restore degraded lands; mitigating the impacts of climate change, enhance carbon sequestration, and

Frameworks, Policies, Plans and Acts	Relevance to Climate actions
	increasing agricultural productivity in vulnerable areas, with the goal of contributing to **climate adaptation and greenhouse gas reduction**.
The Paris Agreement 2016	The **Paris Agreement** is a core in limiting global temperature rise to well below 2°C and pursue efforts to stay within 1.5°C; it guides the formulation and implementation of **NDCs**, which outline sector-specific strategies for climate mitigation and adaptation; enhances access to **international climate finance, capacity building and technology transfer**, and supports the transition to a low-carbon and climate-resilient development pathway.
Kyoto Protocol (2005)	The **Kyoto Protocol** primary focus is on reducing greenhouse gas emissions; implementing **emission-reduction projects**, access **climate finance**, and promote **low-carbon technologies**, supporting climate action goals is easy through Clean Development Mechanism CDM.
Sustainable Development Goals (2015).	The **SDGs**, specifically **Goal 13 (Climate Action)**, focus on strengthening resilience and adaptive capacity to climate-related hazards; promoting the integration of climate change measures into national policies, strategies, and planning; encouraging access climate finance, invest in renewable energy, and promote sustainable land and resource use to achieve a **low-carbon, climate-resilient future**.
African Union Agenda (2063)	Focuses on promoting a prosperous and sustainable Africa by supporting inclusive green growth, environmental sustainability, and climate-resilient economies; advocating for **renewable energy adoption, sustainable land use**, and **climate-smart agriculture;** encouraging regional cooperation and resource mobilization to tackle climate change effectively.
IGAD Initiatives on Dry spell & Desertification Strategy (2021-2025)	The strategy focuses on promoting climate-resilient agriculture, **sustainable land management, ecosystem restoration**; addressing land degradation and reduce vulnerability to climate shocks; promoting **cross-border collaboration**, capacity building, and the use of **climate-smart practices**; contributing to greenhouse gas reduction, enhanced adaptive capacity and improved food security in dry spell-prone areas.
UN 2030 Agenda	The agenda adopted in 2015, outlines **17 SDGs**, with **Goal 13 (Climate Action)** directly calling for urgent steps to combat climate change and its impacts; guides the integration of climate change into national planning, encourages **resilient development**, and supports **access to international climate finance and technology**.
The Ramsar Convention on Wetlands (1971)	The Ramsar Convention promotes the **conservation and wise use of wetlands**, which advocates for **carbon storage, climate regulation**, and **biodiversity conservation** by buffering climate impacts and supporting climate-resilient livelihoods including fishing, eco-tourism, and sustainable agriculture.
National Planning frameworks	
Uganda Vision (2040)	The Vision acknowledges climate change as a hindrance to development thus promotes a shift to a **green economy** focusing on **low-carbon development, renewable energy,** and **sustainable natural resource use**; It also supports integration of climate change adaptation and mitigation into all sectors of the economy to ensure long-term sustainability.
Fourth National Development Plan (2025/26 - 2029/30)	NDPIV provides the policy, institutional, and financing framework for Busia Municipality to implement effective local climate actions that support Uganda's transition toward a green and resilient economy. The Plan guides integration of climate resilience into planning, budgeting, and service delivery particularly

Frameworks, Policies, Plans and Acts	Relevance to Climate actions
	through improved solid waste management, drainage systems, urban greening, and pollution control. It also opens access to climate finance and green investment opportunities, encourages nature-based solutions to urban flooding, and promotes climate-smart livelihoods under the Parish Development Model.
Busia Municipal Development Plan (2020/21 – 2024/25)	The plan integrates environmental sustainability and resilience-building across all development sectors. The plan recognises key climate-related challenges such as wetland degradation, deforestation, flooding, and poor waste management, and prioritises interventions to restore natural ecosystems, expand green cover, improve solid waste management, and strengthen urban drainage systems. It emphasises sustainable urban planning, including enforcement of physical development guidelines, wetland protection, and nature-based infrastructure to mitigate flood risks. Moreover, the plan promotes climate-smart livelihoods by supporting agriculture, energy efficiency, and renewable energy adoption.
Updated Nationally Determined Contribution (2022)	The Updated NDC outlines country's enhanced commitments to **reduce greenhouse gas emissions** by 24.7% by 2030, prioritizing sectors including **agriculture, energy, forestry, and waste management**. It promotes **transition to clean energy climate-smart agriculture** and **afforestation**, while advocating for inclusive participation and gender-responsive approaches.
Uganda Disaster Preparedness Plan (2005 – 2009)	Although it was formulated before Uganda's formal climate change policy frameworks, the plan indirectly supports climate goals by enhancing national capacity to prepare for **climate-induced hazards** such as floods and dry spells.
National Disaster Risk Management (DRM) Plan (2011 – 2028)	The DRM Plan supports country's climate resilience efforts by promoting **risk-informed development planning**. It acknowledges the growing impact of **climate-induced hazards** including dry spells, floods, and landslides, and advocates for **adaptation measures** that reduce long-term vulnerability to climate change.
NRM manifesto (2021 – 2026)	The Manifesto fronts the importance of sustainable **natural resource management** as a foundation for Uganda's future development. It profiles a commitment to **climate-smart agriculture**, which aims to enhance productivity while minimizing environmental degradation. It promotes the adoption of **innovative technologies** that can reduce carbon emissions and enhance environmental sustainability. It also calls for the integration of **climate change adaptation** and **mitigation** strategies across all sectors, including agriculture, energy, infrastructure, and transport to ensure **climate resilience** in both urban and rural communities.
Uganda National Adaptation Programmes of Action (2007	NAPA establishes strategic approach to **climate change adaptation** by identifying the most vulnerable communities and sectors. It focuses on actions that enhance resilience in sectors including health agriculture and water resources. It proposes **adaptation measures** including promoting dry spell-resistant crops, improving water storage, and enhancing EWS for extreme weather events.
Health Sector Development Plan (2015-2020)	The plan recognizes the growing impact of **climate change** on public health, basically through **climate-sensitive diseases** including cholera malaria, and waterborne diseases. It aims to enhance the need for **climate adaptation strategies** to protect health systems and improve **healthcare access** for vulnerable populations. The plan also supports initiatives such as **vector control** in malaria-prone areas and strengthening health sector capacity to handle climate-related health crises.

Frameworks, Policies, Plans and Acts	Relevance to Climate actions
The Water Action Plan (1995)	The plan centers on improving **water resource management** by ensuring sustainable water use in the face of growing climate change impacts. It emphasizes the development of **water infrastructure, water conservation** and promotion of **efficient irrigation** practices that are important for adapting to **climate-induced water scarcity** and dry spells. It also advocates for better management of **wetlands** to improve water retention and resilience to climate-related shifts in water availability.
National Policies	
The 1995 Constitution of Uganda	The Constitution lays the **foundation for environmental protection**, recognizing the duty of the state and citizens to protect natural resources, such as water, land, wetlands, and biodiversity. It mandates that **development must be ecologically sustainable**, which supports climate action by providing a legal basis for integrating environmental and climate considerations into national and local policies.
National Environment Management Policy (1995)	NEMP establishes a framework that focus on integrating **climate considerations** and **environmental sustainability** into Uganda's development agenda by promotes **sustainable use of natural resources**, supports climate change mitigation and adaptation measures, and advocates for **integration of climate issues into sectoral plans, policies and budgets**. NEMP encourages the **mobilization of financial and technical resources** for environmental protection and resilience building.
Uganda National Land Policy (2013)	The policy advocates for **climate-resilient land use planning** by promoting **sustainable land management practices** that prevent degradation and enhance productivity. It encourages **protection of fragile ecosystems** including forests, wetlands and mountainous areas, which are crucial for carbon sequestration and climate regulation. The policy also emphasizes the integration of **climate change adaptation strategies** into land tenure and utilization systems.
Uganda National Climate Change Policy (2015	The policy is a **central framework for addressing climate change**, guiding both mitigation and adaptation efforts, promotes **low-carbon development**, encourages **sustainable energy use**, and advocates for **integration of climate change into all national and sectoral plans;** supports **green economy initiatives** and provides direction for mobilizing **climate finance**, research, and technology transfer to build national climate resilience.
Disaster Preparedness and Management Policy (2010)	Although the policy primarily focuses on disaster management, it also recognizes the increasing climate-related hazards including floods, dry spells, and landslides and their impacts; promotes the mainstreaming of climate change adaptation into disaster risk reduction strategies and supports actions that build community resilience to the long-term impacts of climate change.
The Uganda Forestry Policy	The policy seeks to promote sustainable forest management for climate change mitigation through biodiversity conservation and carbon sequestration; encourage afforestation, reforestation and restoration of degraded forest ecosystems, all which contribute to greenhouse gas emissions reduction and enhancing climate resilience across landscapes.
The Water Statute (1995)	The Water Statute advocates for **sustainable use, conservation, efficient water use, protection of water resources**, and resilience building in water supply systems which is key for climate adaptation. It establishes the legal basis for **integrated water resources management (IWRM)** approach to ensure water availability amidst changing climate patterns.

Frameworks, Policies, Plans and Acts	Relevance to Climate actions
The Gender Policy (1997)	The policy primarily emphasizes **equity and inclusiveness in climate change planning and response**. It recognizes that women and men experience climate impacts differently and promotes the **integration of gender perspectives into environmental and climate policies**; it advocates for **women's participation in climate actions**, mainly in sectors including agriculture, water, and energy, which are highly climate-sensitive
National Acts	
National Forestry and Tree Planting Act (2003)	The Act establishes a legal framework that prioritize sustainable expansion of forests and management for climate change mitigation through carbon sequestration. It also promotes afforestation, tree planting, and reforestation in degraded areas, and supports the conservation of natural forest reserves to reduce greenhouse gas emissions and protect biodiversity.
National Climate Change Act (2021)	The Act primarily seeks to address climate change. It mandates the **integration of climate change into all national and sectoral plans, policies and budgets**. It has established institutional structures for **climate governance**, enforces commitments under international agreements (e.g., the Paris Agreement), and promotes **emissions tracking, low-carbon development**, and **climate finance** mechanisms to support climate-resilient growth.
National Disaster Preparedness and Management Act (2021)	The Act supports **climate change adaptation** by integrating **disaster risk reduction (DRR)** into national development plans which helps address the vulnerabilities of sectors including water resources, agriculture and health to climate change impacts such as dry spells and floods. The Act enhances Uganda's capacity to prepare for and manage **climate-induced hazards**, promoting the **sustainability** of communities through EWS, resource mobilization, and adaptive measures.
The National Environment Act (NEA) 2019	The NEA provides a framework for environmental management which emphasizes sustainable development and the integration of environmental concerns into national planning. It established the NEMA, a coordinating, monitoring, regulatory, and supervisory body for environmental activities. The Act seeks to address emerging environmental issues, including climate change, by promoting strategic environmental assessments and the management of hazardous chemicals.
The National Water Policy (1999)	The **policy** provides a framework that prioritize sustainable management and development of water resources. It has promoted IWRM for adapting to climate variability and ensuring the equitable and efficient use of water across all sectors. It also supports water conservation and sustainable water supply for rain-fed agricultural production affected by climate change; it addresses the need for efficient use of water in industries and urban areas to reduce the carbon and water footprints of these sectors.
The Water Act (1997)	The Act establishes a framework for the use, protection, and management of water resources. It supports climate adaptation efforts, ensuring that water use for various purposes including agricultural, domestic, industrial, and energy production is conducted sustainably. This helps mitigate the impacts of climate change by maintaining the availability and integrity of water resources.
Land Act, 1998	The Act establishes a framework for land tenure including customary, freehold, Mailo, and leasehold; ownership, and management. Although the Act does not explicitly address climate change issues, but it encourages sustainable land-use

Frameworks, Policies, Plans and Acts	Relevance to Climate actions
	practices and long-term investments in land conservation, which are important in climate change mitigation and adaptation strategies.
The Local Governments Act (1997)	The Act, entrusts local governments with the management of natural resources within their jurisdictions. It empowers local authorities to implement environmental policies and programs customized to their specific contexts, facilitating more effective responses to climate change challenges; LGs can develop and enforce ordinances related to environmental conservation, promote sustainable land use practices, and engage communities in climate adaptation initiatives and enables grassroots-level climate action, fostering resilience and sustainable development.
Public Finance Management Act, 2015	PFMA carries out the systematic integration of climate change in planning and budgeting by emphasizing prudent financial management which ensures that resources are efficiently allocated toward climate-related initiatives; it facilitates the government's ability to fund climate adaptation and mitigation programs which help building resilience against climate change impacts.
The National Water & Sewerage Corporation Act. 1995	The policy gave rise to establishment of the National Water and Sewerage Corporation (NWSC). The NWSC has been responsible for piped water provision and focus on expanding water and sewerage services in large urban centres and small urban centres. In this context, the Act supports the implementation of **IWRM**, encouraging the sustainable management and conservation of water resources, contributes to enhancing **climate resilience** in urban areas, helping communities adapt to the impacts of climate change, such as altered precipitation patterns and water scarcity.

CHAPTER TWO: CLIMATE CHANGE AND VULNERABILITY

2.1 Global Observed and Projected Climate Trends

Global surface temperature has increased faster since 1970 than in any other 50-year period over at least the last 2000 years. Global surface temperature was 1.09°C higher in 2011–2020 than 1850–1900 (Figure 2). Global warming will continue to increase in the near term (2021-2040) mainly due to increased cumulative CO_2 emissions in nearly all the GHG emission scenarios (Figure 3). Annual precipitation is also projected to increase in almost all the continental regions.

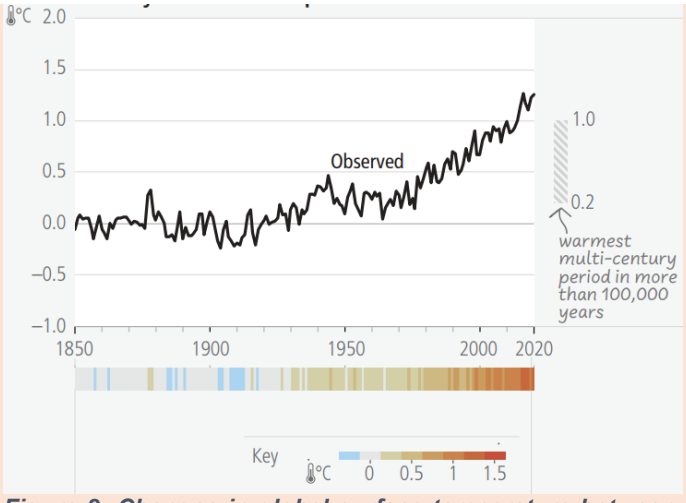

Figure 2: Changes in global surface temperature between 1850 and 2020

Source: IPCC, 2023

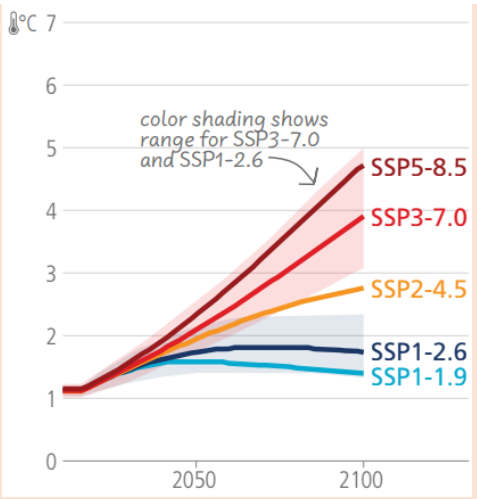

Figure 3: Global surface temperature for SSP-based scenarios over the 21st century

Source: IPCC, 2023

2.2 National Observed and Projected Climate Trends

2.2.1 Temperature trends and projections

The observed mean annual near-surface temperatures for Uganda are about 21 °C, with a minimum of 15°C in July and a maximum of 30°C in February (MWE, 2015). For the climatological period 1950-2023, mean temperature in Uganda has increased at a rate of 0.44°C per decade (UNMA, 2023). The projections of mean annual temperature (2031-2060) indicate an increase from 1 to 1.5 °C under low (RCP 2.6) and moderate (RCP 4.5) greenhouse gas (GHG) concentration scenarios for most parts of the country; and an increase of 1.5 to 3 °C under the high GHG scenario of 8.5; relative to the 1981-2010 average (**Figure 4**).

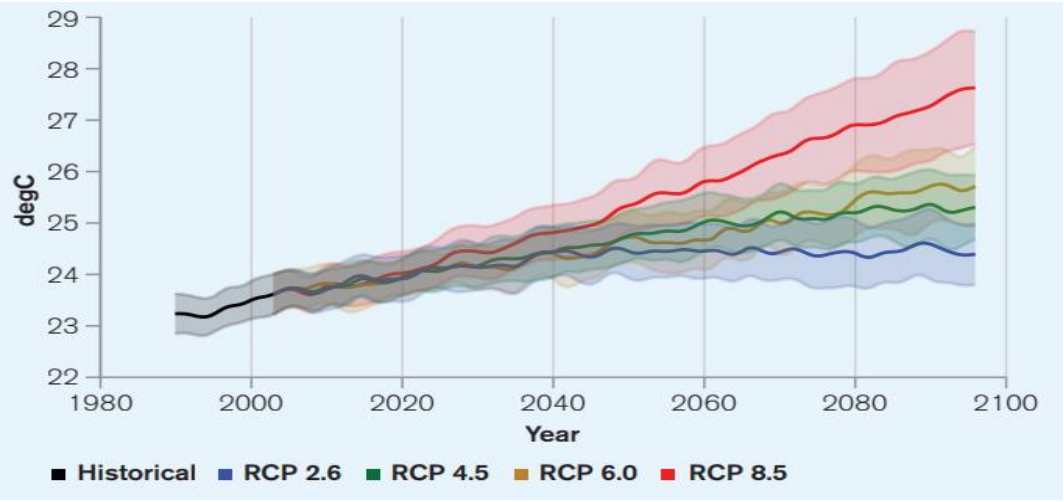

Figure 4: Historical and projected mean temperature for Uganda from 1986 to 2099

Source: World Bank, 2021

The Northern and South Western regions of the country are projected to have the highest temperature increase of between 2.5 and 3 °C compared to other areas especially in the 2050s (Figure 5). A warming ranging between 1.4 ^{0}C and 4.2 ^{0}C is projected for the end of the century (CSCG, 2015).

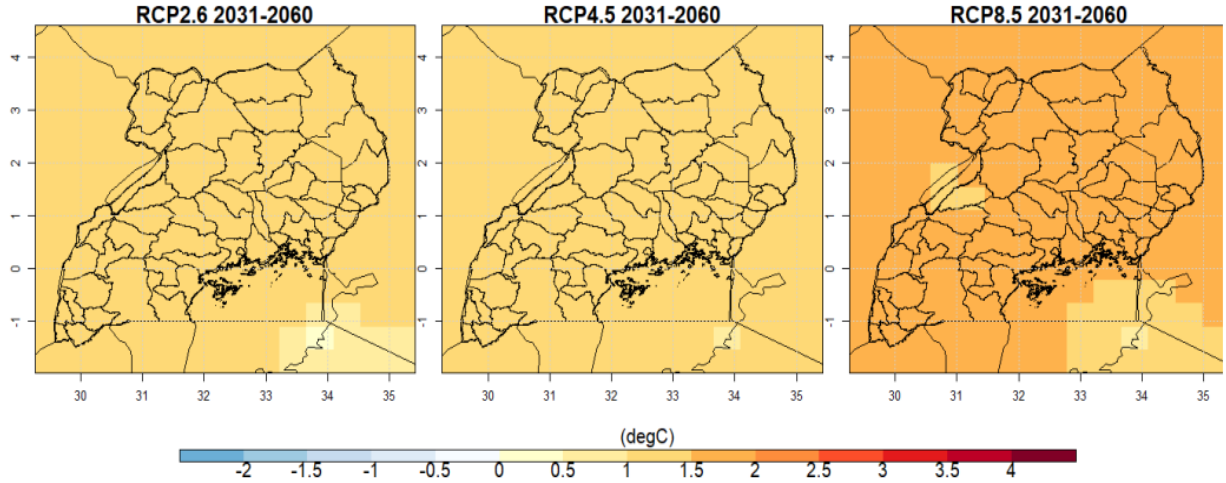

Figure 5: Projected mean annual temperature changes for the 2031-2060 climate period in relation to the 1981-2010 average

Source: MWE, 2022

2.2.2 Rainfall trends and projections

Between 1901 and 2019, the total annual average rainfall was 1,197 mm, and mean monthly rainfall of the country varied from 39.6 mm in January to 152.7 mm in April (World Bank, 2021). Total annual rainfall for the period 1981-2010 varied between 750- 2400mm with highest amounts of 1700-2400mm observed around the Lake Victoria and the Mt. Elgon region while the least amounts (750-950mm) are observed in the Karamoja sub-region and some South Western cattle corridor districts, such as Isingiro.

The projections indicate an increase of mean rainfall for Uganda with uncertainty (**Figure 6**). However, the projections indicate an increase in rainfall in the DJF (December-January-February) season, which is typically a dry season in the entire country (MWE, 2015). This could have negative impacts on water resources causing floods in extreme cases.

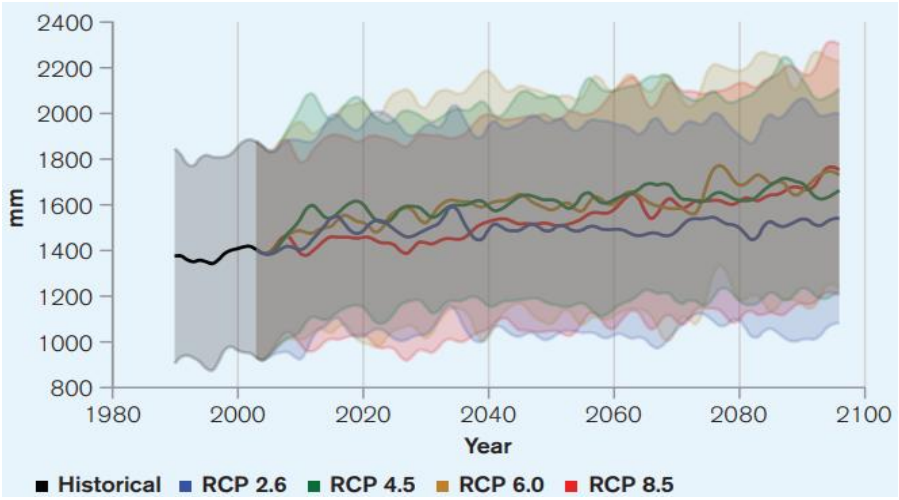

Figure 6: Historical and projected annual average rainfall for Uganda from 1986 to 2099

Source: World Bank, 2021

Under RCP 2.6, there is no expected significant variation in annual rainfall by mid-century as compared to the 1981–2010 average, apart from the Masindi, Hoima area (mid-Western Uganda), and Karamoja (North Eastern) regions, where rainfall is projected to decrease by 5 to 10% relative to the baseline (**Figure 7**). Under RCP 4.5, no significant changes are also projected across the country, with only the South Western highlands projected to have an increase in rainfall of between 5 and 10% relative to the baseline. In contrast, under RCP 8.5 scenario, the mean annual rainfall by mid-century is expected to decrease by 5 to 15% in most parts of central Uganda and increase by 5 to 10% in South Western Uganda.

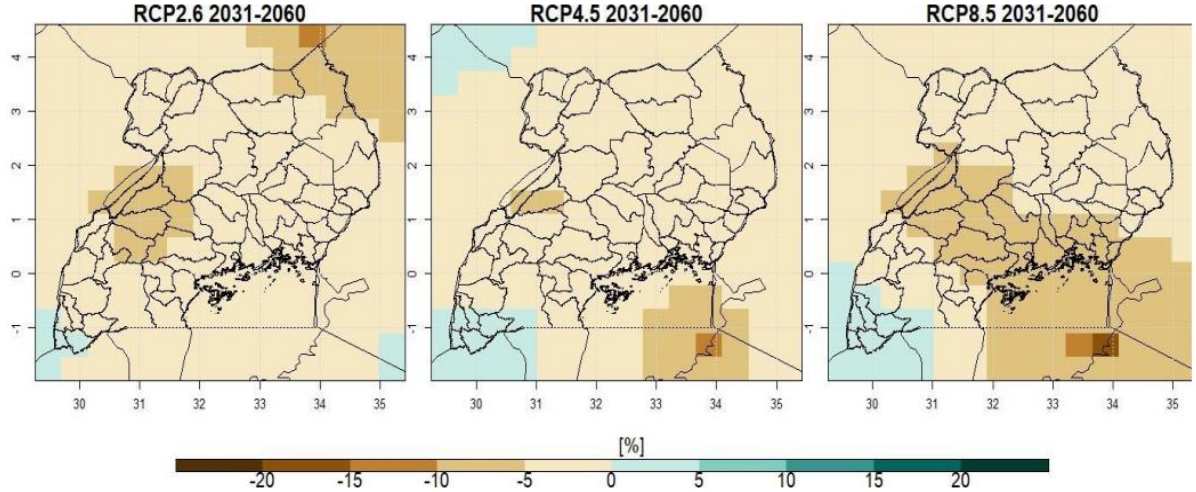

Figure 7: Projected mean total annual rainfall for the 2031-2060 climate period in relation to the 1981-2010 average

Source: MWE, 2022

2.3 Observed and Projected Climate Trends in Busia Municipality

2.3.1 Mean Temperature trends and projections

The historical mean temperature trend for Busia Municipality, covering the period from 1994 to 2024, shows a gradual warming pattern. Temperatures fluctuated annually due to natural climate variability, with notable peaks in 1998, 2005, and 2016 (**Figure 8**). Despite these short-term variations, the overall trend indicates an increase from 22.4 °C in 1994 to about 23.2 °C by 2024. For the climatological period 1994-2024, the mean temperature in Busia Municipality has increased at a rate of 0.19 °C per decade. The overall trend indicates a slow but steady increase in temperatures across the three decades, setting the stage for warmer conditions in the future.

Future projections indicate a continuation of this warming trend under both climate scenarios. Under the moderate emissions pathway (SSP2-4.5), mean temperatures are expected to range mainly between 23.2°C and 23.9°C. In contrast, the high emissions pathway (SSP5-8.5) projects slightly higher values, reaching approximately 24.0°C in the warmest years. The SSP5-8.5 scenario consistently produces higher annual temperatures than SSP2-4.5, particularly toward the latter part of the projection period. By 2040, the district could be around 0.7°C warmer under the moderate emissions pathway and 0.8°C warmer under the high emissions pathway compared to the 1994-2024 average.

Busia Municipality is projected to become warmer under both emissions scenarios, with the degree of warming dependent on global greenhouse gas emission levels. While SSP2-4.5 indicates a gradual and relatively controlled rise in temperature, SSP5-8.5 shows a sharper and more intense warming trend. Compared to the historical period, both scenarios suggest a significant shift to a hotter climate, which may affect agricultural productivity, water resources, and human health if adaptive measures are not prioritized.

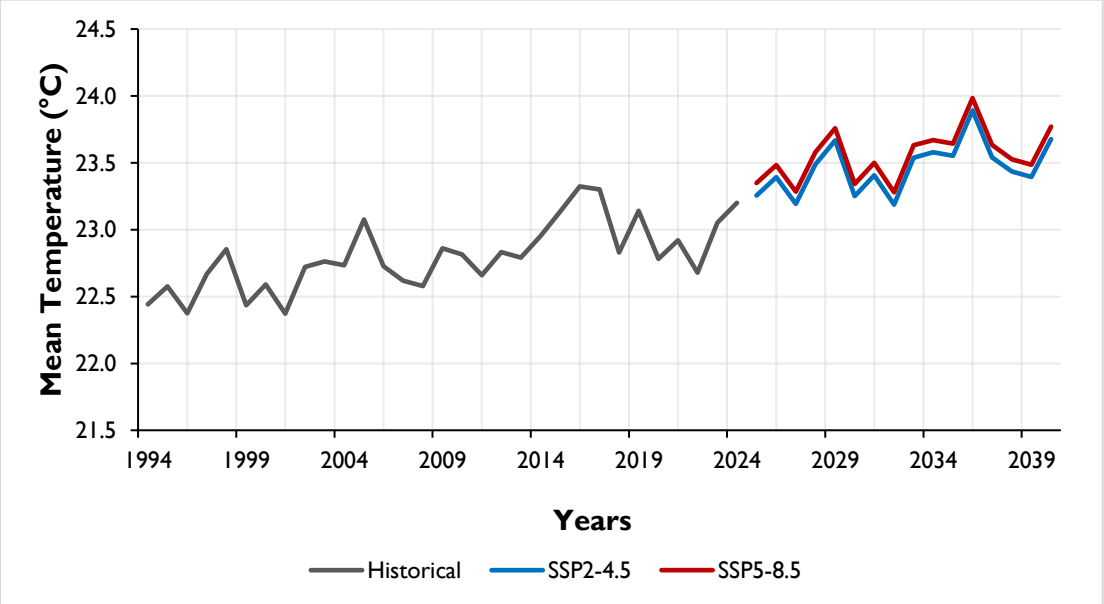

Figure 8: Historical and projected mean temperature for Busia Municipality between 1994 and 2040

2.3.2 Rainfall trends and projections

Between 1994 and 2024, the total annual average rainfall for Busia Municipality was 1,778 mm, and mean monthly rainfall varied from 68.8 mm in January to 277.8 mm in April. For the climatological period 1994-2024, rainfall in Busia municipality has increased at a rate of 154 mm per decade. Between 1994 and 2024, the highest annual rainfall of 2,621.9 mm was recorded in 2020 whereas the lowest (1,429.6 mm) was recorded in 2016 (**Figure 9**).

The projections (2025-2040) indicate an increase of mean rainfall for Busia Municipality. Under SSP2-4.5, mean rainfall is projected to increase by 30.5 mm (1.7%) relative to the 1994-2024 average. Similarly, under SSP5-8.5, mean rainfall is projected to increase by 15 mm (0.9%) relative to the 1994-2024 average. The projections suggest that while long-term averages remain relatively stable, extreme rainfall events may occur more frequently under high emissions scenarios. This implies that the municipality may continue to experience challenges related to both excessive rainfall and occasional shortfalls, with implications for agriculture, water resources, and local livelihoods.

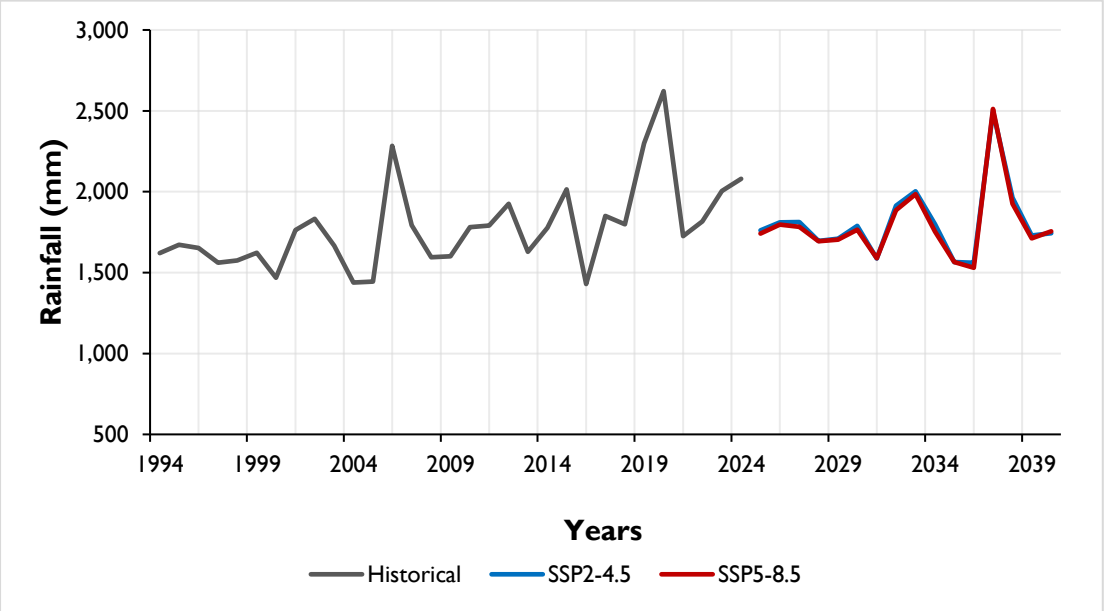

Figure 9: Historical and projected rainfall for Busia Municipality between 1994 and 2040

2.4 Climate Hazards

The climate hazards that affect Busia municipality include dry spell, heat waves, floods, lightning, hailstorms, and windstorms. However, there are compounding risks such as air pollution that increases community vulnerability to climate-related hazards (e.g., respiratory illnesses making people more at-risk during heatwaves or floods). These climate hazards and compounding risks are briefly described below.

2.4.1 Air Pollution

Air pollution is defined as a change in the air quality resulting from human activity, through direct or indirect input of pollutants that may be harmful to human health and the environment, or cause damage to property or disturb or affect amenities of life and any other legitimate manner of environment use. Busia Municipality is undergoing rapid urbanization, which has led to increased concerns about air quality. Monitoring air quality is essential to identify pollution hotspots, assess compliance with national and international guidelines, and inform strategies to reduce exposure to harmful pollutants.

Air pollution in Busia Municipality is driven by a combination of urban, economic, and household activities. As a busy border town, transport emissions from trucks, buses, and motorcycles are a major source of fine particulate matter ($PM_{2.5}$), with old and poorly maintained vehicles worsening the problem. Open burning of solid waste, often plastics and organic refuse, further contributes to toxic emissions due to limited waste management services. At the household level, many residents rely on charcoal, firewood, and other biomass fuels for cooking and heating, releasing heavy smoke into both indoor and outdoor air. Cross-border trade and economic activities also intensify localized pollution, with congestion, idling vehicles, and informal businesses at the border adding to poor air quality. Additionally, small-scale industries such as welding, carpentry, and grain milling, which often use diesel generators, contribute to localized emissions, while dust from unpaved roads and construction activities, particularly in peri-urban areas, exacerbates the problem during the dry season.

The sampled air quality in Busia Municipality, measured through $PM_{2.5}$ concentrations, reveals a serious public health concern, with values across all wards exceeding the World Health Organization (WHO) safe limit of 15 µg/m³ and most also surpassing the National Environment Management Authority (NEMA) standard of 35 µg/m³ (**Figure 10**). The highest concentrations were recorded in Central (281.3 µg/m³) and North East A (231.6 µg/m³), reaching levels more than fifteen times higher than the WHO guideline. Other parishes such as North East B (118.9 µg/m³), North B (97.5 µg/m³), and South West (81.3 µg/m³) also showed elevated levels well above both standards. Even the relatively lower concentrations in South East (60.3 µg/m³) and North A (43.2 µg/m³) remain unsafe, while North C (32.8 µg/m³) is the only ward below the NEMA threshold but still more than double the WHO guideline. Overall, the results indicate that air quality in Busia Municipality is severely degraded, with the Eastern Division (particularly Central and North East A) being the most affected. This situation underscores the urgent need for targeted interventions in waste management, traffic control, and urban planning to protect residents from the growing health risks associated with prolonged exposure to dangerous $PM_{2.5}$ levels.

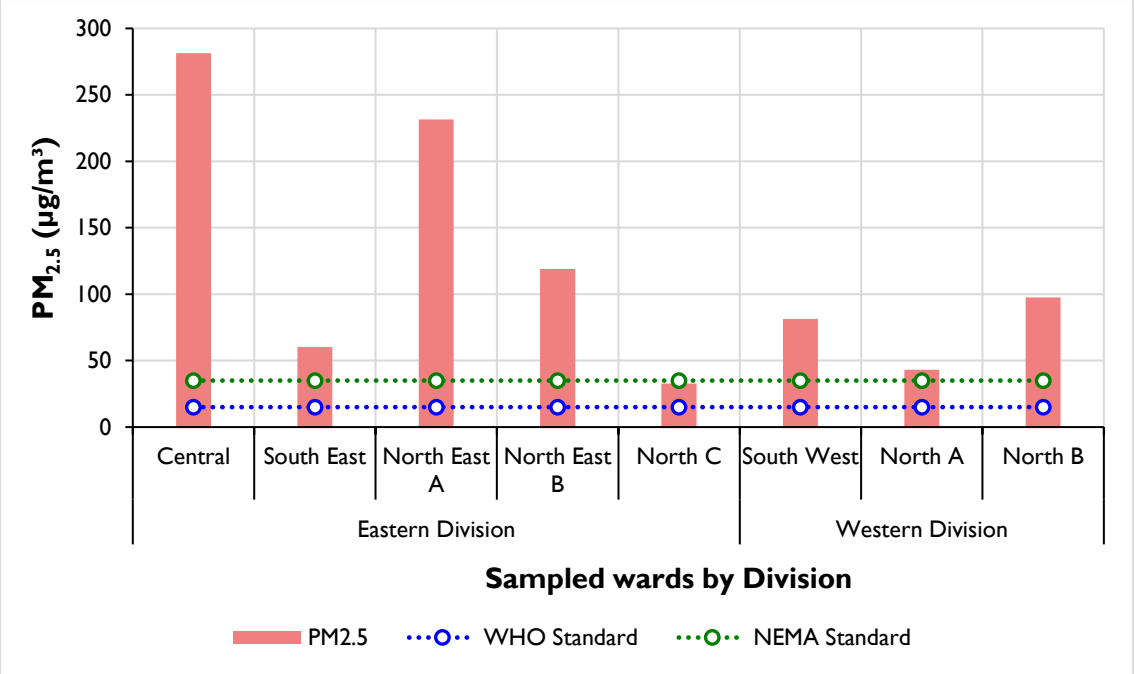

Figure 10: Air quality ($PM_{2.5}$) in the sampled wards of Busia Municipality (July 2025)

In the Western Division, North B and South West record levels ranging from moderate (26.8–35.4 µg/m³) to unhealthy for sensitive groups (35.5–55.4 µg/m³), which, while lower than other areas, still endanger vulnerable populations such as children, the elderly, and people with respiratory illnesses. South West ward has the biggest area coverage with moderate air quality. North A registers unhealthy levels (55.5–150.4 µg/m³), indicating more widespread exposure to harmful particulate matter. In the Eastern Division, the situation is much worse, with Central and North East A reaching hazardous levels (250.5–279.1 µg/m³), which present extremely high health risks for the entire population (**Figure 11**). South East and North East B also experience air quality within the unhealthy to very unhealthy range (55.5–250.4 µg/m³), while North C shows levels considered unhealthy for sensitive groups (35.5–55.4 µg/m³). Overall, the findings highlight that Busia Municipality is facing a critical air pollution challenge, with Central and North East A being the most severely affected, underscoring the urgent need for interventions to reduce emissions and safeguard community health.

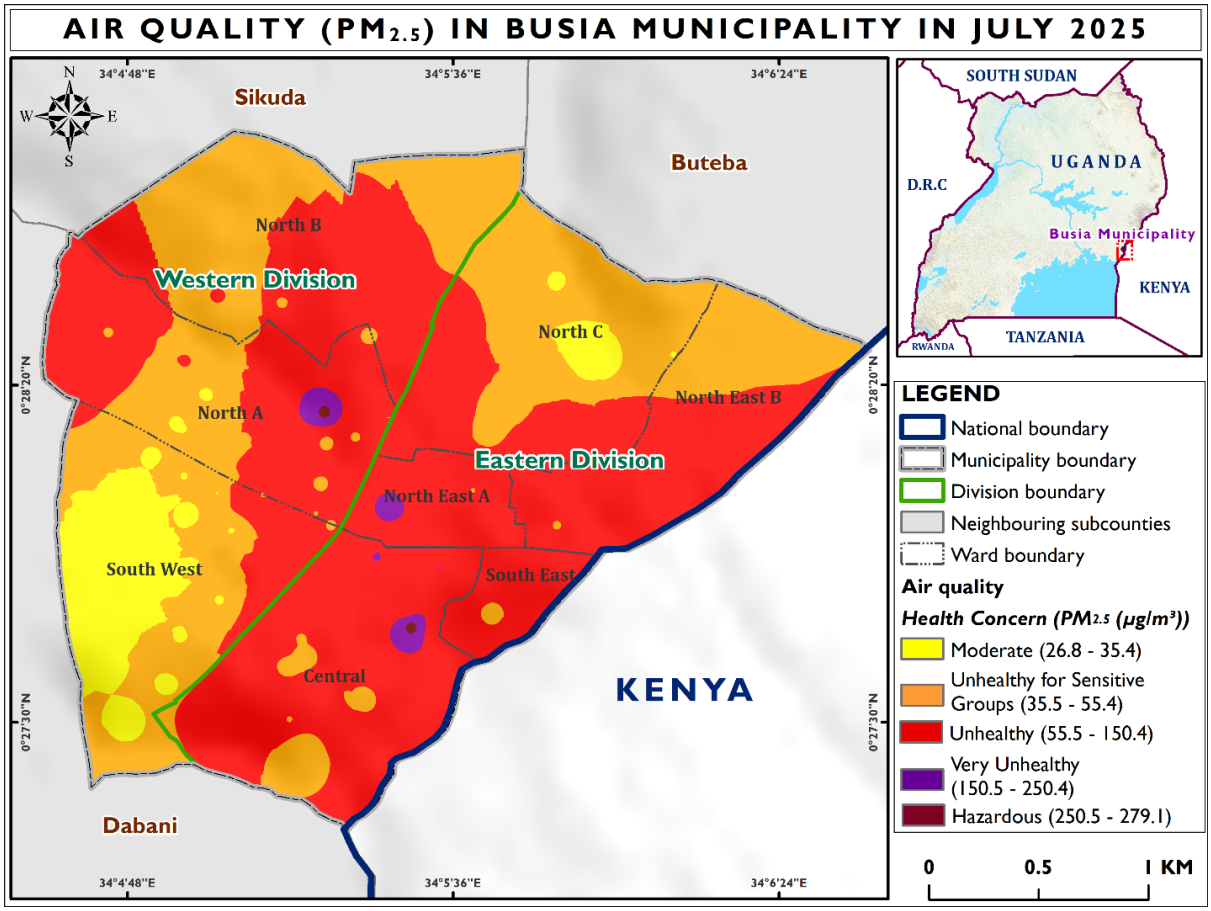

Figure 11: Air quality ($PM_{2.5}$) in Busia Municipality in July 2025

The impacts of air pollution in Busia Municipality are far-reaching, affecting health, livelihoods, and the environment. High $PM_{2.5}$ levels, which exceed both WHO and NEMA standards, pose serious health risks, leading to respiratory illnesses such as asthma, bronchitis, and pneumonia, as well as cardiovascular complications. Children, the elderly, and those with pre-existing conditions are the most vulnerable, but the entire population faces elevated risks in the most polluted wards. Chronic exposure contributes to reduced life expectancy and lowers the quality of life. Economically, poor air quality drives up healthcare costs, burdens the already stretched health system, and reduces productivity as residents lose workdays due to illness. Environmentally, persistent emissions reduce visibility, contaminate soil and water, and can lower agricultural productivity, further threatening livelihoods. Air pollution also contributes to climate change by releasing greenhouse gases from waste burning and fossil fuel use, compounding broader climate risks. Socially, low-income communities that rely heavily on biomass fuels and have limited access to healthcare bear the greatest burden, deepening inequality and vulnerability.

2.4.2 Dry Spell

Dry spell is defined as a recurrent feature of climate that occurs when there is an extended period of abnormal deficiency in precipitation (relative to what is considered normal) (Sivakumar & Wilhite, 2002). Monitoring dry spell in Busia Municipality is critical for understanding and managing the area's vulnerability to climate variability and its impacts on livelihoods, ecosystems, and socio-economic development. Moreover, evaluating dry spell trends supports policy alignment with national climate change strategies, informs municipal development planning, and strengthens

community resilience by guiding targeted interventions for the most affected and vulnerable groups.

Dry spell is primarily driven by extended periods of below-average rainfall, which are often linked to large-scale climatic processes such as the El Niño–Southern Oscillation (ENSO) that alters regional rainfall patterns and suppresses precipitation (Nicholson, 2017). Rising global temperatures due to climate change further exacerbate dry spell risk by intensifying evapotranspiration and accelerating soil moisture loss (IPCC, 2021). Local anthropogenic factors, including deforestation, wetland degradation, and unsustainable land use, also contribute to the frequency and severity of dry spells by disrupting hydrological cycles and reducing groundwater recharge capacity (UNEP, 2011). In addition, population growth and increased water demand for agriculture, industry, and domestic use can transform natural dry spells into more severe and recurrent dry spell events (FAO, 2017).

The Standardised Precipitation Index (SPI-1) time series for Busia covering 1994-2024 (**Figure 12**) illustrates the temporal dynamics of short-term rainfall anomalies and highlights both dry spell and wettest month occurrences. The monthly SPI values, represented by the blue line, fluctuate substantially around the zero baseline, which denotes near-normal rainfall. Negative deviations signify meteorological dry spell, while positive deviations indicate wetter-than-normal conditions. Thresholds have been plotted for moderate dry spell (SPI ≤ –1, dashed yellow line), severe dry spell (SPI ≤ –1.5, marked with orange crosses), and extreme dry spell (SPI ≤ –2, indicated by red crosses). Conversely, wet anomalies are highlighted by a green dashed line for wet conditions (SPI ≥ +1).

The time series reveals a recurring pattern of rainfall extremes, with notable clusters of dry spell events in the late 1990s (e.g., 1997-1999), early 2000s (2000-2002), mid-2000s (2005), early 2010s (2011-2012), and mid-2010s (2015-2018). These include several extreme dry spell episodes where SPI values dropped below -2, underscoring the severity of water deficits in those years. More recent instances of extreme dry spell are also observed around 2023, signalling the persistence of rainfall variability into the current decade.

Overall, the SPI-1 profile demonstrates Busia's high inter-annual and intra-annual rainfall variability, characterised by alternating cycles of short-duration meteorological dry spells and intense wet spells. The presence of multiple severe and extreme dry spells, combined with episodic excessive rainfall, suggests an underlying climate pattern of extremes rather than stability. This variability poses challenges for water resource planning, agriculture, and disaster preparedness, reinforcing the need for adaptive climate risk management and early warning systems in the municipality.

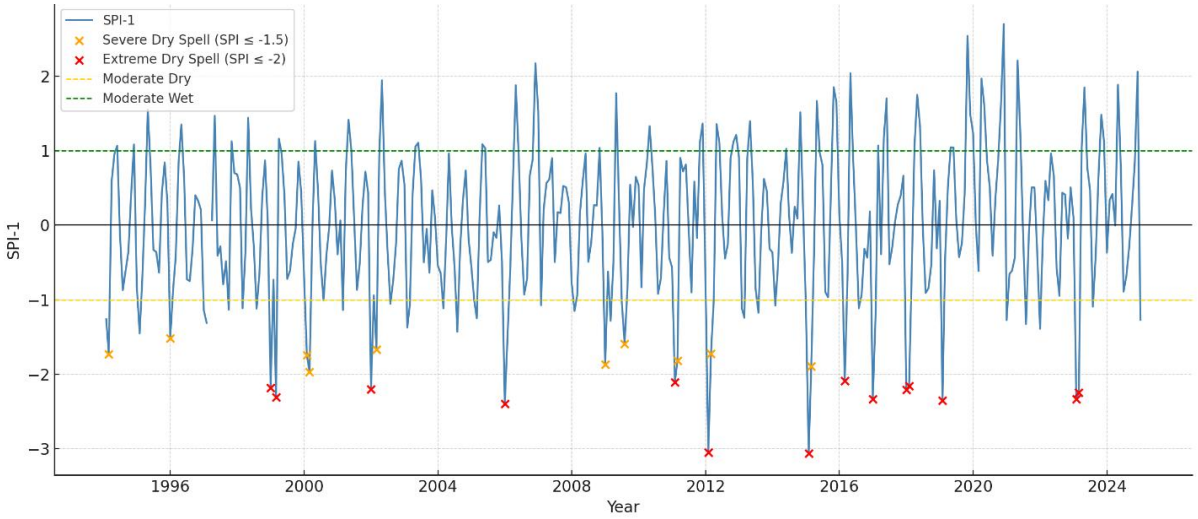

Figure 12: Standardised Precipitation Index (SPI-1) for Busia Municipality between 1994 and 2024, highlighting dry spells

Figure 13 highlights a strong seasonal pattern across the four climatological seasons of December-February (DJF), March-May (MAM), June-August (JJA), and September-November (SON). The DJF season is the most dry-spell-prone, with severe and moderate events repeatedly occurring in January and February, for example in 2011, 2015, 2016, 2019, and 2023. This reflects the vulnerability of the early-year months that follow the short rains, when soil moisture deficits are most acute. The MAM season, which corresponds to the long rains, has few episodes of moderate dry spell events. In the JJA season, which is generally the cool dry period, scattered moderate dry spells are observed in years such as 2009, 2013, 2016, and 2022, highlighting the persistence of dry conditions that strain pastures and water supplies. The SON season, dominated by the short rains, is largely reliable but not entirely free of dry spell, with a notable severe event recorded in September 1997. This seasonal distribution underscores the critical importance of the MAM and SON rains for buffering annual water stress, while signalling the need for targeted dry spell preparedness during DJF and JJA.

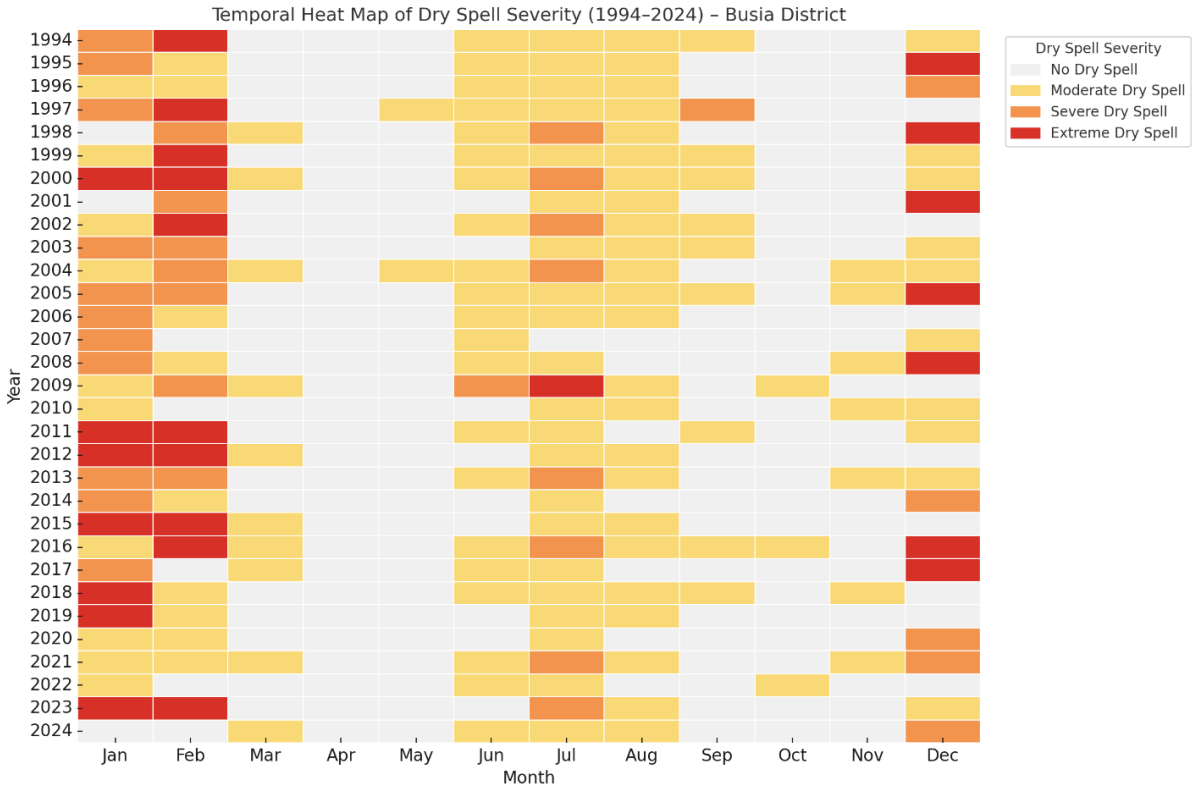

Figure 13: Drought severity in Busia Municipality per month between 1994 and 2024

Dry spell in Busia Municipality can be categorized as low (23.9%), moderate (66%) and high (10.1%). The western division (North A, North B, and South West wards) is mostly exposed to low dry spell hazard. North C ward (22.6%), North B ward (19.7%), and Central ward (16.8%) are mostly exposed to moderate dry spell hazard. Exposure to high dry spell hazard is only seen in North East B (92.5%), and North C (7.4%) wards (**Table 2**).

Table 2: Coverage of drought hazard in Busia Municipality

Division	Ward	Low		Moderate		High		Total	
		Area (Km²)	%	Area (Km²)	%	Area (Km²)	%	Area (Km²)	%
Eastern	Central	0.35	20.4	0.81	16.8	0.00	0.0	1.16	16.0
Eastern	North C	0.00	0.0	1.08	22.6	0.05	7.4	1.13	15.7
Eastern	North East A	0.00	0.0	0.30	6.2	0.00	0.0	0.30	4.1
Eastern	North East B	0.00	0.0	0.17	3.5	0.68	92.5	0.84	11.6
Eastern	South East	0.00	0.0	0.21	4.5	0.00	0.0	0.21	3.0
Western	North A	0.28	16.3	0.78	16.2	0.00	0.0	1.06	14.6
Western	North B	0.39	22.5	0.94	19.7	0.00	0.0	1.33	18.4
Western	South West	0.71	40.8	0.50	10.5	0.00	0.0	1.21	16.7
Total		**1.73**	**100**	**4.78**	**100**	**0.73**	**100**	**7.25**	**100**

Spatially, in the Western Division, wards such as South West, North A, and North B predominantly experience low dry spell hazard, while some areas transition into moderate levels. Conversely, the Eastern Division shows greater variability, with Central, North C, North East A, and South East largely falling under moderate hazard, while North East B shows large exposure to high dry spell hazard (**Figure 14**). This spatial pattern demonstrates that dry spell risk is more

severe and concentrated in the eastern parishes, particularly North East B, while the western side is relatively less affected, exhibiting mainly low to moderate hazard conditions.

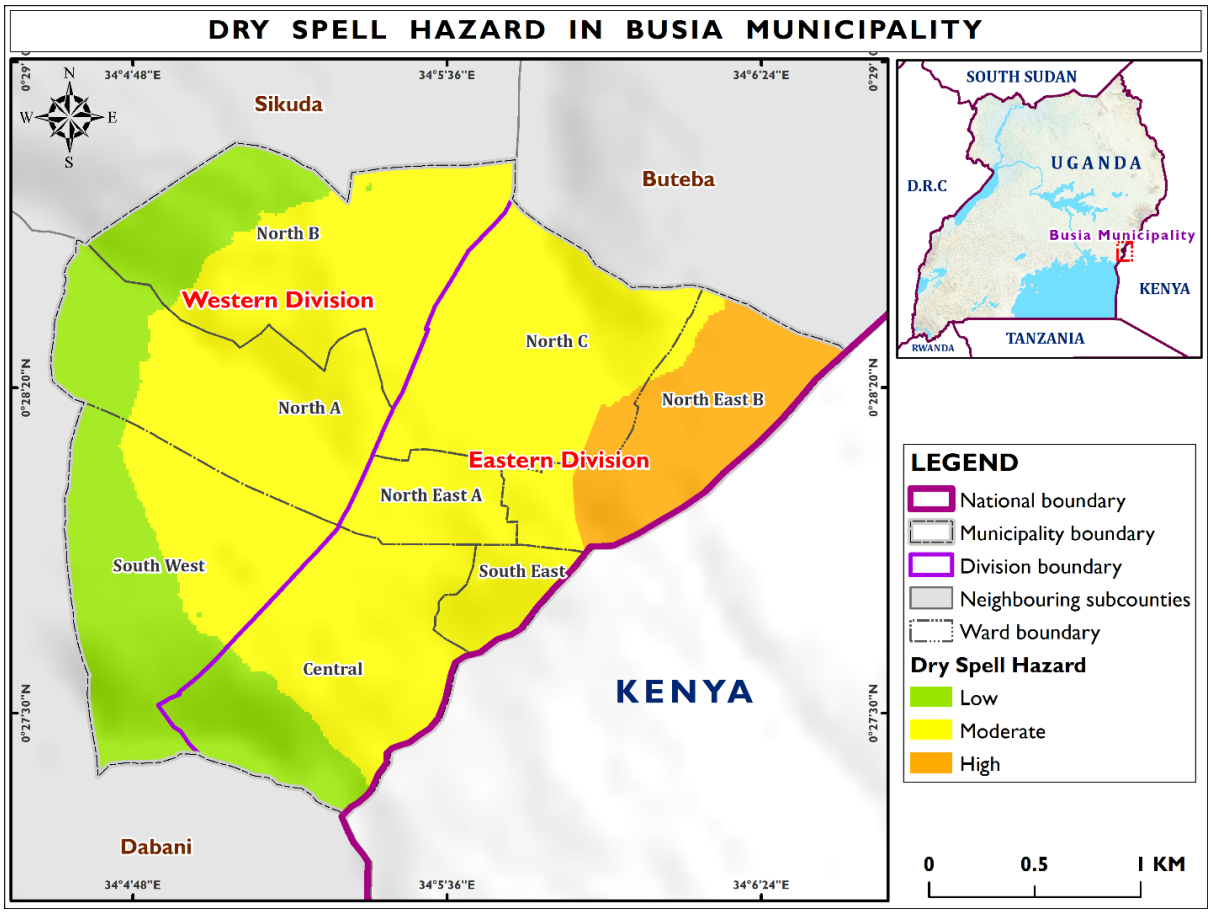

Figure 14: Dry spell hazard in Busia Municipality

2.4.3 Floods

Flooding is an overflow of water that submerges land that is usually dry (Farida & Maswanku, 2022). Assessing floods in Busia Municipality helps identify high-risk zones and vulnerable communities, supports evidence-based land-use planning, and guides the design of resilient drainage and infrastructure systems. Moreover, it strengthens climate adaptation planning and ensures resources are prioritised for the most at-risk areas, contributing to long-term municipal resilience and sustainable development.

Flooding in Busia Municipality, is driven by a combination of natural and human-induced factors. Intense seasonal rains, often linked to climate variability and extreme weather events, overwhelm local drainage capacity, leading to flash floods in urban and peri-urban zones. Poor solid waste management and inadequate stormwater infrastructure exacerbate the problem by blocking drainage channels and increasing surface runoff. In addition, the conversion of wetlands and floodplains for agriculture and settlement reduces natural water retention capacity, while deforestation in surrounding catchments diminishes infiltration and accelerates runoff. Together, these factors create recurrent flood episodes that severely affect livelihoods, infrastructure, and ecosystems in the municipality.

Table 3 presents the distribution of flood hazard across wards in Busia Municipality, highlighting varying levels of exposure. Out of a total area of 7.26 km², 2.27 km² (31.2%) is not prone to flooding, while the remainder is exposed to low (0.58 km², 8.0%), moderate (1.74 km², 24.0%), and high (2.67 km², 36.7%) flood hazards. In the Eastern Division, Central and North C wards are most affected, with 27.5% and 24.1% of their areas classified under high hazard respectively, while North East B also records a substantial high hazard share (19.9%). By contrast, South East and North East A remain relatively less exposed, each contributing less than 2% to the municipality's high hazard zone. In the Western Division, North A is notable for its dominance in low hazard coverage (60.3%), while North B shows a balanced spread across low (38.9%), moderate (31.0%), and high (12.3%) categories. South West stands out as the least flood-prone, with 41.9% of its area falling under the "not prone" class and only 8.6% classified as high hazard. Overall, flood risk is unevenly distributed, with Eastern wards bearing more severe impacts, while parts of the Western Division, particularly South West, offer relatively safer zones.

Table 3: Coverage of flood hazard in the different wards and divisions of Busia Municipality

Division	Ward	Not Prone		Low		Moderate		High		Total
		Area (Km²)	%	Area (Km²)	%	Area (Km²)	%	Area (Km²)	%	Area (Km²)
Eastern	Central	0.12	5.1	0.00	0.0	0.31	17.9	0.73	27.5	1.16
Eastern	North C	0.22	9.7	0.00	0.8	0.27	15.5	0.64	24.1	1.14
Eastern	North East A	0.15	6.6	0.00	0.0	0.10	5.7	0.05	1.7	0.30
Eastern	North East B	0.24	10.7	0.00	0.0	0.07	4.2	0.53	19.9	0.85
Eastern	South East	0.12	5.4	0.00	0.0	0.06	3.6	0.03	1.1	0.22
Western	North A	0.23	10.1	0.35	60.3	0.35	20.2	0.13	4.8	1.06
Western	North B	0.24	10.6	0.23	38.9	0.54	31.0	0.33	12.3	1.34
Western	South West	0.95	41.9	0.00	0.0	0.03	1.9	0.23	8.6	1.21
	Total	**2.27**	**100**	**0.58**	**100**	**1.74**	**100**	**2.67**	**100**	**7.26**

Floods in Busia Municipality have had widespread and recurring impacts on human settlements, infrastructure, and socio-economic activities. Recorded events highlight loss of life, such as the 2019 house collapse in Western Division following heavy rainfall, which caused at least one fatality. Flooding has repeatedly displaced households, damaged housing and schools, and disrupted transport and market access, thereby undermining livelihoods in both the Eastern and Western divisions. The inundation of low-lying zones has also destroyed crops and farmlands, exacerbating food insecurity and economic vulnerability among smallholder households. Public health risks are significant, with stagnant floodwaters contributing to outbreaks of waterborne diseases including cholera, dysentery, and typhoid. Infrastructural damages, particularly to roads, drainage channels, and sanitation facilities, further deepen vulnerability by limiting mobility and access to services during extreme events. At a broader scale, recurrent floods have undermined municipal development gains by increasing poverty risks, displacing residents, and straining limited disaster response resources.

Spatially, areas not prone to flood hazards dominate large sections of South West, parts of North East B, and scattered patches in Central and South East wards, reflecting relatively safer zones (**Figure 15**). However, significant stretches of low and moderate flood hazard are interspersed,

particularly along streams and low-lying areas, indicating heightened exposure to seasonal inundation. High flood hazard zones are more localised but occur in both divisions, often clustering near drainage channels and depressions, such as in Central, North A, North C, and parts of North East B. Overall, while much of the municipality is moderately safe, pockets of elevated flood hazard highlight the need for targeted adaptation, especially in wards intersected by streams and low-lying terrain.

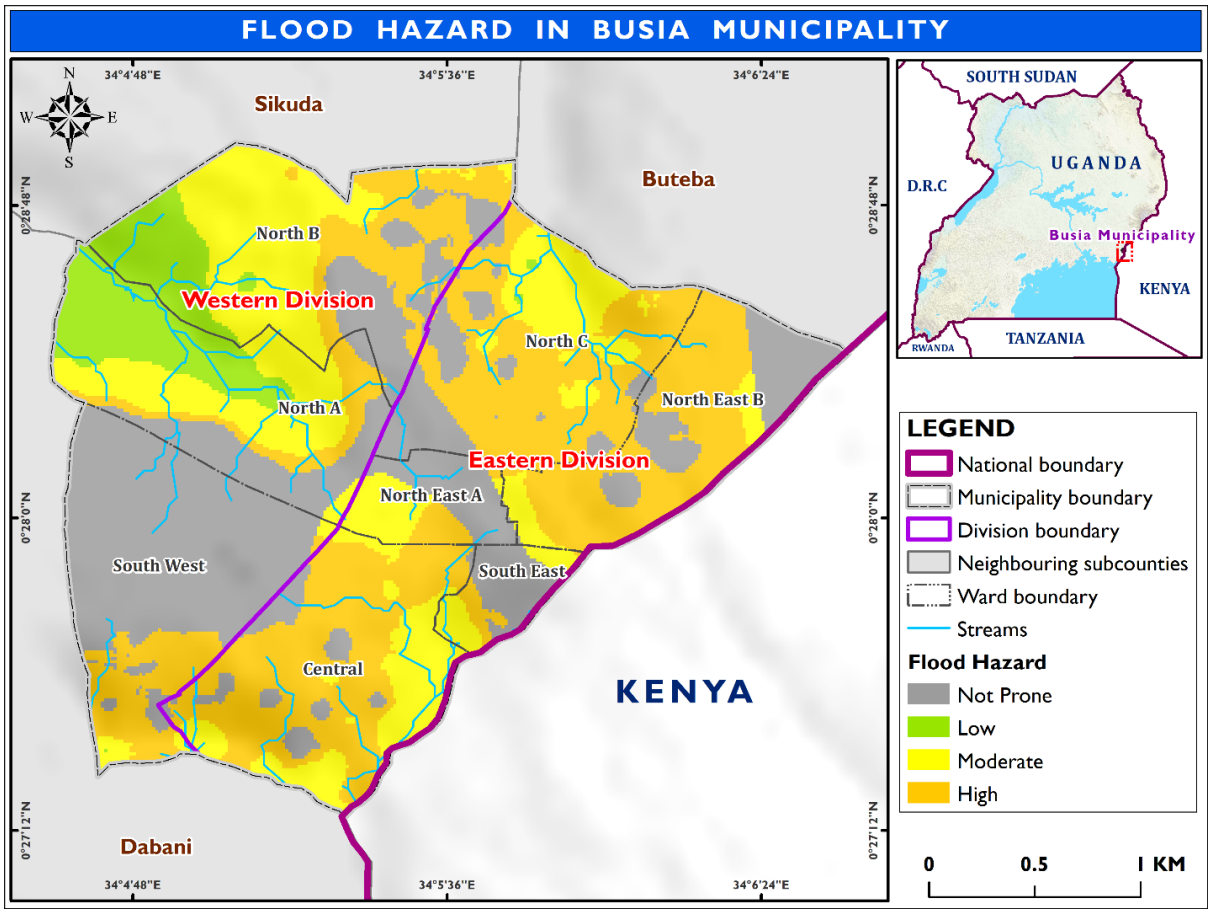

Figure 15: Flood hazard zonation in Busia Municipality

2.4.4 Heat Waves

A heat wave is defined as a period of unusually hot and dry or hot and humid weather, lasting at least two to three consecutive days, during which the daily maximum temperature exceeds the average maximum temperature by 5°C or more, relative to the normal climate of that location (WMO, 2023). Monitoring heatwaves provides evidence to guide health protection, agricultural planning, and urban service delivery in the face of rising climate risks. Reliable data on heatwave frequency and intensity helps authorities design early warning systems, allocate resources for vulnerable groups, and integrate climate adaptation into development plans. By tracking heat extremes, decision makers can prioritise interventions that safeguard public health, sustain food security, and reduce economic losses, ensuring that climate resilience is embedded in long-term policy framework.

Heatwaves are primarily triggered by persistent high-pressure systems that inhibit cloud formation and suppress wind-driven cooling, causing surface temperatures to rise over several consecutive days. This mechanism is being intensified by anthropogenic climate change, as even an additional

0.5 °C of global warming is sufficient to increase the frequency, intensity, and duration of extreme heat events (IPCC, 2021; WMO, 2023). Regional climatic drivers, such as El Niño- Southern Oscillation phases, can also disrupt rainfall and temperature patterns in East Africa, contributing to hotter and drier spells that heighten heatwave risks (WHO, 2018). In Busia Municipality, these global and regional processes are compounded by localised pressures such as deforestation, wetland degradation, and rapid urbanisation, which amplify the urban heat island effect and diminish natural cooling.

Figure 16 shows the annual number of heatwave days in Busia Municipality between 1994 and 2024, measured as periods of at least three consecutive days above the 90th percentile threshold. The trend is highly variable, with some years recording very few or no heatwave days (e.g., 1996, 2002, 2020), while others experienced extreme peaks, such as 2005 with around 50 days and 2017 with close to 60 days. In recent years, there is evidence of sharp fluctuations alongside episodes of high intensity, including a resurgence of over 30 heatwave days in 2023. Trend analysis further shows that annual heatwave days have been increasing by about 0.56 days per year, a rise that is marginally significant ($p \approx 0.052$), with the trend explaining around 12% of the variation. Although interannual variability is strong, the underlying increase reflects the combined effects of climate change and local land-use dynamics, such as urbanisation and vegetation loss. The results signal an emerging risk of more frequent and prolonged heat extremes, underscoring the urgency of integrating heat-health action plans, urban greening, and resilient infrastructure measures into Busia's climate adaptation strategies.

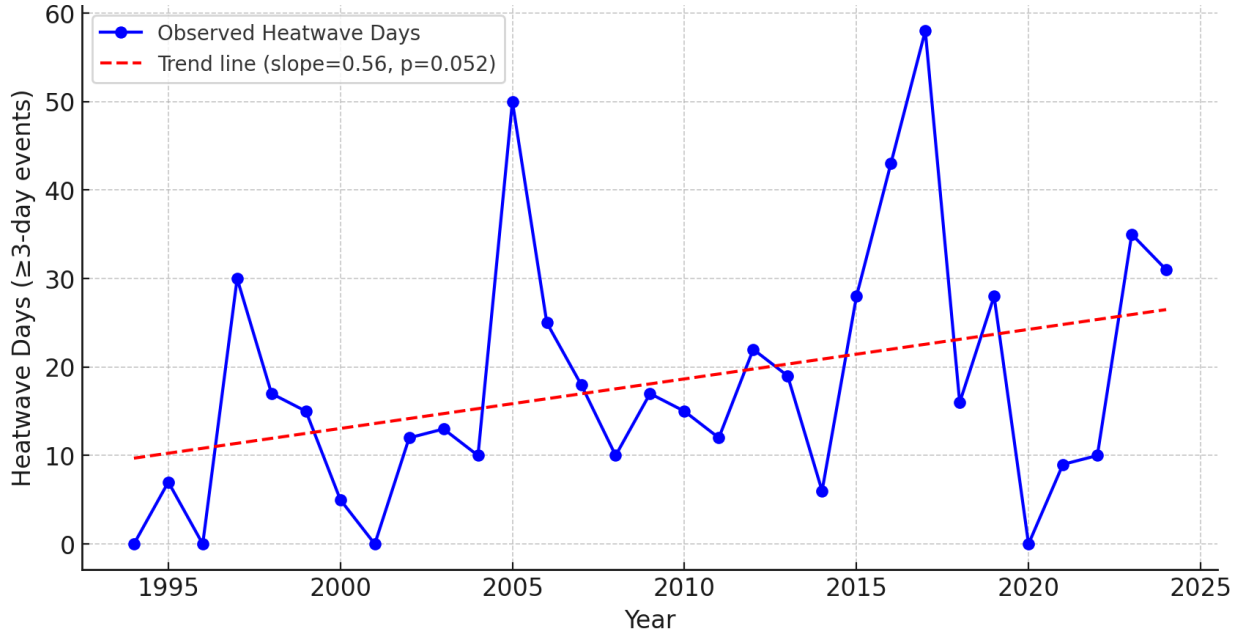

Figure 16: Trend in annual heatwave days in Busia Municipality between 1994 and 2024

Figure 17 illustrates the monthly and annual distribution of heatwave days, highlighting both their frequency and seasonal concentration. Heatwave activity is strongly clustered in the months of February, March, and December, with a smaller but consistent secondary peak in May. These patterns align with the late dry season, the transition into the first rainy season, and the end-of-year dry spell, underscoring periods of heightened vulnerability. The map also shows a marked intensification after 2010, with darker shading in several years such as 2015, 2016, and 2017, and

a resurgence in 2023 and 2024, reflecting both longer and more frequent heatwave episodes. This trend signals a shift towards more persistent extreme heat conditions, posing risks to public health, agricultural productivity, and urban service provision.

Importantly, these seasonal peaks overlap with critical phases of the agricultural calendar: February-April coincides with the first planting season, where excessive heat can reduce germination and stress young crops; June-September aligns with flowering and growth phases, when heat can lower yields and exacerbate pests; while December overlaps with the post-harvest and storage period, increasing spoilage risks and aflatoxin contamination. The results highlight the need for seasonally targeted interventions, including early warning systems, labour management guidelines, climate-smart crop choices, irrigation measures, and improved post-harvest storage to safeguard food security and livelihoods during these high-risk months.

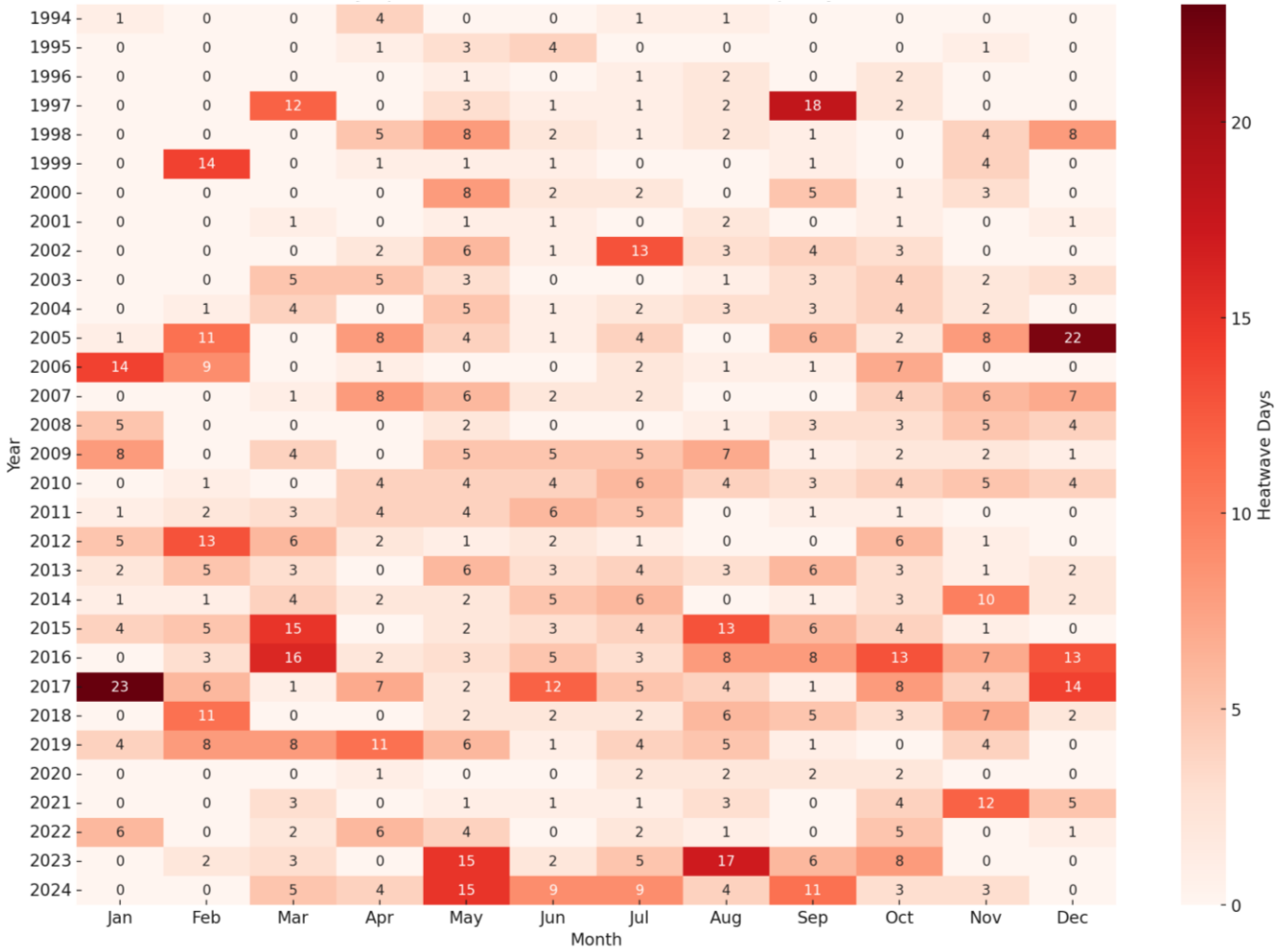

Figure 17: Heatwave days per month and year in Busia Municipality between 1994 and 2024

Figure 18 shows the number of annual heatwave events in Busia Municipality from 1994 to 2024, disaggregated by severity levels (low, mild, moderate, and severe). The data reveal strong interannual variability, with relatively few events in the 1990s and early 2000s, followed by pronounced peaks in 2005, 2015, and 2017. The year 2005 recorded the highest concentration of events up to that point, including moderate and severe heatwaves, while 2017 stands out as the most extreme year overall, with more than 18 events across all severity levels, including multiple

severe episodes. In recent years, especially from 2015 onward, the municipality has experienced more frequent and more intense heatwave events, reflecting a shift towards greater climatic extremes. The increase in moderate-to-severe episodes is particularly concerning, as these pose heightened risks to public health, agriculture, energy demand, and urban services. Overall, the graph highlights a transition from predominantly low-severity events in earlier decades to more frequent and severe heatwaves in the last 15 years, signalling an urgent need for heat-health action plans and climate adaptation policies in Busia Municipality.

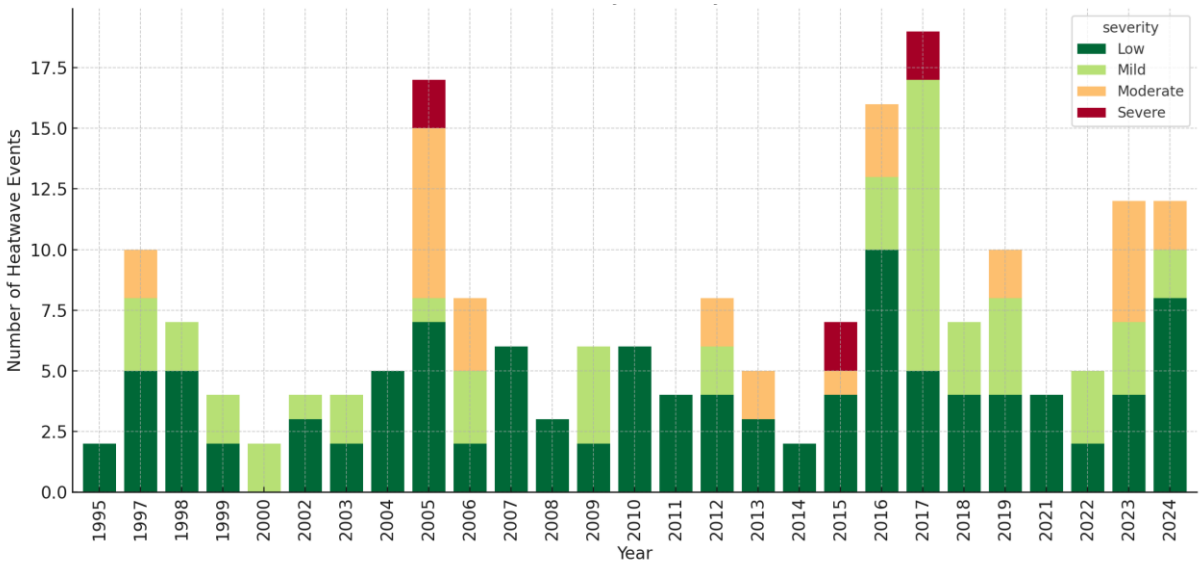

Figure 18: Number of heatwave events by severity in Busia Municipality between 1994 and 2024

Figure 19 illustrates the spatial distribution of average annual heatwave days in Busia Municipality between 1994 and 2024, highlighting differences across divisions and wards. Most of the municipality, including Western Division (North A, North B, South West, Central) and large parts of Eastern Division (North East A, South East, North C), falls within the moderate category (21-35 heatwave days per year). However, North East B ward in Eastern Division stands out as a hotspot, recording significantly higher values in the high category (36-50 days per year). This spatial concentration indicates that communities in North East B are disproportionately exposed to prolonged extreme heat conditions, likely due to localised environmental and land-use factors such as vegetation loss, settlement patterns, or urban heat island effects. These findings underscore the need for targeted heat adaptation strategies, prioritising North East B as a high-risk area, while maintaining broader resilience interventions across the rest of the municipality where moderate but frequent heatwaves are the norm.

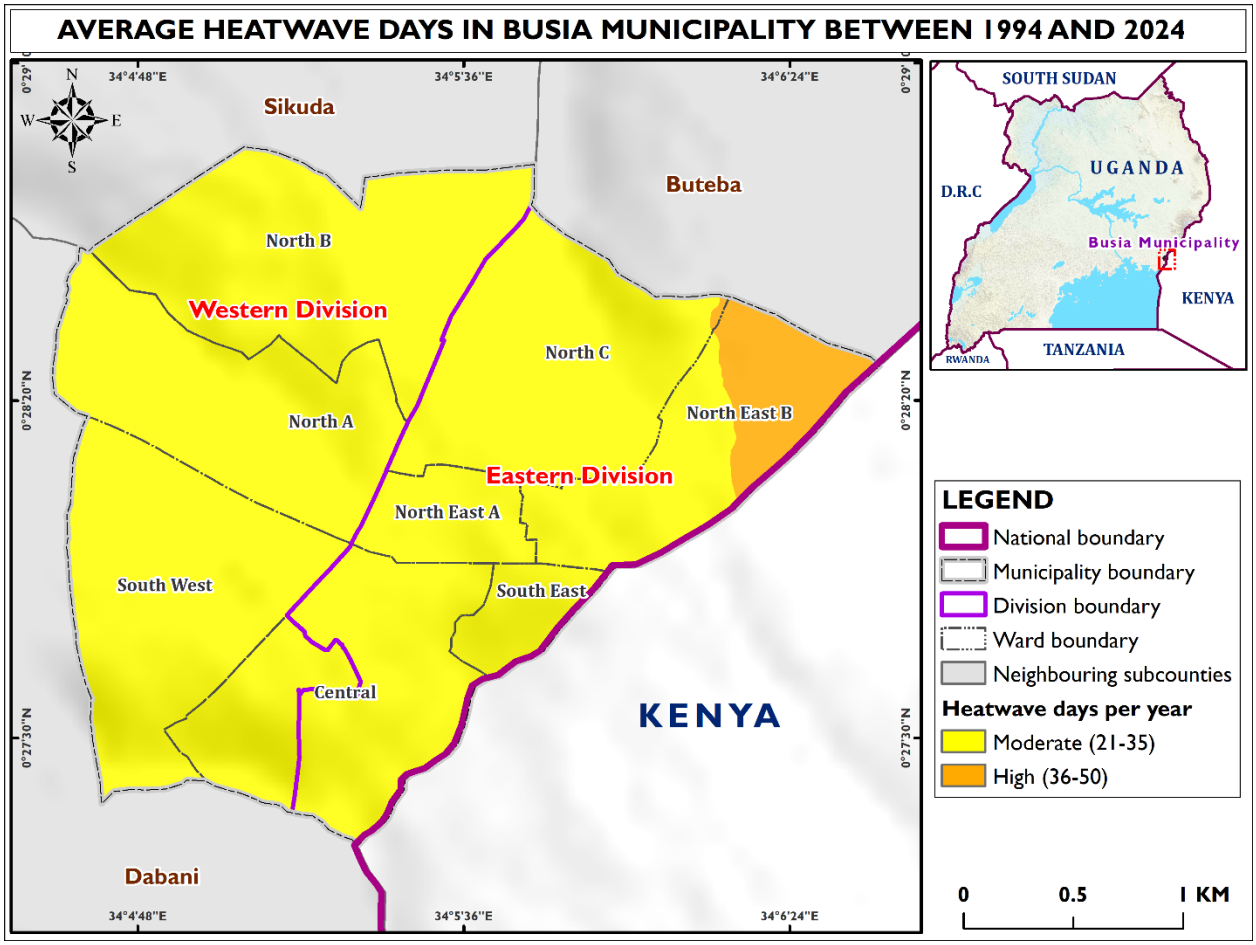

Figure 19: Average heatwave days in Busia Municipality between 1994 and 2024

2.4.5 Lightning

Lightning is the occurrence of a natural electrical discharge of very short duration and high voltage between a cloud and the ground or within a cloud (Agrawal & Nigam, 2014). Lightning assessment provides evidence-based insights into the spatial extent, frequency, and severity of lightning hazards, which directly affect public safety, infrastructure resilience, and socio-economic development. By identifying high-risk areas, policymakers can prioritise investments in protective infrastructure such as lightning arrestors for schools, health facilities, and markets, integrate hazard considerations into urban planning, and allocate resources for early warning and community sensitisation. Furthermore, systematic assessment ensures that lightning risks are mainstreamed into broader disaster risk reduction frameworks and national development plans, thereby reducing vulnerability, safeguarding livelihoods, and supporting sustainable development

Lightning is primarily caused by the build-up and discharge of electrical energy within cumulonimbus clouds during thunderstorms. As warm, moist air rises and cools, it forms ice particles that collide with one another, resulting in the separation of positive and negative charges within the cloud. Typically, lighter ice crystals carry positive charges and accumulate at the cloud's upper regions, while heavier hailstones and water droplets carry negative charges and settle at the bottom. This charge separation creates a strong electric field, and when the potential difference between the cloud and the ground (or between clouds) becomes sufficiently large, it is discharged as a lightning flash. Ground objects such as tall trees, buildings, or open fields often facilitate this discharge pathway. The process is further influenced by atmospheric instability,

humidity, and convection currents, which increase thunderstorm activity and lightning occurrence (Rakov & Uman, 2003; NASA, 2021).

Busia Municipality is exposed to very low (27%) and low (73%) lightning hazard intensities. North East A (43%), North C (26.8%), and South East (10.9%) wards have the biggest exposure to very low lightning hazard (**Table 4**). On the other hand, the Western division (particularly North B, North A, and South West wards) has the biggest exposure to low lightning hazard. The results show that most of Busia Municipality (73%) falls under low lightning hazard, with the Western Division entirely exposed, while the Eastern Division displays mixed levels of exposure. These patterns call for ward-specific interventions, including targeted lightning protection infrastructure, integration of hazard considerations into urban planning, and stronger community preparedness measures to guide evidence-based policy and resource allocation.

Table 4: Coverage of lightning hazard in the different wards of Busia Municipality

Division	Ward	Very Low		Low		Total	
		Area (Sq.km)	%	Area (Sq.km)	%	Area (Sq.km)	%
Eastern	Central	0.24	12.3	0.92	17.4	1.16	16.0
Eastern	North C	0.53	26.8	0.61	11.5	1.13	15.7
Eastern	North East A	0.14	7.0	0.16	3.0	0.30	4.1
Eastern	North East B	0.84	43.0	0.00	0.0	0.84	11.6
Eastern	South East	0.21	10.9	0.00	0.0	0.21	3.0
Western	North A	0.00	0.0	1.06	20.0	1.06	14.6
Western	North B	0.00	0.0	1.33	25.2	1.33	18.4
Western	South West	0.00	0.0	1.21	22.9	1.21	16.7
Total		**1.96**	**100**	**5.29**	**100**	**7.24**	**100**

Figure 20 illustrates the spatial distribution of lightning hazard in Busia Municipality, Uganda, expressed in flashes per year per square kilometre. The entire Western Division, including North B, North A, and South West, falls within the low category. In contrast, significant portions of the Eastern Division; particularly North East B, South East, and parts of Central, North C and North East A are exposed to very low lightning hazard. Overall, the map highlights that while lightning risk remains relatively limited across the municipality, certain areas in the Western Division are more exposed, necessitating targeted awareness and preparedness measures.

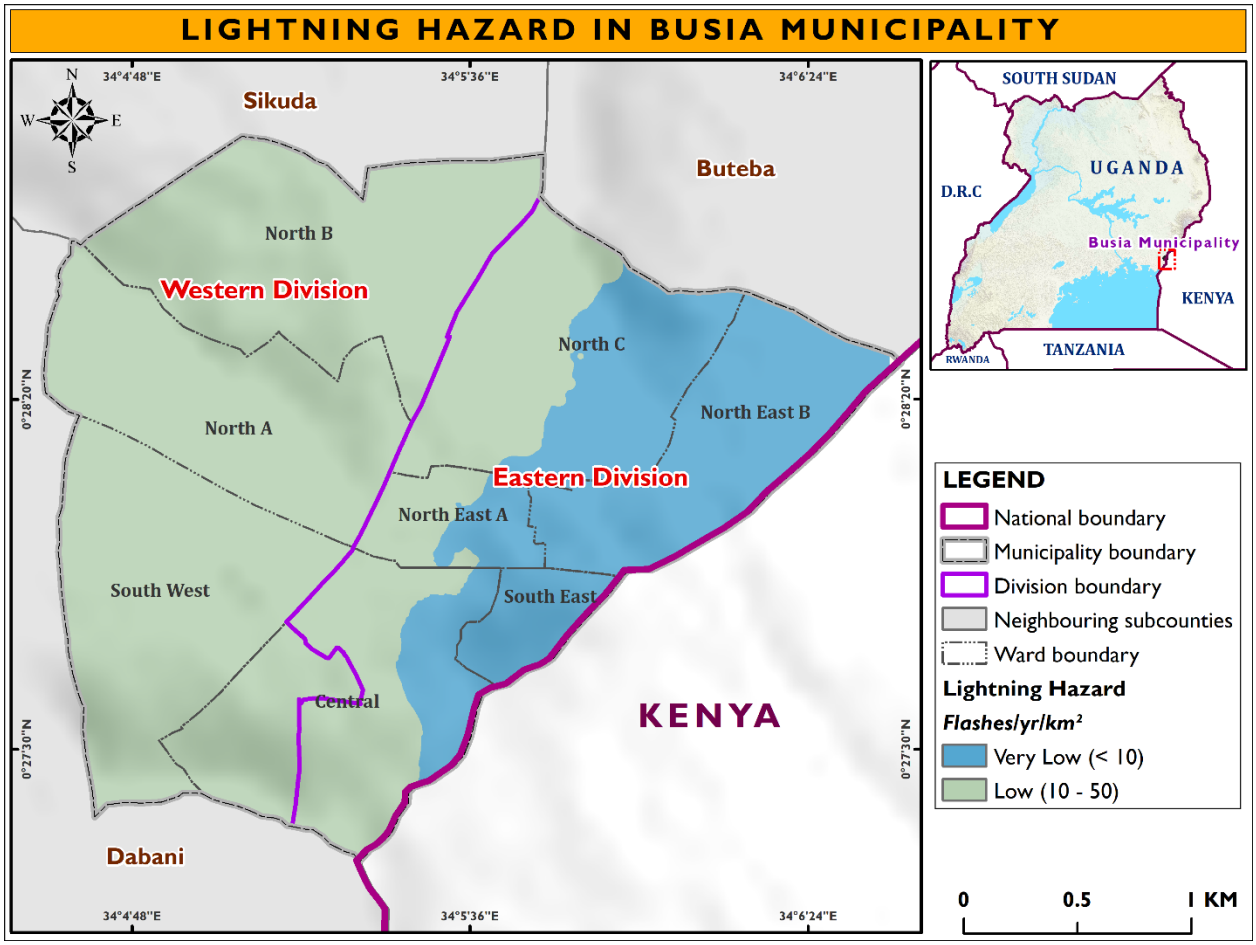

Figure 20: Lightning hazard zonation in Busia Municipality

2.4.6 Windstorms

A windstorm is defined as a storm marked by strong wind with little or no precipitation (MWO, 2023). Windstorms are classified by wind speed intensity and may include phenomena such as gales, hurricanes, or cyclones, depending on strength and scale. Assessing windstorms in Busia Municipality provides policymakers with critical data to guide disaster risk reduction and climate adaptation strategies. It informs infrastructure planning, emergency response, and community awareness initiatives. The assessments help integrate windstorm risks into land-use regulations and building codes, thereby reducing vulnerability.

The causes of windstorms in Busia Municipality are primarily linked to atmospheric and climatic factors. The municipality's proximity to Lake Victoria contributes to strong convective activity, which can generate localized gusts and thunderstorms. Seasonal shifts of the Inter-Tropical Convergence Zone (ITCZ) also bring periods of intense wind as air masses converge. Additionally, atmospheric pressure differences between regions can create strong wind currents, while thunderstorm activity often produces sudden and damaging gusts. Human-induced factors, such as deforestation and land degradation, reduce natural windbreaks, intensifying the impact of these storms. Together, these natural and anthropogenic factors make Busia Municipality prone to windstorms that can disrupt communities and infrastructure.

The windstorm vulnerability assessment across Busia Municipality shows variation among divisions and wards. In the Eastern division, Central Ward has a predominantly low to moderate

vulnerability, covering 10.3% and 21.0% of the area, respectively, while North East B Ward is highly vulnerable, with 92.6% of its area classified as very low vulnerability but also showing moderate exposure in smaller portions. North C and North East A Wards have moderate vulnerability areas of 12.8% and 7.0%, respectively (**Table 5**). South East Ward has minimal vulnerability, with only 0.8% low and 4.5% moderate. In the Western division, North A, North B, and South West Wards have significant areas under low and moderate vulnerability, with North B showing the highest combined exposure at 41.1% of its area. Overall, out of the total 7.25 km² assessed, very low vulnerability covers 0.40 km², low vulnerability 2.60 km², and moderate vulnerability 4.25 km², indicating that the majority of Busia Municipality falls under moderate vulnerability to windstorms.

Table 5: Coverage of windstorm hazard in the different wards of Busia Municipality

Division	Ward	Very Low		Low		Moderate		Total	
		Area (Km²)	%	Area (Km²)	%	Area (Km²)	%	Area (Km²)	%
Eastern	Central	0.00	0.0	0.27	10.3	0.89	21.0	1.16	16.0
Eastern	North C	0.03	7.4	0.56	21.5	0.55	12.8	1.13	15.7
Eastern	North East A	0.00	0.0	0.00	0.0	0.30	7.0	0.30	4.1
Eastern	North East B	0.37	92.6	0.39	14.9	0.09	2.0	0.84	11.6
Eastern	South East	0.00	0.0	0.02	0.8	0.19	4.5	0.21	3.0
Western	North A	0.00	0.0	0.22	8.5	0.84	19.8	1.06	14.6
Western	North B	0.00	0.0	0.66	25.2	0.67	15.9	1.33	18.4
Western	South West	0.00	0.0	0.49	18.8	0.72	17.0	1.21	16.7
Total		**0.40**	**100**	**2.60**	**100**	**4.25**	**100**	**7.25**	**100**

Busia Municipality has experienced several destructive windstorm events in recent years, usually occurring alongside heavy rains and hailstorms. In Mawero East B and Sofia villages, strong winds combined with hail have devastated crops such as maize, beans, cassava, and soybeans, leaving farmers staring at famine[1]. The intensity of these storms has also caused severe damage to property, with rooftops being blown off houses and families displaced. A prolonged downpour lasting nearly twelve hours was reported in parts of the municipality in September 2022, including Mawero East B, and Sofia B, where powerful winds tore through settlements, injuring residents and scattering debris[2]. These windstorms have consistently left a trail of destruction, affecting homes, gardens, and livelihoods, making them a recurrent hazard in Busia Municipality.

[1] https://www.monitor.co.ug/uganda/news/national/farmers-stare-at-famine-as-storm-destroys-crops-4010520
[2] https://www.monitor.co.ug/uganda/news/national/two-hospitalized-after-12-hour-busia-downpour-3959682

Plate 1: A man inspects his house which was destroyed by windstorms

Photo Credit: David Awori

Figure 21 shows the windstorm hazard zonation in Busia Municipality. The windstorm hazard map shows varying levels of windspeed risks across different divisions and wards. The majority of the municipality, particularly within the Western Division (covering areas like North A, North B, and South West), experiences moderate windstorm hazard with wind speeds ranging between 20.1-22.0 m/s. The Eastern Division has a mix of hazards: North East A faces moderate risk, while areas such as North East B, South East, and North C fall under low to very low categories.

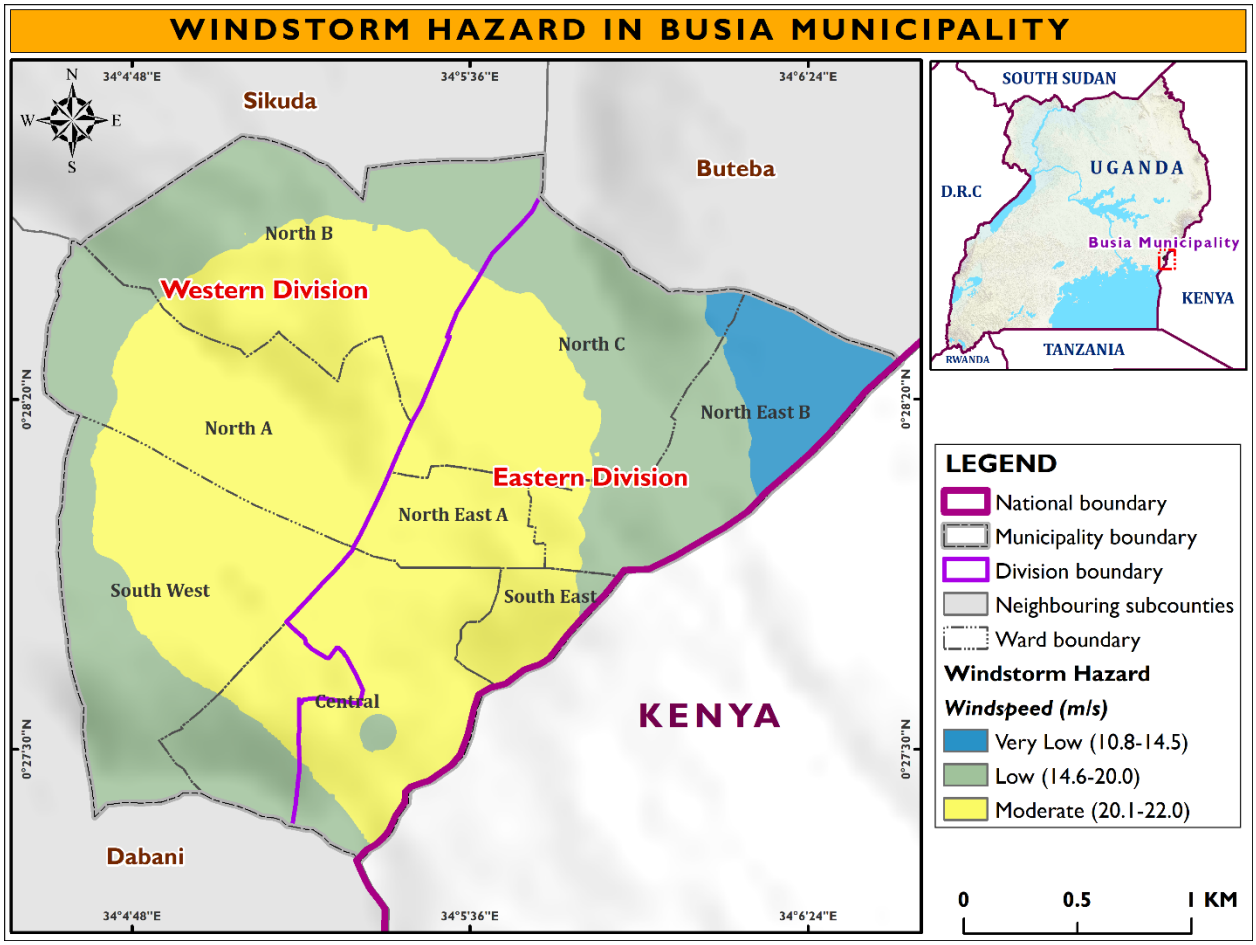

Figure 21: Windstorm hazard zonation in Busia Municipality

2.5 Climate Risk and Vulnerability Assessment

2.5.1 Exposure of communities to multi-hazards

Exposure refers to the extent to which a system is exposed to climate change-related hazards. Busia Municipality is mostly exposed to dry spell, floods, heatwaves, lightning, and windstorms. These hazards were ranked, weighed and normalized to produce the exposure index. The Western Division, particularly North B and North A, is highly exposed (above 70%). Similarly, in the Eastern Division, North East B and parts of South East and North East A also show high to very high exposure. Conversely, South West and some parts of Central ward have relatively lower exposure levels (50-60%) (**Figure 22**). The map highlights the widespread and overlapping hazard pressures across the municipality, demonstrating the urgent need for integrated disaster risk reduction and climate adaptation strategies tailored to both divisions.

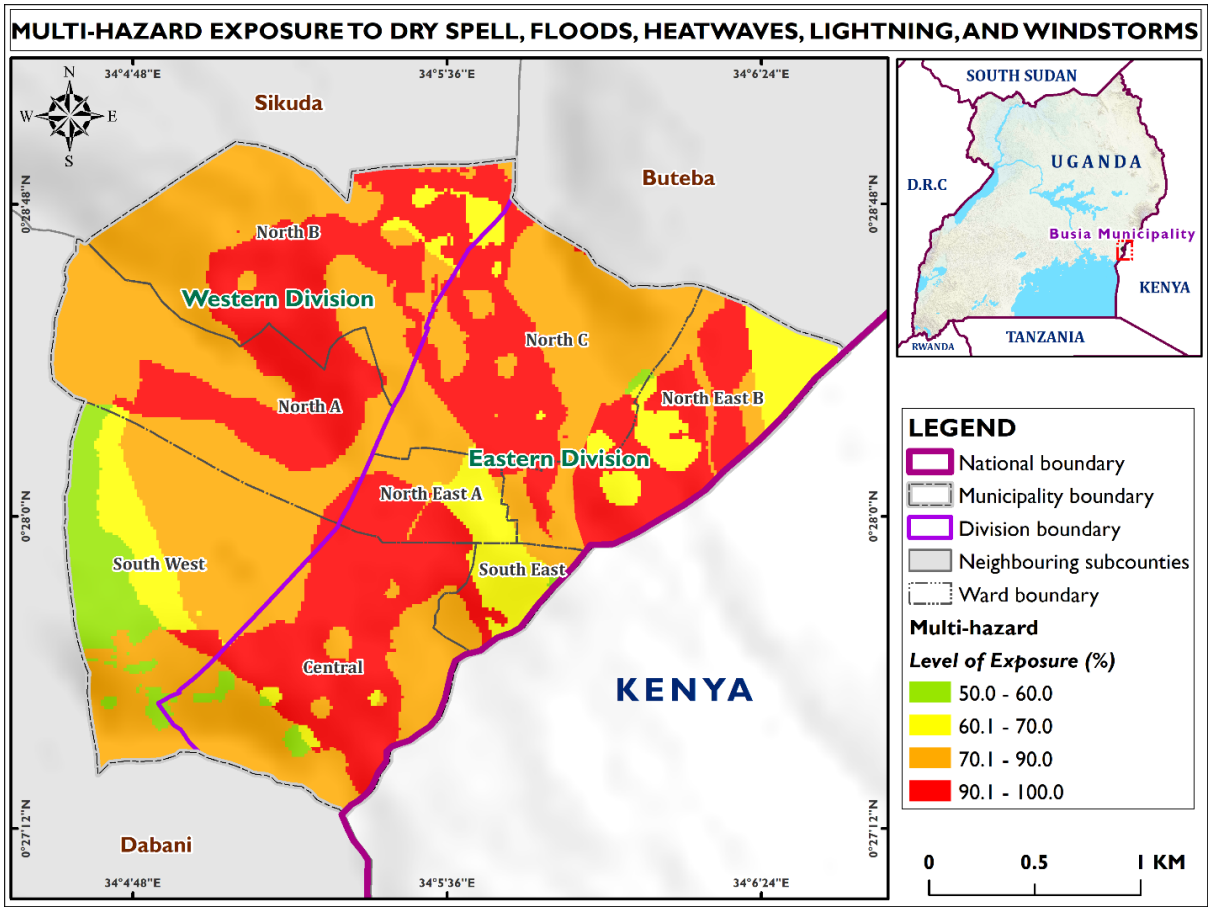

Figure 22: Multi-hazard exposure to dry spell, floods, heatwaves, lightning, and windstorms

2.5.2 Sensitivity of communities to multi-hazards

Sensitivity describes the socio-economic or demographic characteristics that can make people susceptible to the negative effects of exposure (Declet-Barreto et al., 2020). The sensitivity indicators that were assessed at ward level are presented in

Table 6. Access to early warning information enables communities to prepare for and respond effectively to climate-related hazards. Access to early warning information is low in North East A and South East and high in South West ward. Clearance of vegetation reduces natural buffers against floods, and strong winds, thereby increasing community exposure and weakening ecological resilience. Vegetation clearance is very low in South West ward and low in North East A ward. Dependency on climate-sensitive sectors highlights how heavily communities rely on industries like agriculture, fisheries, and tourism, which are directly affected by climate variability, making them more vulnerable to disruptions caused by extreme weather events, changing temperatures, and shifting ecosystems. North B and North C wards are highly dependent on climate-sensitive sectors.

Poverty limits households' ability to access resources, adopt protective measures, and recover quickly from disasters, thereby heightening their vulnerability to hazard impacts. Poverty is perceived to be high in North C, North-East B, and South East wards and low in South West ward. The design and capacity of drainage systems determine how well a community can manage increased rainfall, flooding, and storm surges, with inadequate or poorly maintained systems heightening vulnerability to climate-induced water-related hazards. The drainage systems in North East A, North East B, and North C, are perceived to be poor. Housing quality reflects how well homes can protect occupants from climate-related hazards like floods, with poor-quality housing increasing the risk of damage, displacement, and health impacts during climate shocks. Housing quality in South West ward is perceived to be poor. Wetland degradation weakens the natural buffers that wetlands provide against climate impacts like flooding, storm surges, and dry spells, reducing ecosystem resilience and increasing the vulnerability of both human and ecological communities that depend on them. Wetland degradation is perceived to be high in North B, North-East B, and North C wards.

High-density areas can amplify the impacts of climate hazards such as heatwaves, and disease spread while straining infrastructure and emergency response systems, increasing overall community vulnerability. Population density is high across the municipality with the exception of North B and South West wards. Degradation of streams signifies the reduced ability of freshwater ecosystems to absorb and adapt to climate impacts, thereby increasing the vulnerability of communities that rely on these streams for water, food, and livelihoods. North-East B, North C, Central, North A, and North B wards has the highest degradation of streams. Access to health services reflects a community's ability to prevent, respond to, and recover from climate-related health impacts such as heat stress, disease outbreaks, and injuries from extreme weather. Access to health centres is high across the municipality. Unemployment reflects limited economic resilience and reduced access to resources, making individuals and communities less able to adapt to or recover from climate-related events such as floods. Unemployment is perceived to be high across the municipality, with the exception of South West ward that exhibits some employment opportunities.

From a gendered lens, women are thought to be more sensitive to the effects of climate change for the much same raised reasons above. First of all, they have limited access to and control over resources. Gender-based constraints to land, social capital, financial resources and technology make it more difficult for women to adapt to climate change. Second, women have less education and limited access to information. High illiteracy levels prevent women from securing decent jobs,

government funding and other opportunities which when compounded by discriminatory laws and gender norms increase their vulnerability to climate change. Third, women have restricted mobility. They not only lack the economic and social resources that would allow them to relocate, but they also confront cultural and religious limitations that impede their mobility during disasters. Fourthly, women are socially excluded from decision-making processes, leaving them marginalized and more susceptible to the effects of climate change. These and other factors such as poverty, political hurdles and gender discriminatory roles render women more vulnerable to climate change.

Table 6: Sensitivity indicators to multi-hazards in Busia Municipality

No	Sensitivity Indicators	EASTERN DIVISION					WESTERN DIVISION		
		North East A	North East B	North C	South East	Central	North A	North B	South West
1	Access to early warning information/systems	2	3	3	2	3	3	3	4
2	Clearance of vegetation	2	3	3	3	3	3	3	1
3	Dependency on climate sensitive sectors e.g., agriculture	2	3	4	2	2	3	4	2
4	Poverty	3	4	4	4	3	3	3	2
5	Drainage systems	2	1	1	3	3	3	3	3
6	Temporary structures (Housing quality)	4	4	4	4	3	3	3	2
7	Wetland degradation	2	4	4	3	3	3	4	3
8	Population density	5	5	4	4	4	4	3	3
9	Degradation of streams	0[3]	4	4	3	4	4	4	3
10	Access to health centers	4	5	4	4	4	4	5	4
11	Unemployment	4	4	4	5	4	4	4	2
	Total	**30**	**40**	**39**	**37**	**36**	**37**	**39**	**29**
KEY									
0=Not Available, 1=Very Low, 2=Low, 3=Moderate, 4=High, 5=Very High									
Source: District key informants, 2025									

Figure 23 depicts the sensitivity of communities to climate hazards in Busia Municipality, Uganda. North B, North C, and North East B wards, exhibits the highest sensitivity, indicating communities are highly susceptible to hazard impacts. Areas such as the Central ward fall within the moderate sensitivity range, while South West and North East A records low to very low levels. This spatial distribution highlights significant intra-municipality differences in hazard sensitivity, underlining the need for tailored interventions that prioritise the most at-risk communities while building on existing resilience in less sensitive areas.

[3] There are no streams in North East A hence, no degradation of streams in that ward

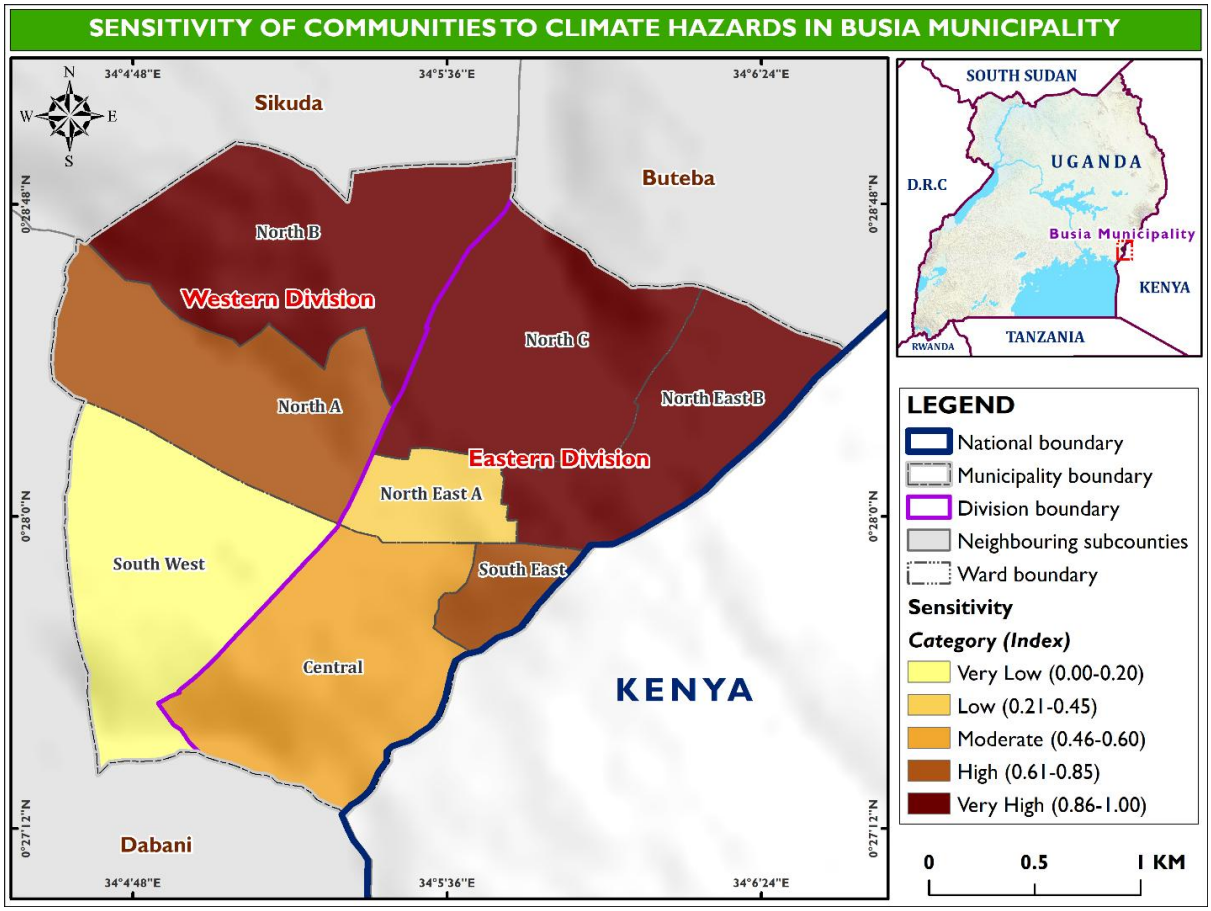

Figure 23: Sensitivity of communities to multi-hazards

2.5.3 Adaptive capacity of communities to multi-hazards

Adaptive capacity is defined as the ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences of climate change (IPCC, 2023). The adaptive capacity indicators that were assessed at the ward level are shown in **Table 7**. Employment opportunities enhance household income stability, enabling individuals and communities to invest in resilient housing, diversify livelihoods, access insurance and healthcare, and recover more quickly from hazard impacts, thereby reducing long-term vulnerability. Employment opportunities are low in South East ward and high in Central and South-West wards. Access to clean water and sanitation ensures that communities can maintain good health and hygiene, reducing the risk of waterborne diseases during extreme weather events, and enabling better resilience to climate-induced health challenges. Access to clean water and sanitation is moderate in mist wards; and high in Central and South-West ward.

Access to credit allows individuals and communities to invest in resilience-building measures, such as climate-smart agriculture, infrastructure improvements, or emergency preparedness, providing the financial resources needed to recover and adapt to climate-related disruptions. Access to credit is high in South West ward, and moderate in other wards. Access to renewable energy provides communities with a sustainable and reliable energy source, reducing dependence on fossil fuels, minimizing greenhouse gas emissions, and enhancing resilience by ensuring energy availability during climate-related disruptions like storms or power outages. Access to renewable energy is high in North A, Central, and South-West, and moderate in other wards. Awareness of climate risks and adaptation practices reflects how well individuals and communities understand climate-

related challenges and the actions they can take to mitigate risks, enabling them to make informed decisions and implement strategies that enhance resilience to changing climate conditions. Awareness of climate risks is low in North-East B and high in South West ward.

Diverse livelihood options provide communities with multiple sources of income and resources, allowing them to better withstand climate shocks, and adapt by shifting to more resilient economic activities when needed. Diverse livelihood options are low in South East ward, and high in North-East A, North B, North A, and South-West. Higher levels of education enable individuals and communities to better understand climate risks, access information, and adopt effective adaptation strategies, thereby enhancing their ability to respond to and recover from climate-related challenges. The communities in most wards have moderate education levels whereas those in South West have high education levels. Extension services provide farmers, communities, and local businesses with essential knowledge, skills, and resources to adopt climate-resilient practices, improve productivity, and enhance the ability to cope with changing climate conditions. Extension services are high across the municipality.

Good environmental management practices promote sustainable resource use, reduce environmental degradation, and enhance ecosystem resilience, enabling communities to better withstand and adapt to climate impacts. South-East and North-East B have poor environmental management practices. Robust and well-maintained healthcare systems improve a community's ability to respond to climate-related health challenges, such as heatwaves, disease outbreaks, and extreme weather events, by providing timely medical care, disease prevention, and emergency services. The healthcare infrastructure is average (moderate) in South-East, North C, Central, and North-East A; and good (high) in North-East B, North B, North A, South-West wards. Proper waste disposal helps prevent environmental degradation, reduces the risk of disease outbreaks, and ensures cleaner, healthier living conditions, enabling communities to better withstand the health and environmental impacts of climate change, such as flooding. Waste management is poor in South-East, North-East B, North C, Central, and North-East A wards; and properly disposed of in South West ward.

Rainwater harvesting provides an alternative and supplemental water source, reducing dependence on traditional sources such as rivers especially during the dry season. Rainwater harvesting is low in most of the wards with the exception of South West ward. Strong, connected communities are better able to share resources, information, and support during climate events, helping individuals and groups recover more quickly and effectively from climate impacts. Social networking is high across all wards of the municipality. Urban greening initiatives enhance municipality’s resilience by increasing green spaces, improving air quality, reducing heat island effects, and providing natural buffers against extreme weather, all of which help communities better cope with climate-related challenges. Urban greening initiatives are high in North B, North A, and South-West and low in South-East, North-East B, and North-East A wards. Wetland and ecosystem restoration enhances the natural ability of wetlands to absorb climate impacts such as flooding, while supporting biodiversity, improving water quality, and strengthening the resilience of communities that rely on these ecosystems. Wetland and ecosystem restoration is low in most wards of the municipality with the exception of North-East B, North-East A, North A, and South-West wards.

Table 7: Adaptive capacity indicators to multi-hazards in Busia Municipality

No	Adaptive capacity indicators	EASTERN DIVISION				WESTERN DIVISION			
		North-East A	North-East B	North C	South-East	Central	North A	North B	South-West
1	Access to health and social services	4	5	4	3	4	4	4	5
2	Employment opportunities	3	3	3	2	4	3	3	4
3	Access to early warning information, weather forecast or government support information	2	2	3	2	3	3	3	4
4	Access to clean water and sanitation	3	3	3	3	4	3	3	5
5	Access to credit	3	3	3	3	3	3	3	5
6	Access to renewable energy e.g., solar	3	3	3	3	4	4	3	5
7	Awareness of climate risks and adaptation practices	3	2	3	3	3	3	3	4
8	Diverse livelihood options	4	3	3	2	3	4	4	4
9	Education levels	3	3	3	3	3	3	3	5
10	Extension services	4	4	4	4	4	4	4	4
11	Good environmental management practices	3	2	3	2	3	3	3	4
12	Healthcare infrastructure	3	4	3	3	3	4	4	4
13	Proper waste disposal	2	1	2	1	2	3	3	4
14	Rainwater harvesting	2	2	2	2	2	2	2	4
15	Social networks	4	4	4	4	4	4	4	5
16	Urban greening initiatives	2	2	3	2	3	4	4	5
17	Wetland and ecosystem restoration	0	0	2	2	2	3	2	3
	Total	**48**	**46**	**51**	**44**	**54**	**57**	**55**	**74**
	KEY 0= Not Available, 1= Very Low, 2= Low, 3= Moderate, 4= High, 5= Very High								
	Source: District key informants, 2025								

Figure 24 shows the adaptive capacity of communities to climate hazards in Busia Municipality, Uganda. The Eastern Division, particularly South East ward has very low adaptive capacity, meaning these communities are least equipped to cope with and recover from hazards. In contrast, South West ward reflects very high adaptive capacity, suggesting stronger resilience and preparedness mechanisms. Central, North A and North B also show relatively high adaptive capacity, while North C fall in the moderate range. This spatial distribution underscores disparities in resilience levels across the municipality, highlighting the urgent need to strengthen adaptive capacity in highly vulnerable zones while consolidating the strengths of better-prepared communities.

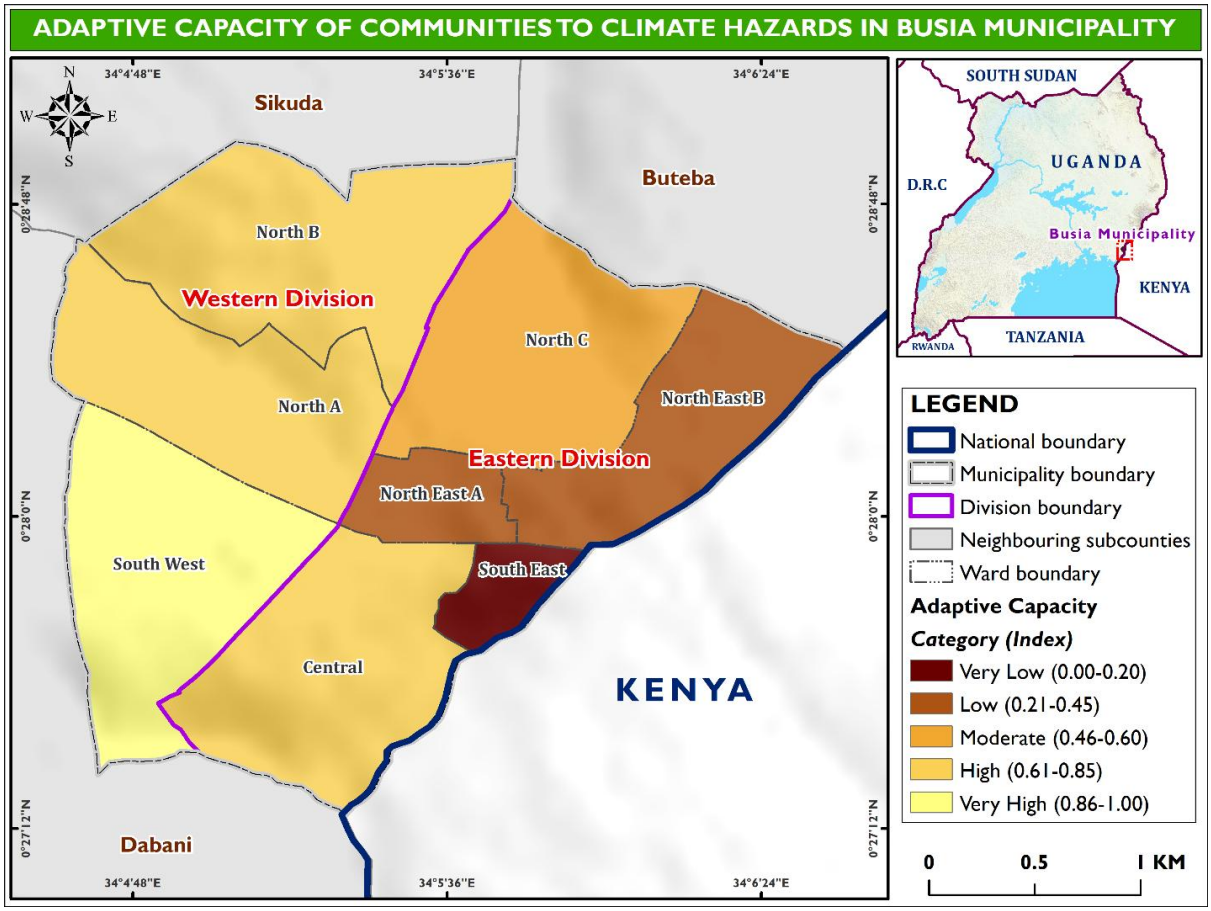

Figure 24: Adaptive capacity of communities to multi-hazards

2.5.4 Vulnerability of communities to multi-hazards

Figure 25 presents the vulnerability of communities to climate hazards in Busia Municipality, with spatial variations categorised into four levels: low, moderate, high, and very high. The Eastern Division stands out as the most vulnerable, particularly North C, South East and North East B, indicating very high vulnerability (0.86-1.00). In contrast, the South West ward reflects low vulnerability (0.00-0.45), while North East A and North A exhibit moderate to high levels of vulnerability. Generally, the Western Division portrays a more mixed profile, where South West shows relatively low vulnerability, whereas North A and North B fall within moderate to high categories.

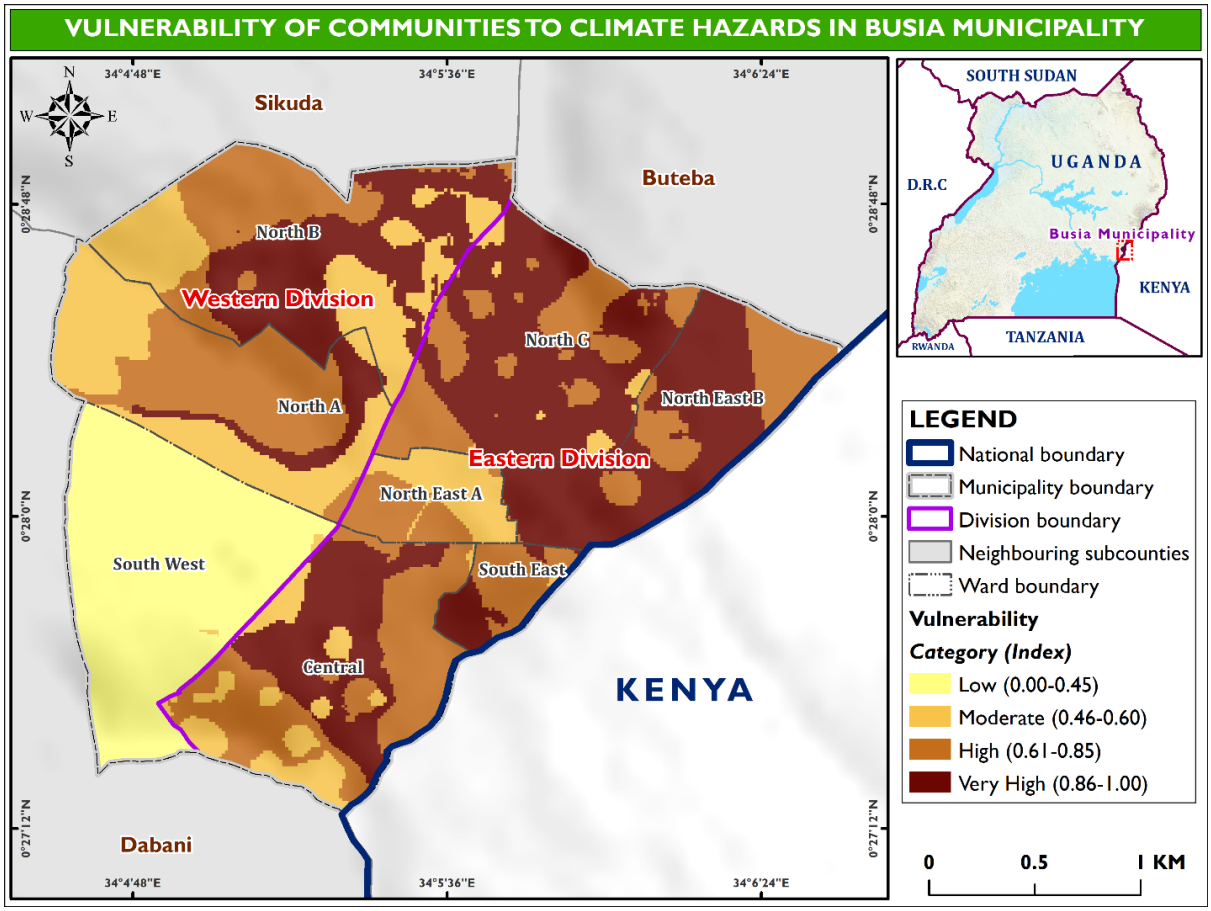

Figure 25: Vulnerability of communities to multi-hazards

2.5.6 Risk of communities to multi-hazards

The risk of communities to climate hazards (dry spell, floods, heatwaves, lightning, and windstorms) in Busia Municipality is presented in **Figure 26**. Eastern Division (particularly North C, and Central) is dominated by areas of high to very high risk whereas the Western Division presents a more varied risk profile, with South West exhibiting relatively low risk, while North A, and North B experience moderate to high risks.

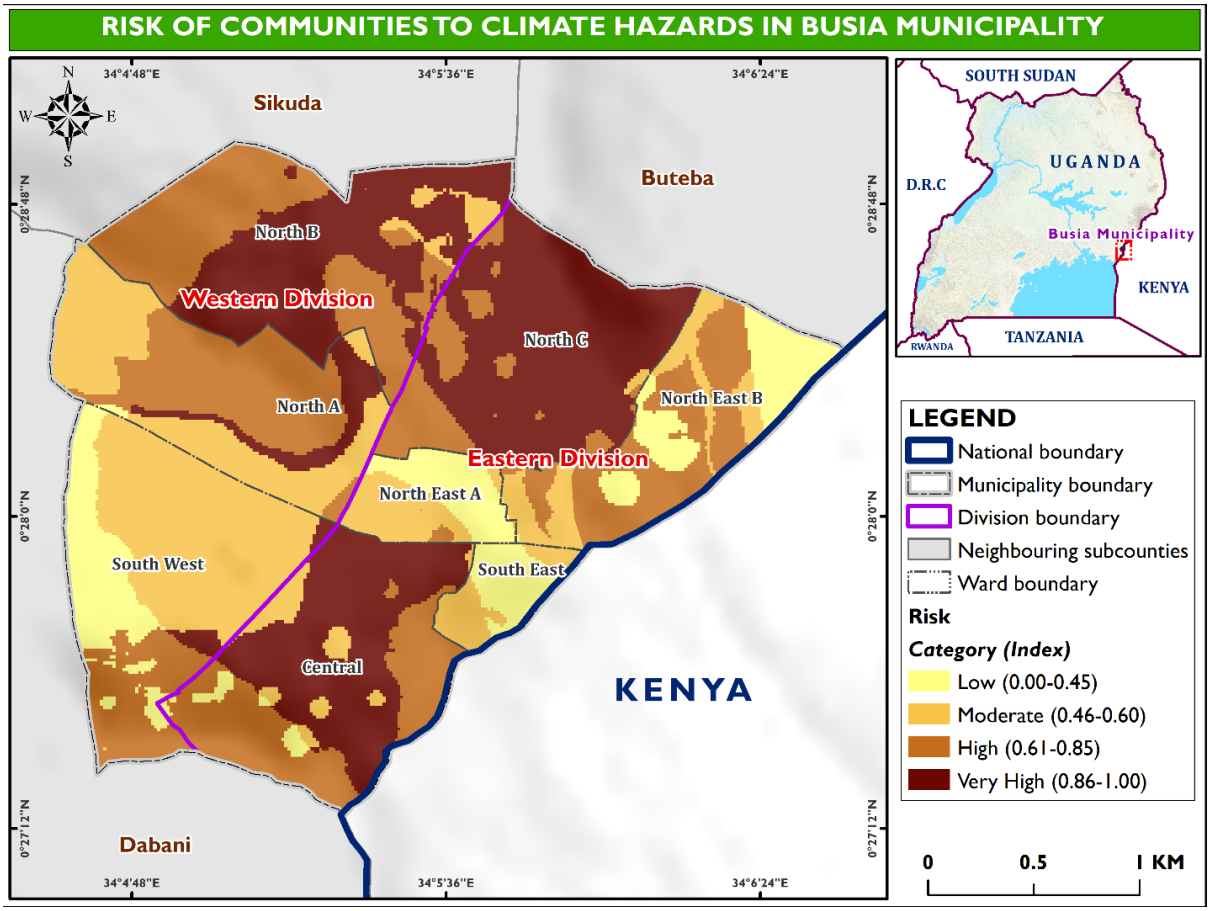

Figure 26: Risk of communities to multi-hazards

2.6 Greenhouse Gas Emissions

Based on the Global Protocol for Community-scale Greenhouse Gas Emission Inventories (GPC) standard, this assessment facilitates transparent calculation and reporting of emissions for all sectors. The current population and Gross Domestic Product were used as the scale factors.

The results of this assessment are presented according to the GHG Protocol's scopes as well as the BASIC reporting stipulated by the GPC standard. The GPC standard refers to the "Global Protocol for Community-Scale Greenhouse Gas Emission Inventories" and provides a standard for compiling city level GHG inventories. The standard is based on Scope 1, 2 and 3 emission categories outlined in the corporate standard for GHG Inventories.

These scopes of the municipal are defined as follows:

- Scope 1: GHG emissions from sources located within the municipal boundary
- Scope 2: GHG emissions occurring as a consequence of the use of grid-supplied electricity, heat, steam and/or cooling within the municipal boundary
- Scope 3: All other GHG emissions that occur outside the municipal boundary as a result of activities taking place within the municipality boundary.

Furthermore, the GPC defines two reporting frameworks for urban areas i.e., BASIC and BASIC+. The BASIC framework covers emissions sources that occur in most of the urban areas including Stationary Energy, In-boundary transportation and in-boundary generated waste. The calculation methodologies and data are more readily available.

The BASIC+ framework includes the BASIC emissions sources plus two additional sectors, industrial processes and product use (IPPU) and agriculture, forestry and other land use (AFOLU). The BASIC+ framework also includes transboundary transportation and energy losses. This reflects more challenging data collection and calculation procedures. Notation keys such as Not Occurring (NO) and Not Estimated (NE) were used.

The waste sector has the largest source of emissions, followed by transport sector as shown in (Table 87 & Figure 277). Notably, most of the emissions are scope 1 emissions. Whereas, scope 2 emissions only form a small portion of the overall total. On the other hand, scope 3 emissions were not estimated in this assessment due to lack of this data.

Table 8: GHG Emissions Summary

GHG Emissions Source (By Sector)		Total GHGs (metric tonnes CO2e)		
		Scope 1	Scope 2	BASIC
STATIONARY ENERGY	Energy use	57599	475	58074
	Energy generation supplied to the grid			
TRANSPORTATION		121625		121625
WASTE	Waste generated in the municipality	34636		185227
	Waste generated outside city			
IPPU				
AFOLU				
OTHER SCOPE 3				0
TOTAL		213860	475	364926

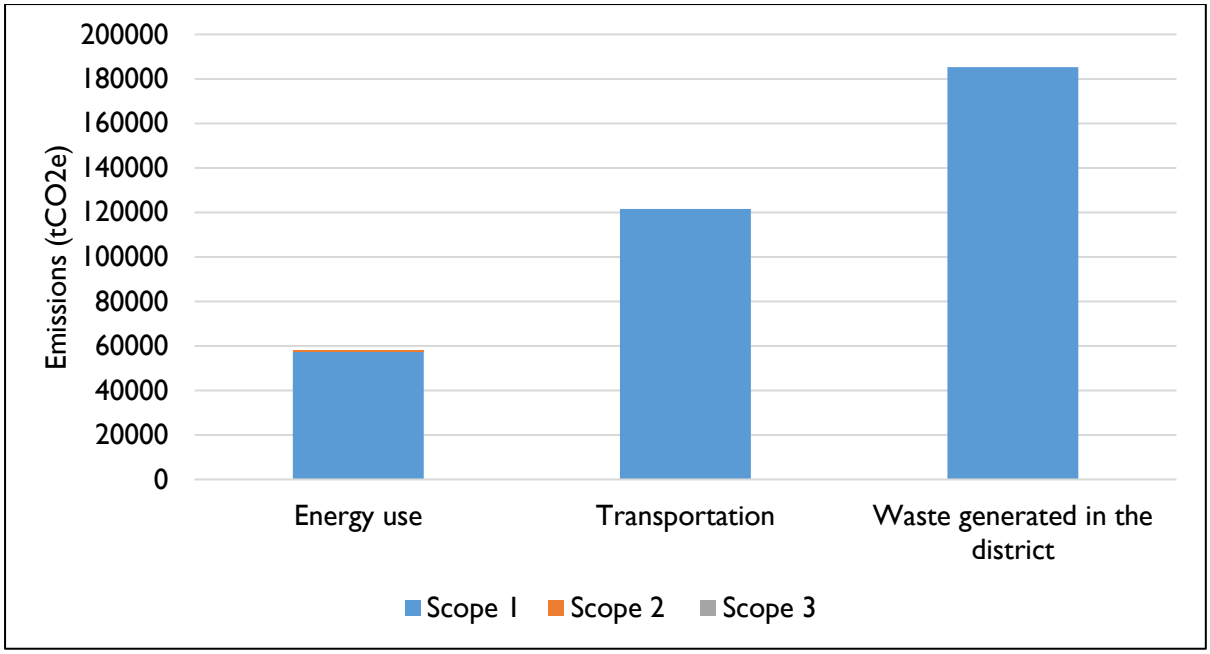

Figure 27: Busia district GHG emissions summary

Furthermore, the emissions by sector and sub-sector are presented below (*Table 9*): The alarming source of emissions for the various sectors or sub-sectors is the solid waste generated in the district, followed by on-road transportation and non-specified sources. The contribution of each sector/ sub-sector is illustrated in (*Table 9* & *Figure 28*28) below:

Table 9: Emissions by sector and sub-sector

GHG Emissions Source (By Sector and Sub-sector)	Total GHGs (metric tonnes CO2e)		
	Scope 1	**Scope 2**	**Total**
I. STATIONARY ENERGY			
Residential buildings	4032	27	4059
Commercial and institutional buildings and facilities	7080	11	7091
Manufacturing industries and construction	18419	51	18470
Energy industries	3558	0	3558
Agriculture, forestry and fishing activities	2323	0	2323
Non-specified sources	22188	0	22188
SUB-TOTAL	**57599**	**89**	**57688**
II. TRANSPORTATION			0
On-road transportation	22743	NO	22743
SUB-TOTAL	22743		**22743**
III. WASTE			0
Solid waste generated in the city	23337		23337
Wastewater generated in the city	11299		11299
SUB-TOTAL	**34636**		**34636**
TOTAL	**229956**	**178**	**230134**

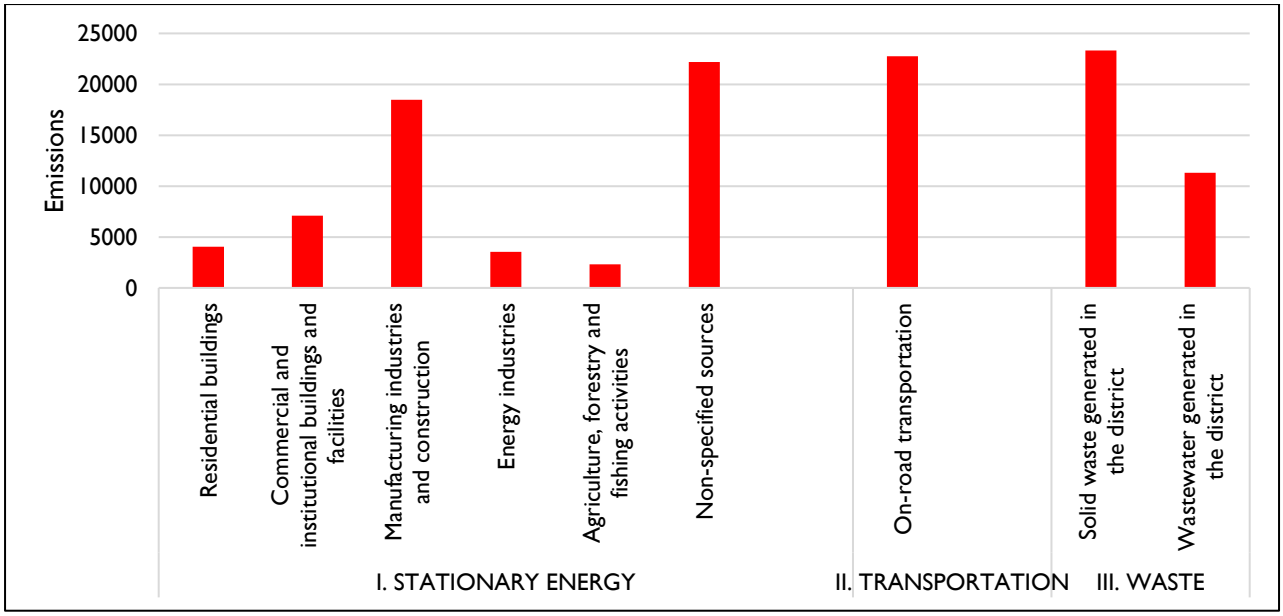

Figure 28: Emissions summary by sector and sub-sector

There are numerous fuels used to generate energy for transportation or stationary uses. The summary is presented in (*Table 10*).

Table 10: Emissions by fuel for the various sectors or subsectors

Sector	Subsector	Fuel	Emissions (tCO2e)
Stationary Energy	Residential	Wood or wood waste	1920.73
		Charcoal	2111.4
		Electricity	26.68
	Commercial and Institutional	Wood or wood waste	6656.43
		Charcoal	423.43
		Electricity	10.81
	Manufacturing and Construction	Petrol	2159.01
		Diesel	8362.34
		Paraffin	1258.79
		Charcoal	6638.72
		Electricity	51.29
	Energy Industries	Charcoal	3557.64
	Agriculture, Forestry and Fisheries	Petrol	2322.77
	Non-Specified	Wood or wood waste	22188.1
		Electricity	0
Transportation	On-road Transportation	Petrol	3807.19
		Diesel	18935.67

CHAPTER THREE: CLIMATE ACTION OPTIONS

4.1 Introduction

The prioritised climate actions in this plan are meant to reduce the Greenhouse Gas emissions (mitigation) and facilitate climate adaptation in Busia Municipality. These actions target 10 sectors here referred to as result areas. These are: Energy, Transportation, Trade and industry, Agriculture, Water and Environment, ICT, Land and housing, social development (Communities), Education, and Sports and Health**.** For each result area, an outcome and output statement are provided for envisioning the desired actions for implementation.

4.1.1 Energy

Despite the vital role energy plays in the public and private sphere, the energy coverage is facing climate change threats. Recurrent heat waves, drought and fire outbreaks are reported around Custom Road, Arubaine, Marachi, and Sofia-areas. In response, communities asked for better building standards and extinguishers. Lightning incidents were also flagged in Marachi, Mugungu, and Arubaine, prompting calls for arresters on public and private buildings. Expanding solar for public facilities and cold chains, distributing efficient cookstoves, and installing lightning protection cut fire risk, reduce biomass use, and lower emissions. Communities also proposed "cool roofs," shade trees, and public cooling shelters-especially for markets, schools and health posts-to reduce heat exposure and power needs. In all the interventions given, women should be centrally placed to help expand more efficient and renewable energy solutions and this is because they are primary custodians of energy use and energy collection in the household, Understanding the limitations surrounding women's knowledge of and access to improved and efficient energy technologies, including financing, will be crucial to uptake

Outcome

A transition to integrate modern energy into climate action which are affordable, reliable, and low-carbon energy systems that reduce household vulnerability and municipal emissions is promoted.

Output

Adoption of clean cooking technologies, expansion of solar-powered productive energy, and energy efficiency retrofits in public infrastructure scaled up to promote affordable and low-carbon energy use across Busia Municipality.

Actions

Action 1.1: Install additional solar photovoltaic (PV) systems on schools, health centers, markets, and cold storage units (cold chains) within Busia Municipality.

Action 1.2: Facilitate the widespread distribution and adoption of efficient, low-emission cooking stoves (e.g., LPG, briquettes, improved biomass stoves) to households, institutions, and local businesses

Action 1.3: Install lightning protection systems, including arresters on homes, schools, health centers, markets, and other critical community infrastructure.

Action 1.4: Establish and enforce stricter building codes that incorporate fire-resistant materials, safe electrical wiring, and proper ventilation

Action 1.5: Promote the use of reflective roofing materials ("cool roofs") in public and private buildings, and organize tree-planting campaigns to create shade in markets, schools, and health posts.

Action 1.6: Construct and designate cooling shelters in markets, near schools, and health facilities, equipped with shade structures, fans, or cooling fans.

4.1.2 Transportation

Flooding repeatedly disrupts mobility in Eastern Division-Sofia A/B at the border, Marachi C-Solo-Matope (near Pade Spring), Mugungu A/B (Junia's Spring), Mawero East B, and the Taxi Park due to undersized or silted drains; Western Division reports Solo A/B/C, Madibira A, and Nangwe as culvert and drainage bottlenecks. Poor road conditions and low lighting drive accident risk in Busia town corridors (e.g., Busumba Road, Solo A/C) and around the border point with heavy truck traffic. There is need for climate-proofed drainage (right-sized culverts, lined channels), routine desilting, traffic calming, pedestrian/boda lanes, and better street lighting reduce flood losses and accidents. Greener transport planning (walkways, cycling, logistics zoning near border) cuts emissions and congestion.

Outcome

Climate-resilient, safe, and low-emission transport system supporting livelihoods and trade in Busia Municipality is established.

Output

Municipal transport systems climate-proofed through improved drainage and resilient road networks, expansion of non-motorized infrastructure, and transition to low-emission public and municipal fleets.

Actions

Action 2.1: Upgrade drainage infrastructure and resurface roads to withstand flooding, adopting climate-resilient materials.
Action 2.2: Develop and promote non-motorized transport infrastructure (walkways) to reduce emissions, starting with congested zones like customs road
Action 2.3: Pilot and incentivize low-emission municipal fleet (e.g., electric vehicles, fuel-efficient trucks), aligning with national policies.
Action 2.4: Conduct road safety and climate risk campaigns in schools and border business centers
Action 2.5: Establish community transport committees to monitor culvert/drain blockages and road safety issues.
Action 2.6: Enforce vehicle emission standards for cross-border buses and trucks, in collaboration with URA and Traffic Police.

4.1.3 Trade and Industry

Markets and small industries along Custom Road, Arubaine, Marachi and border cells face heat stress, fires, waste pile-ups, and flood-related business interruptions; communities suggested relocating high-risk enterprises (e.g., distillers/welders) to an industrial area and improving building standards. Drainage upgrades in trading zones, business continuity planning, fire safety compliance, and energy-efficient equipment lower losses; formal recycling and briquette enterprises create green jobs while reducing open burning and methane from dumps.

Outcome

Local trade and industry adaptive, green, and resilient to climate shocks, enhancing Busia's role as a cross-border trade hub is established.

Output

Climate-resilient trade and industry are fostered by upgrading market infrastructure, promoting eco-friendly enterprises, and integrating energy-efficient technologies into small-scale industries.

Actions

Action 3.1: Upgrade market drainage and sanitation systems in Busia Central, Arubaine, Nangwe, and Marachi to minimize flood-related business disruptions.
Action 3.2: Promote and provide incentives for eco-enterprises (solar, recycling, briquette manufacturing), especially targeting youth and women.
Action 3.3: Support industries to adopt energy-efficient machinery and processes (e.g., solar-powered equipment), with training sessions.
Action 3.4: Enforce fire and building safety standards for small industries and markets in flood-prone and high-density trading centers to reduce risk of disasters.
Action 3.5: Develop a Municipal Green Business Hub to incubate and support youth and women entrepreneurs in climate-smart enterprises
Action 3.6: Develop Mobile Market Information Systems (SMS- or app-based platforms tailored for low-literacy, rural women traders) to help increases visibility of markets, real-time market prices, climate alerts, and trade opportunities.
Action 3.7: Upskill women and marginalized groups in green trade and production. This can be done through mobile-accessible women groups with interactive training modules on renewable energy, circular production.

4.1.4 Agriculture

Drought affects all cells in both divisions, with farmers seeking training in climate-smart practices, rainwater harvesting, and drought-tolerant crops; livestock health shocks follow droughts and floods in Mugungu, Sofia, Marachi, Mawero East B, and Arubaine. CSA extension (mulching, shade nets, early/late work hours), solar-powered irrigation, fodder banks, and vaccination/surveillance reduce climate losses. Household and institutional rainwater harvesting buffers dry spells and reduces pumping energy needs.

Outcome

Urban and peri-urban agriculture that is climate-smart, water-efficient, and market-oriented, reducing household vulnerability is established.

Output

Urban and peri-urban agriculture is strengthened through adoption of climate-smart practices, expansion of innovative farming models, and improved market linkages for resilient agricultural products.

Actions

Action 4.1: Train farmers on climate-smart agriculture techniques (mulching, drought-tolerant seeds, agroforestry) to mitigate emissions
Action 4.2: Promote urban farming models (kitchen gardens, poultry, beekeeping) through extension services in the communities
Action 4.3: Link farmers to climate-smart markets by promoting aggregation centers, cold storage, and certification for climate-resilient produce.
Action 4.4: Introduce affordable small-scale solar-powered irrigation schemes and rain water harvesting systems to ensure sustainable water supply to support food production.

Action 4.5: Facilitate access to agroforestry seedlings (fruit, shade, nitrogen-fixing trees) through tree nurseries establishment managed by groups

4.1.5 Water and Environment

Busia Municipality faces a combined crisis of poor waste management, water contamination, and wetland degradation. In Western Division (Solo-Madibira-Nangwe corridor), communities reported "massive garbage heaps" and pit latrines overflowing into drains during floods, directly polluting water sources and raising cholera fears. In Eastern Division, flood-prone cells such as Sofia A/B, Marachi C-Solo-Matope, Mugungu A/B, and Mawero East B face similar risks, where blocked or undersized drains carry solid waste into streams and springs (e.g., Pade Spring, Junia's Spring). Wetlands such as Mugungu, Arubaine, Solo, and Marachi are being encroached for cultivation and settlements, reducing their buffering role against floods.

These solutions address the dual need to adapt urban water systems to climate change (e.g. floods, droughts, water scarcity) while ensuring they are equitable and accessible particularly for women and marginalized groups**,** who are often most affected by water insecurity. Establishing source-segregation, composting/briquette enterprises, and scheduled waste collection reduces flood blockages and methane emissions. Protecting and restoring wetlands improves natural drainage, recharges groundwater, and sequesters carbon. Expanding rainwater harvesting, safe sanitation, and community-managed water points buffers dry spells and improves public health. Tree planting along drains and riparian zones stabilizes soils and reduces erosion. Collectively, these measures address both adaptation (flood and drought risk reduction, disease prevention) and mitigation (lower emissions from waste and land degradation).

Outcome

Waste, water, and wetlands in Busia Municipality are sustainably managed to safeguard public health, reduce flooding, and strengthen ecosystems.

Output

Municipal ecosystems safeguarded through improved waste management, protection and restoration of critical wetlands, and expansion of sustainable water harvesting and sanitation systems.

Actions

Action 5.1: Strengthen waste segregation, recycling programs, and community clean-up campaigns.
Action 5.2: Protect, restore, and sustainably manage wetlands and water bodies through community engagement and legal enforcement.
Action 5.3: Invest in rainwater harvesting, solar powered boreholes, protected wells and improve sanitation facilities in public institutions.
Action 5.4: Intensify tree planting along drains, road reserve and riparian zones to stabilize soils and reduce erosion.
Action 5.5: Invest in integrated waste and water resources management.
Action 5.6: Improve/introduce smallscale irrigation systems to adapt to droughts

4.1.6 Information, communication, and technology (ICT)

ICT is leveraged to support early warning systems, data-driven planning, awareness campaigns, and digital access to climate-smart solutions. This area aims to enhance connectivity, digital literacy, and the integration of modern technology into climate resilience strategies across sectors. Residents proposed SMS/voice alerts via local leaders and telecoms, radio talk shows, and school/community workshops as core early-warning tools, including lightning detection and drought alerts. A low-cost, multi-channel ICT early warning system (SMS, FM radio, community noticeboards) improves last-mile risk communication, reduces losses from flash floods and storms, and supports heat and disease advisories.

Outcome

Gender responsive climate information access, early warning, and municipal service delivery for resilience and low-carbon growth is strengthened by ICT.

Output

ICT is leveraged to strengthen climate resilience through improved early warning systems, enhanced community digital literacy, and integration of ICT tools into municipal climate planning and governance.

Actions

Action 6.1: Establish community-based early warning systems using SMS alerts, WhatsApp groups, and community radios to disseminate flood, storm, and heat warnings.
Action 6.2: Develop digital climate information centers at Busia Municipal HQ and division offices for real-time updates, forecasts, and community training that help women farmers and workers adapt to climate change (e.g., weather alerts, market prices, regenerative agriculture advice
Action 6.3: Partner with telecom providers (MTN, Airtel) to deliver zero-rated climate alerts and voice messages, ensuring accessibility for low-literacy groups.
Action 6.4: Equip schools and community hubs with ICT tools (radios, solar-powered tablets) for climate education, risk reporting, and disaster preparedness activities.
Action 6.5: Digitalize municipal climate monitoring systems (e.g., waste management, road drainage, energy use) to improve planning, accountability, and service delivery.
Action 6.6: Define and promote women as agents of change and technology solutions providers, rather than only as users
Action 6.7: Promote the use of gender-responsive technologies products that address women's safety, reproductive health, or caregiving needs.
Action 6.7: Shift to purchasing of renewable energy sources for powering technology operations.

4.1.7 Land and housing

Informal construction in flood-prone cells (e.g., around springs in Marachi, Mugungu, Mawero East B; Solo-Madibira-Nangwe) increases exposure to flash floods, wind, and lightning. Communities called for "municipal authority guided construction," zoning, and green setbacks. Enforcing climate-sensitive planning (no-build in wetlands, elevated/flood-resistant designs, ventilation, cool roofs) and creating buffer strips along Solo Stream and spring lines reduce hazard impacts and urban heat.

Outcome

Land use and housing systems in Busia Municipality are climate-resilient, sustainable, and inclusive, reducing exposure to hazards.

Outputs

Urban settlements made more resilient by enforcing risk-sensitive land use zoning, promoting affordable climate-proof housing, and integrating green building and efficiency standards into municipal regulations.

Actions

Action 7.1: Develop and enforce climate-sensitive zoning regulations to prevent settlement in wetlands and floodplains (e.g., around Mugungu and Marachi), supported by community sensitization.

Action 7.2: Promote affordable, eco-friendly, storm-resistant housing for vulnerable families (elevated floors, strong roofing, cross ventilation, and rainwater harvesting systems) for flood-prone cells like Nangwe, Solo, and Marachi.

Action 7.3: Train local builders and artisans in climate-proof construction techniques and green building materials to improve uptake at household and institutional level.

Action 7.4: Create municipal green buffers and open spaces along drainage channels and wetlands to reduce flood risks and provide shade in densely populated cells.

Action 7.5: Regularize and monitor informal developments by integrating them into municipal risk-based land use planning to minimize exposure to hazards.

Action 7.6: Upgrade informal settlements with proper drainage and sanitation

4.1.8 Social development (Communities)

All groups including women, youth, elderly, persons with disabilities reported impacts from floods, heat, disease, and income loss; barriers include limited mobility (PWDs), exclusion from decision-making (women/youth), and psychosocial stress. Communities asked for awareness, by-laws, VHT support, and inclusive committees. Strengthening community structures (environment/drainage committees, VHTs), social protection, and gender/youth leadership in adaptation increases uptake of measures like tree planting, drain maintenance, and safe shelter use.

Outcome

Community resilience and inclusion in climate action is enhanced

Output

Community resilience is enhanced through establishment of climate action committees, promotion of alternative livelihoods for vulnerable groups, and strengthening of local savings and credit groups for adaptation financing.

Actions

Action 8.1: Establish Community Climate Action Committees (CCACs) in each division and cell (e.g., Sofia A/B, Nangwe, Mugungu) to oversee local adaptation measures, enforce by-laws, and coordinate disaster preparedness.

Action 8.2: Create alternative green livelihoods (briquette production, poultry, crafts, beekeeping) targeting women, youth, and persons with disabilities, to reduce dependency on climate-sensitive casual labor.

Action 8.3: Strengthen Village Health Teams (VHTs) with training, first-aid kits, and climate-health response skills (cholera, malaria, heat stress), enabling them to act as frontline responders in climate emergencies.

Action 8.4: Support community-based savings and credit groups (VSLA/SACCOs) to finance small-scale climate-resilient enterprises and adaptation investments such as rainwater tanks or solar lamps.
Action 8.5: Conduct inclusive gender and climate change sensitisation aawareness campaigns through radio, drama, and school clubs to mainstream gender, youth, and disability inclusion in climate action planning.
Action 8.6: Formation of gender/women's organisations trained on climate change and gender differentiated impacts, with particular emphasis on female headed households
Action 8.7: Offering cash transfers, food aid, and insurance targeting vulnerable populations.

4.1.9 Education and Sports

Schools are affected by floods (access and sanitation), heat (learning conditions), lightning (incidents noted municipality-wide), and disaster disruptions; proposals included climate-resilient school infrastructure, EWS clubs, and integrating climate education. Installing lightning arresters, shade trees, rainwater tanks, and resilient latrines keeps learners safe; school-based early-warning clubs and sports-ground greening double as awareness hubs and heat refuges.

Outcome
Climate change awareness, environmental education, and adaptive capacity among learners and youth are improved.

Output
Education and sports institutions mainstream climate resilience through greening of school grounds, integration of climate change into curricula and extracurriculars, and development of safe, climate-smart sports facilities.

Actions
Action 9.1: Implement tree planting campaigns, establish eco-gardens, and rainwater harvesting systems in all public schools.
Action 9.2: Incorporate gendered climate change education into school curricula, including extracurricular programs like debates, drama, and environmental clubs.
Action 9.3: Conduct training sessions for teachers on climate change impacts, eco-friendly teaching methods, and project-based learning.
Action 9.4: Upgrade sports grounds with proper drainage systems, shade trees, and sustainable materials to prevent damage during floods and heatwaves.
Action 9.5: Promote water-saving and energy-efficient practices in school facilities
Action 9.6: Organize climate awareness campaigns, environmental days, and competitions involving students, parents, and local communities to foster environmental stewardship.
Action 9.7: Strengthen the knowledge and skills of women leaders, candidates, and elected authorities for their participation in decision-making spaces.

4.1.10 Health

Human disease spikes (malaria, cholera, M-pox) were reported across both divisions during floods and heat; VHTs need supplies and clinics need surge capacity. Malaria accounted for about 30% outpatient visits, while 27.2% of inpatient death among children under five in Busia district in 2022 (Chemutai et al., 2023). About 247 cases of cholera were reported seven lives claimed in 2021 while by May 2025, three cases of Mpox were reported in Busia referral hospital (Lamarque & Brown, 2025). Heat stress is municipality-wide, with calls for public cooling spots and hydration

points in markets, bus/taxi parks, and border queues. Climate-smart primary health care (stockpiles, surveillance, ORS, risk communication), WASH upgrades where drains overflow, and vector control aligned with early warnings reduce morbidity; shading and water access in public places lower heat risks.

Outcome

Climate-resilient health systems, reducing vulnerability to climate-induced disease and health emergencies are established in Busia municipality.

Output

Health systems are climate-resilient through improved WASH in health facilities, installation of lightning protection in schools and centres, and capacity strengthening of Village Health Teams for climate-induced emergencies.

Actions

Action 10.1: Upgrade water, sanitation, and hygiene facilities in health centers (e.g., Busia HC IV, Arubaine HC) with climate-resilient infrastructure.

Action 10.2: Equip schools, health centers, and community centers in flood-prone areas with lightning protection systems to prevent weather-related accidents.

Action 10.3: Train Village Health Teams and frontline health workers on managing climate-induced health emergencies such as heat stress, cholera outbreaks, and vector-borne diseases.

Action 10.4: Establish climate-informed early warning and response systems to monitor and control outbreaks of diseases like malaria, cholera, and respiratory illnesses.

Action 10.5: Conduct education sessions on climate-related health risks, preventive measures, and the importance of clean water and sanitation.

Action 10.6: Develop disaster response plans for climate emergencies (floods, heatwaves) with community involvement and ensure availability of first aid and medical supplies.

4.2 Implementation Plan

Table 11: Climate action Implementation plan

Result Area	Outcome and Output	Mitigation & adaptation actions	Priority Location	Short -term	Medium -term	Long - term	Responsibility (lead and collaborators)
1. Energy	**Outcome 1:** A transition to affordable, reliable, and low-carbon energy systems that reduce household vulnerability and municipal emissions is realised.						
	Output 1: Adoption of clean cooking technologies, expansion of solar-powered productive energy, and energy efficiency retrofits in public infrastructure scaled up.						
Action 1.1: Install additional solar photovoltaic (PV) systems on schools, health centers, markets, and cold storage units (cold chains).			Municipal-wide	X			Municipal Engineering Dept. MEMD, NGOs (SNV, GIZ), Solar Companies
Action 1.2: Facilitate the widespread distribution and adoption of efficient, low-emission cooking stoves (e.g., LPG, briquettes, improved biomass stoves) to households, institutions, and local businesses			Municipal-wide	X			Municipal Production & Natural Resources Dept. MEMD, NGOs, Private stove vendors
Action 1.3: Install lightning protection systems, including arresters and grounding, on homes, schools, health centers, markets, and other critical community infrastructure.			Flood-prone divisions (Mawero East, Marachi, Mugungu)	X	X		Municipal Engineering Dept. OPM, MoH, NGOs
Action 1.4: Establish and enforce stricter building codes that incorporate fire-resistant materials, safe electrical wiring, and proper ventilation			Municipal-wide		X	X	Municipal Physical Planning Dept. MoLHUD, Building Inspectorate
Action 1.5: Promote the use of reflective roofing materials ("cool roofs") in public and private buildings, and organize tree-planting campaigns to create shade in markets, schools, and health posts.			Markets, schools, health facilities	X	X		Municipal Engineering Dept. Community committees, NGOs

Result Area	Outcome and Output	Mitigation & adaptation actions	Priority Location	Short -term	Medium -term	Long - term	Responsibility (lead and collaborators)
Action 1.6: Construct and designate cooling shelters in markets, near schools, and health facilities, equipped with shade structures, fans, or cooling fans.			Markets and schools in urban core		X	X	Municipal Engineering Dept. NGOs, MoH, MoES
2. Transportation	Outcome 2: Climate-resilient, safe, affordable and low-emission transport system supporting livelihoods and trade in Busia Municipality is established.						
	Output 2.1: Municipal transport systems climate-proofed.						
Action 2.1: Upgrade drainage infrastructure and resurface roads to withstand flooding, adopting climate-resilient materials.			Marachi Solo, Mugungu A/B, Mawero East B	X	X		Municipal Engineering Dept. MoWT, UNRA, CBOs
Action 2.2: Develop and promote non-motorized transport infrastructure (walkways, bike lanes) to reduce emissions, starting with congested zones.			Busia Town core and high-density cells		X	X	Municipal Physical Planning Unit. NGOs, boda-boda associations
Action 2.3: Pilot and incentivize low-emission municipal fleet (e.g., electric vehicles, fuel-efficient trucks), aligning with national policies.			Municipal-wide		X	X	Municipal Engineering Dept. MEMD, MoWT, Private sector
Action 2.4: Conduct road safety and climate risk campaigns in schools and border business centers			Municipal-wide	X			Municipal Education Dept. Traffic Police, NGOs
Action 2.5: Establish community transport committees to monitor culvert/drain blockages and road safety issues.			Flood-prone zones (Marachi, Nangwe, Mugungu)	X	X		Municipal Engineering Dept. Community leaders, CBOs
Action 2.6: Enforce vehicle emission standards for cross-border buses and trucks, in collaboration with URA and Traffic Police.			Municipal border and transport hubs		X	X	Municipal Engineering Dept. URA, Traffic Police
3. Trade and Industry	**Outcome 3:** Local trade and industry adaptive, green, and resilient to climate shocks, enhancing Busia's role as a cross-border trade hub is established.						
	Output 3.1: Climate-resilient trade and industry fostered.						

Result Area	Outcome and Output	Mitigation & adaptation actions	Priority Location	Short -term	Medium -term	Long - term	Responsibility (lead and collaborators)
Action 3.1: Upgrade market drainage and sanitation systems to minimize flood-related business disruptions.			Busia Central, Arubaine, Nangwe, Marachi	X			Municipal Trade & Industry Dept. Market committees, NGOs
Action 3.2: Promote and provide incentives for eco-enterprises (solar, recycling, briquette manufacturing), especially targeting youth and women.			Municipal-wide	X	X		Municipal Trade & Industry Dept. Private sector, NGOs
Action 3.3: Support industries to adopt energy-efficient machinery and processes (e.g., solar-powered equipment), with training sessions.			Industrial zones		X	X	Municipal Trade & Industry Dept. MEMD, NGOs
Action 3.4: Enforce fire and building safety standards for small industries and markets in flood-prone and high-density trading centers to reduce risk of disasters.			Flood-prone and high-density centres	X			Municipal Physical Planning Dept. Fire Dept, Police
Action 3.5: Develop a Municipal Green Business Hub to incubate and support youth and women entrepreneurs in climate-smart enterprises.			Busia Town		X	X	Municipal Trade & Industry Dept. NGOs, Private incubators
4. Agriculture	**Outcome 4:** Urban and peri-urban agriculture that is climate-smart, water-efficient, and market-oriented, reducing household vulnerability is established.						
	Output 4.1: Urban and peri-urban agriculture strengthened.						
Action 4.1: Train farmers on climate-smart agriculture techniques (mulching, drought-tolerant seeds, agroforestry).			Peri-urban cells (Mugungu, Nangwe, Marachi)	X			Municipal Agriculture Dept. MAAIF, NGOs, Farmer groups
Action 4.2: Promote urban farming models (kitchen gardens, poultry, beekeeping) through extension services.			Urban households (Sofia, Marachi, Nangwe)	X	X		Municipal Agriculture Dept. CBOs, NGOs
Action 4.3: Link farmers to climate-smart markets by promoting aggregation centers, cold storage, and certification for climate-resilient produce.			Busia Town markets		X	X	Municipal Agriculture Dept. Private sector, Trade Dept.

Result Area	Outcome and Output	Mitigation & adaptation actions	Priority Location	Short -term	Medium -term	Long - term	Responsibility (lead and collaborators)
Action 4.4: Introduce small-scale solar-powered irrigation schemes for vegetable and horticulture farmers in dry-prone cells to increase year-round production.			Dry-prone cells		X	X	Municipal Agriculture Dept. MEMD, NGOs
Action 4.5: Facilitate access to agroforestry seedlings (fruit, shade, nitrogen-fixing trees) through nurseries managed by youth and women groups.			Municipal-wide	X	X		Municipal Agriculture Dept. NFA, NGOs
5. Environment	Outcome 5: Waste, water, and wetlands in Busia Municipality are sustainably managed to safeguard public health, reduce flooding, and strengthen ecosystems.						
	Output 5.1: Municipal ecosystems safeguarded.						
Action 5.1: Strengthen waste segregation, recycling programs, and community clean-up campaigns.			Sofia A/B, Marachi, Mugungu, Nangwe	X	X		Municipal Environment Dept. NGOs, CBOs
Action 5.2: Protect, restore, and sustainably manage wetlands and water bodies through community engagement and legal enforcement.			Mugungu, Solo, Marachi, Arubaine	X	X	X	Municipal Environment Dept. NEMA, NFA, NGOs
Action 5.3: Expand rainwater harvesting and improve sanitation facilities in public institutions.			Schools and health centers	X	X		Municipal Engineering Dept. MoH, MoES
Action 5.4: Intensify tree planting along drains and riparian zones to stabilize soils and reduce erosion.			Municipal-wide	X	X	X	Municipal Environment Dept. NFA, NGOs
Action 5.5: Invest in integrated waste and water management.			Busia Town		X	X	Municipal Environment Dept. NGOs, Private sector
6. ICT	Outcome 6: Climate information access, early warning, and municipal service delivery for resilience and low-carbon growth is strengthened by ICT.						
	Output 6.1: CT leveraged to strengthen climate resilience.						
Action 5.1: Establish community-based early warning systems using SMS alerts, WhatsApp groups, and community radios to disseminate flood, storm, and heat warnings.			Municipal-wide	X			Municipal ICT Dept. Telecoms, NGOs

Result Area	Outcome and Output	Mitigation & adaptation actions	Priority Location	Short -term	Medium -term	Long - term	Responsibility (lead and collaborators)
Action 5.2: Develop digital climate information centers at Busia Municipal HQ and division offices for real-time updates, forecasts, and community training.			Municipal HQ and division offices		X		Municipal ICT Dept. NGOs, MoWE
Action 5.3: Partner with telecom providers (MTN, Airtel) to deliver zero-rated climate alerts and voice messages, ensuring accessibility for low-literacy groups.			Municipal-wide	X	X		Municipal ICT Dept. MTN, Airtel
Action 5.4: Equip schools and community hubs with ICT tools (radios, solar-powered tablets) for climate education, risk reporting, and disaster preparedness activities.			Schools, CBO centres	X	X		Municipal ICT Dept. MoES, NGOs
Action 5.5: Digitalize municipal climate monitoring systems (e.g., waste management, road drainage, energy use) to improve planning, accountability, and service delivery.			Municipal HQ		X	X	Municipal ICT Dept. Engineering Dept., NGOs
7. Land & Housing	**Outcome 7**: Land use and housing systems in Busia Municipality are climate-resilient, sustainable, and inclusive, reducing exposure to hazards.						
	Output 7.1: Urban settlements made more resilient.						
Action 7.1: Develop and enforce climate-sensitive zoning regulations to prevent settlement in wetlands and floodplains, supported by community sensitization.			Mugungu, Marachi	X	X		Municipal Physical Planning Dept. Community leaders, NGOs
Action 7.2: Promote affordable resilient housing designs (elevated floors, strong roofing, cross ventilation, and rainwater harvesting systems) for flood-prone cells like Nangwe, Solo, and Marachi.			Nangwe, Solo, Marachi	X	X		Municipal Physical Planning Dept. MoLHUD, NGOs
Action 7.3: Train local builders and artisans in climate-proof construction techniques and green building materials to improve uptake at household and institutional level.			Municipal-wide	X			Municipal Physical Planning Dept. Vocational Institutes, NGOs

Result Area	Outcome and Output	Mitigation & adaptation actions	Priority Location	Short -term	Medium -term	Long - term	Responsibility (lead and collaborators)
Action 7.4: Create municipal green buffers and open spaces along drainage channels and wetlands to reduce flood risks and provide shade in densely populated cells.			Drainage channels, wetlands		X	X	Municipal Physical Planning Dept. NEMA, NFA
Action 7.5: Regularize and monitor informal developments by integrating them into municipal risk-based land use planning to minimize exposure to hazards.			Busia Town slums		X	X	Municipal Physical Planning Dept. NGOs, MoLHUD
8. Social Development	Outcome 8: Community resilience and inclusion in climate action is enhanced.						
	Output 8.1: Community resilience enhanced.						
Action 8.1: Establish Community Climate Action Committees (CCACs) in each division and cell to oversee local adaptation measures, enforce by-laws, and coordinate disaster preparedness.			Sofia A/B, Nangwe, Mugungu	X			Municipal Community Devt. Dept. Community leaders, NGOs
Action 8.2: Create alternative green livelihoods (briquette production, poultry, crafts, beekeeping) targeting women, youth, and persons with disabilities, to reduce dependency on climate-sensitive casual labor.			Municipal-wide	X	X		Municipal Community Devt. Dept. NGOs, Farmer groups
Action 8.3: Strengthen Village Health Teams (VHTs) with training, first-aid kits, and climate-health response skills (cholera, malaria, heat stress), enabling them to act as frontline responders in climate emergencies.			Flood-prone divisions	X	X		Municipal Health Dept. MoH, NGOs, Microfinance institutions, NGOs
Action 8.4: Support community-based savings and credit groups (VSLA/SACCOs) to finance small-scale climate-resilient enterprises and adaptation investments such as rainwater tanks or solar lamps.			Municipal-wide	X	X		Municipal Community Devt. Dept. Microfinance institutions, NGOs
Action 8.5: Conduct inclusive awareness campaigns through radio, drama, and school clubs to mainstream gender, youth, and disability inclusion in climate action planning.			Municipal-wide	X			Municipal Community Devt. Dept. Media, NGOs
9. Education and Sports	**Outcome 9**: Climate change awareness, environmental education, and adaptive capacity among learners and youth are improved.						

Result Area	Outcome and Output	Mitigation & adaptation actions	Priority Location	Short -term	Medium -term	Long - term	Responsibility (lead and collaborators)
	Output 9.1: Climate resilience mainstreamed in education and sports institutions.						
Action 9.1: Implement tree planting campaigns, establish eco-gardens, and rainwater harvesting systems in all public schools.			Sofia, Marachi, Nangwe, Arubaine	X	X		Municipal Education Dept. MoES, NGOs
Action 9.2: Incorporate climate change education into school curricula, including extracurricular programs like debates, drama, and environmental clubs.			Municipal-wide	X	X		Municipal Education Dept. MoES, NGOs
Action 9.3: Conduct training sessions for teachers on climate change impacts, eco-friendly teaching methods, and project-based learning.			Municipal-wide		X		Municipal Education Dept. MoES, NGOs
Action 9.4: Upgrade sports grounds with proper drainage systems, shade trees, and sustainable materials to prevent damage during floods and heatwaves.			Busia Town schools		X	X	Municipal Education Dept. MoES, NGOs
Action 9.5: Promote water-saving and energy-efficient practices in school facilities, including rainwater harvesting, solar lighting, and eco-friendly sanitation.			Municipal-wide	X	X		Municipal Education Dept. MoES, NGOs
Action 9.6: Organize climate awareness campaigns, environmental days, and competitions involving students, parents, and local communities to foster environmental stewardship.			Municipal-wide	X	X		Municipal Education Dept. Community leaders, NGOs
10. Health	**Outcome 10:** Climate-resilient health systems, reducing vulnerability to climate-induced disease and health emergencies are established in Busia municipality.						
	Output 10.1: Climate-resilient Health systems created.						
Action 10.1: Upgrade water, sanitation, and hygiene facilities in health centers with climate-resilient infrastructure.			Busia HC IV, Arubaine HC, Mugungu HC II	X	X		Municipal Health Dept. MoH, NGOs
Action 10.2: Equip schools, health centers, and community centers in flood-prone areas with lightning protection systems to prevent weather-related accidents.			Mawero East, Marachi, Mugungu	X	X		Municipal Health Dept. OPM, MoH, NGOs

Result Area	Outcome and Output	Mitigation & adaptation actions	Priority Location	Short -term	Medium -term	Long - term	Responsibility (lead and collaborators)
Action 10.3: Train Village Health Teams and frontline health workers on managing climate-induced health emergencies such as heat stress, cholera outbreaks, and vector-borne diseases.			Municipal-wide	X	X		Municipal Health Dept. MoH, NGOs
Action 10.4: Establish climate-informed early warning and response systems to monitor and control outbreaks of diseases like malaria, cholera, and respiratory illnesses.			Municipal HQ and divisions		X	X	Municipal Health Dept. MoH, NGOs
Action 10.5: Conduct education sessions on climate-related health risks, preventive measures, and the importance of clean water and sanitation.			Municipal-wide	X			Municipal Health Dept. NGOs, Community leaders
Action 10.6: Develop disaster response plans for climate emergencies (floods, heatwaves) with community involvement and ensure availability of first aid and medical supplies.			Municipal-wide		X	X	Municipal Health Dept. OPM, NGOs

4.3 Implementation Arrangements

4.3.1 Overall Coordination framework

Implementation of the CBMCAP will be overseen by Busia Municipal Council, with leadership provided by the Town Clerk as the accounting officer and overall coordinator. The Town Clerk will chair the Municipal Climate Action Steering Committee, which will comprise heads of technical departments (Engineering, Environment, Health, Education, Community Development, Agriculture, Trade, Physical Planning, and ICT).

The Municipal Climate Change Focal Person (Environment Officer) will act as the secretariat for the plan, ensuring integration of actions into municipal budgets, annual work plans, and procurement plans. This office will also be responsible for consolidating progress reports from divisions, coordinating monitoring and evaluation, and ensuring alignment with national frameworks (including the National Climate Change Policy, NDCs, SDGs, and the Parish Development Model).

Development partners, UN agencies, and CSOs working in Busia will engage through formal memoranda of understanding with the Municipality, aligning their projects to CCAP priorities. Regular quarterly review meetings will ensure coordination across all stakeholders.

4.3.2 Division-Level Coordination

At the division level (Eastern Division, Western Division, and Central Division), Division Climate Action Committees will be established, chaired by the Division Town Agents and supported by Community Development Officers (CDOs).
Their key roles will include:

1. Translating municipal-wide climate actions into community-level interventions (e.g., waste management, tree planting, rainwater harvesting).
2. Supervising Community Climate Action Committees (CCACs) at parish and cell levels to ensure community participation.
3. Collecting local data on climate risks and adaptation progress, and feeding it into municipal M&E systems.
4. Mobilizing communities for awareness, training, and implementation of adaptation and mitigation projects (e.g., briquette making, kitchen gardens, early warning systems).

4.3.3 Roles of stakeholders

The stakeholder in the implementation of the climate action plan includes government institutions, non-governmental organizations, community groups, academic institutions, and private sector actors. Each stakeholder will play a unique role ranging from leadership, policy formulation, enforcement, technical support, and funding, to community mobilization, education, innovation, and public awareness. This multi-stakeholder approach will ensure inclusive, participatory, and effective climate action by leveraging diverse expertise, resources, and community knowledge.

Table 12: Roles of stakeholders

Stakeholders	Roles and Responsibilities
Busia Municipal Council (Mayor & Council Committees)	Provide political oversight and policy direction; approve CCAP activities and budgets; mobilize political will and accountability for implementation.
Town Clerk	Overall coordination and management of CCAP implementation; chair the Municipal Climate Action Steering Committee; integrate CCAP into workplans and budgets.
Municipal Climate Change Focal Person (Environment Officer)	Lead coordination of climate action; consolidate division reports; ensure alignment with national climate policies; act as secretariat for M&E and reporting.
Municipal Technical Departments	Works: Climate-proof infrastructure (roads, drainage, public buildings, energy). Production and Marketing: Promote CSA, irrigation, agroforestry, urban farming. Physical Planning: Enforce zoning, land use regulations, climate-resilient housing. Community-based services: Mobilize communities, strengthen CCACs, livelihoods. Health: Climate-resilient WASH, lightning arresters, emergency response. Education & Sports: Integrate climate into school curricula, greening schools, eco-clubs. Trade & Commerce: Promote green enterprises, regulate markets and industries. ICT: Develop and manage early warning systems and climate data.
Division-Level Administrators	Translate municipal CCAP into localized actions; establish and guide Division Climate Action Committees; supervise CCACs; mobilize communities; ensure local data collection.
Community Climate Action Committees	Implement community-level adaptation actions (tree planting, waste management, rainwater harvesting); monitor household and local projects; enforce by-laws; feed local knowledge into planning.
Village Health Teams & School Climate Clubs	Act as frontline responders for climate-health issues; support climate awareness, hygiene, and disaster preparedness campaigns in schools and communities.
National Agencies (NEMA, NFA, MWE, MAAIF, MoLHUD)	Provide technical guidance, policy alignment, and enforcement support; co-finance interventions like wetland restoration, CSA inputs, and climate-proof infrastructure.
Development Partners & NGOs (UNDP, UNHCR, FAO, World Vision, Red Cross, CBOs)	Provide technical assistance and funding; pilot innovative adaptation and mitigation projects; support capacity building and community awareness; co-finance infrastructure and livelihoods.
Private Sector (Agro-input dealers, Solar companies, Telecoms, SACCOs, SMEs)	Supply climate-smart technologies (solar, stoves, irrigation); co-finance through PPPs; disseminate early warning via telecom platforms; provide green jobs and enterprise opportunities.
Local Communities (Households, Farmers, Traders, Women & Youth Groups)	Adopt climate-smart practices; participate in data collection, monitoring, and feedback; contribute co-investment (labour, in-kind support, VSLA savings); maintain local adaptation infrastructure.

4.4 Costing of Climate Actions

The table below provides a detailed breakdown of costs to guide planning, investment mobilization, and effective implementation of climate resilience activities.

Table 13: Costing of climate action outputs (in UGX Millions)

Result Areas	Output	2026	2027	2028	2029	2030	Total
				Uganda Shillings			
1. Energy	1.1 Adoption of clean cooking technologies	356.4	366.4	376.4	386.4	396.4	1882
	1.2 Use of solar-powered lighting and productive energy	649.8	650.7	653.3	663.4	674.2	3291.4
	1.3 Energy efficiency	486.2	493.8	497.7	499.7	514.2	2491.6
2. Transportation	2.1 Drainage-enhanced and climate-proofed municipal roads	381.6	393.3	395.5	398.4	399.6	1968.4
	2.2 Non-motorized transport infrastructure	137.5	137.6	137.7	137.8	137.9	688.5
	2.3 Fuel-efficient and low-emission public transport	246.8	246.9	247	247.1	247.2	1235
3. Trade and Industry	3.1 Climate-proofed market infrastructure	342.3	342.4	342.5	342.6	342.7	1712.5
	3.2 Eco-friendly enterprises	214.1	214.2	214.3	214.4	214.5	1071.5
	3.3 Energy-efficient technologies in small-scale industries	136.7	136.8	136.9	137	137.1	684.5
4. Agriculture	4.1 Climate-smart agriculture	368.3	368.4	368.5	368.6	368.7	1842.5
	4.2 Urban farming models	426.9	437.6	448.3	462.5	473.6	2248.9
	4.3 Market linkages for climate-smart agricultural products	324.1	380.3	394.2	414.8	426.8	1940.2
5. Environment	5.1 Waste segregation, collection, and recycling	213.4	313.4	389.4	423.2	487.4	1826.8
	5.2 Critical ecosystem restoration & protection	423.5	473.5	493.5	523.5	523.6	2437.6
	5.3 Rainwater harvesting and safe sanitation facilities	238.7	338.7	378.7	438.7	488.7	1883.5
6. ICT	6.1 Climate and disaster early warning systems	462.2	562.2	582.2	662.2	762.2	3031
	6.2 Community digital literacy training	263.6	363.6	463.6	563.6	663.6	2318
	6.3 ICT integration into planning & governance	242.2	362.2	372.2	482.2	492.2	1951
7. Land & Housing	7.1 Climate-resilient housing	683.2	693.2	718.2	744.8	883.2	3722.6

Result Areas	Output	2026	2027	2028	2029	2030	Total
				Uganda Shillings			
	7.2 Climate risk integration	209.5	247.5	269.5	289.5	299.5	1315.5
	7.3 Green building codes and energy efficiency standards	260.4	289.4	366.4	369.4	410.4	1696
8. Social Development	8.1 Climate action committee formation and training	324.6	434.6	448.6	448.7	448.8	2105.3
	8.2 Alternative livelihood support programs	653.2	693.2	733.2	759.2	773.2	3612
	8.3 Savings and credit groups	470.7	493.5	520.5	560.2	580.3	2625.2
9. Education and Sports	9.1 Greening of schools	312.3	342.3	365.3	385.3	392.3	1797.5
	9.2 Climate change integration into school debates, sports & drama	248.4	264.4	278.4	288.4	298.4	1378
	9.3 Drainage improvement in sports grounds	354.2	364.2	374.2	384.2	394.2	1871
10. Health	10.1 WASH improvement in health centres	428.6	468.6	488.6	498.6	499.6	2384
	10.2 Lightning arresters in health facilities	6245.3	6545.3	6845.3	6945.3	6989.3	33570.5
	10.3 Village Health Teams' capacity strengthening	328.1	428.1	428.2	428.3	428.4	2041.1

Summary of estimated costs

Result Area	Total (UGX Million)
1. Energy	7,665.00
2. Transportation	3,891.90
3. Trade and Industry	3,468.50
4. Agriculture	6,031.60
5. Environment	6,147.90
6. ICT	7,300.00
7. Land & Housing	6,734.10
8. Social Development	8,342.50
9. Education and Sports	5,046.50
10. Health	37,995.60
Grand Total	**92,623.60**

4.5 Resource mobilization

The implementation of the climate action plan will rely on:

1. Municipal budget allocations through annual budgets aligned to the Climate Action Plan
2. Central government transfers and sector conditional grants for environmental, health, and infrastructure projects
3. Development partner contributions through project-based and technical support programs
4. Private sector investments in renewable energy, housing, waste management, and urban agriculture
5. Community contributions in the form of labor, materials, or voluntary services for local initiatives
6. Innovative financing mechanisms such as climate bonds, carbon credit trading, and green funds

Table 14: Funding sources and use

Funding Source	What to Target	Use
Government of Uganda (Public Finance)	District budget & conditional grants (environment, agriculture, WASH, health, education, roads, community dev.); Programme-Based Budgeting (PBB) & climate tagging; Intergovernmental transfers (DDEG, Road Fund, equalization grants); OPM refugee-host windows; Line ministry projects (MWE, MAAIF, MoES, MoH, NEMA/NFA).	Foundational/recurrent items: sensitization, by-laws, seedlings, extension, early warning O&M, lightning arresters, drainage spot fixes.
Development Partners & Multilaterals	UN agencies (UNHCR, FAO, UNDP, UNICEF, WFP, WHO); World Bank/IDA, AfDB, IFAD; bilateral donors (EU, USAID, GIZ/KfW, FCDO, SIDA, Netherlands, JICA).	Capital-heavy/scale-up: flood gauges, EWS, water for production, nurseries, shelters, drainage hotspots, livelihood packages.
Humanitarian & Refugee-Response Windows	CRRF, UNHCR-led appeals, INGO consortia (World Vision, Red Cross, LWF); pooled refugee response plans.	Safe shelters, emergency stocks, EWS dissemination, joint governance, rapid livelihood recovery.
Private Sector & Blended Finance	Telecoms (MTN, Airtel); agro-input dealers, PAYGo solar firms; SACCOs & MFIs; insurers; carbon market developers.	EWS dissemination, stove adoption, solar irrigation, nursery commercialization, livelihood asset bundles, sustained O&M.
Community Contributions	In-kind labour (tree planting, drain cleaning); VSLAs/SACCOs savings; user fees; local revenue earmarks (fines/permits).	Maintenance, minor tools, meeting logistics, part-payment for seedlings, stewardship incentives.
Climate Funds & Innovative Instruments	Green Climate Fund (GCF), Adaptation Fund; GEF small grants; Payment for Ecosystem Services (PES); Results-Based Finance (RBF); impact philanthropy.	Performance-linked restoration, reliable EWS, governance innovations, catalytic grants.

4.6 Mechanism to Disseminate climate information

To ensure that timely, reliable, and actionable climate information reaches decision-makers, communities, and relevant stakeholders to enhance preparedness, resilience, and informed climate action in Busia Municipality, the following climate information sharing channels will be utilized.

4.6.1 Early Warning Systems

1. Automated SMS and Radio Alerts: Bulk SMS platforms and local FM radios will disseminate warnings on extreme weather events (storms, floods, heatwaves).
2. Weather Stations: Installed stations will continuously monitor local conditions, providing real-time updates to municipal authorities and the public.
3. EWS Mobile Application: A municipal EWS app will deliver forecasts, alerts, and safety advice to residents, community leaders, and institutions.

4.6.2 Community-Based Information Channels

1. Community Meetings (Barazas): Local leaders and municipal staff will organize regular community sensitization meetings, especially before and during rainy seasons.
2. Religious and Social Institutions: Information shared through churches, mosques, schools, and social clubs using noticeboards, bulletins, and announcements.
3. Town Council Noticeboards: Climate updates, emergency alerts, and guidance notices posted at municipal and division offices.

4.6.3 ICT and Digital Platforms

Social Media (WhatsApp, Facebook, Twitter): Busia Municipal Council official accounts will broadcast climate-related information, advisories, and risk alerts.
Website and Online Portals: The municipal website will host climate bulletins, advisories, seasonal forecasts, and emergency contact information.

4.6.4 Institutional Networks

Disaster Committees and Focal Persons: Sectoral and divisional DRR committees will cascade climate information to wards, schools, businesses, and local institutions.
Schools and Health Facilities: Climate alerts and preparedness information shared through school clubs and health centers.

4.6.5 Materials

Posters, Brochures, and Flyers: Distributed in marketplaces, health centers, schools, and churches, carrying simplified climate forecasts, preparedness tips, and emergency contacts.
IEC (Information, Education, and Communication) Materials: Targeted messages in local languages for vulnerable groups like women, elderly, and persons with disabilities.

4.6.6 Feedback and Two-Way Communication

The municipality will provide feedback communication mechanism to allow communities to, report local weather observations, hazards, and incidents; ask questions or seek clarifications through hotlines, social media, and EWS app features; and engage in participatory meetings to review the usefulness and clarity of information.

CHAPTER FOUR: MONITORING, EVALUATION, AND LEARNING

5.1 Introduction

Effective implementation of climate action plan requires a strong and inclusive Monitoring, Evaluation, and Learning (MEL) system. The MEL framework will ensure that progress is systematically tracked, outcomes are evaluated, and valuable lessons are documented and integrated into future planning and decision-making processes. The specific objectives of the MEL include:

i. Monitor the progress of actions across all result areas and sectors.
ii. Evaluate the effectiveness and efficiency of interventions.
iii. Identify and share best practices and lessons learned.
iv. Promote community feedback and inclusive learning.
v. Enable evidence-based decision-making for adaptive management

5.2 Institutional Responsibility

To achieve the objectives of the MEL, a coordinated structure has been established, assigning clear roles and responsibilities to key actors at different levels of the municipal system. These actors range from municipal leadership and departmental focal persons to grassroots community representatives, technical experts, and development partners. Each actor plays a distinct and complementary role, contributing to the overall effectiveness, accountability, and responsiveness of climate actions within the municipality.

Table 15: MEL structure and Roles

Level/Actors	Roles and Responsibilities
Municipal Council (Mayor & Council Committees)	• Provide political oversight and approval of M&E reports. • Ensure integration of CCAP indicators into municipal performance management. • Mobilize political will and accountability for climate action.
Climate Action Plan **Steering** Committee (Chaired by Town Clerk/CAO)	• Overall coordination of MEL implementation. • Review quarterly and annual M&E reports. • Mobilize funding and partnerships for M&E activities. • Facilitate inter-departmental collaboration across result areas.
Municipal Climate Change Focal Person (Environment Officer)	• Lead focal person for coordinating M&E data collection and reporting. • Ensure alignment of CCAP M&E with national climate change frameworks (NCCP, NDCs). • Consolidate division reports into municipal-level reports. • Facilitate learning events and adaptive management.
Department Heads (Sector Leads: Engineer, Planner, Agricultural Officer, CDO, Health Officer, Education Officer, ICT Officer)	• Integrate climate actions and indicators into departmental work plans. • Supervise data collection and quality assurance for sector indicators. • Submit periodic sectoral M&E reports to the Environment Officer. • Support learning through joint review meetings.
Division/Sub-County Administrators	• Coordinate community-level M&E activities. • Supervise collection of data by Community Climate Action Committees (CCACs).

Level/Actors	Roles and Responsibilities
	• Ensure feedback from communities is documented and shared upward. • Support accountability at local level.
Community Climate Action Committees (CCACs)	• Collect data at household and community level on adaptation/mitigation actions. • Report on progress of community actions (tree planting, urban farming, waste segregation). • Participate in participatory monitoring (community scorecards, focus group reviews). • Provide community feedback during review forums.
Civil Society & Development Partners (NGOs, UN Agencies, CBOs)	• Provide technical and financial support for MEL activities. • Strengthen capacity in data collection, reporting, and participatory evaluation. • Share lessons and best practices from projects for integration into CAP monitoring. • Support independent evaluations and external learning exchanges.
Private Sector (e.g., Agro-dealers, Telecoms, Energy Providers)	• Provide business-level monitoring data on adoption of clean technologies. • Support co-financing and reporting of private-sector contributions. • Participate in joint reviews to align business operations with climate action goals. • Innovate data systems (e.g., mobile reporting tools).
Community Members (Households, Farmers, Traders, Schools)	• Participate in community data collection (through surveys, FGDs, participatory mapping). • Report progress of household-level adaptation measures. • Provide local knowledge and feedback to inform adaptive planning. • Engage in review meetings and reflection sessions.

5.3 MEL indicators

Indicator Type	Examples
Input Indicators	Number of climate projects funded; staff trained
Output Indicators	Number of trees planted; early warning systems installed
Outcome Indicators	Reduction in flood impacts, increased renewable energy adoption
Impact Indicators	Improved food security, reduced disaster-related losses

5.4 Tools and Approaches

1. Quarterly progress reports
2. Annual review workshops
3. Community scorecards
4. GIS and remote sensing
5. Mobile-based data collection (e.g., KoboToolbox)
6. Before-and-after assessments

5.5 Learning and Feedback Mechanisms

1. Quarterly review meetings at municipal and divisional levels to reflect on progress, challenges, and lessons.
2. Annual Climate Action Learning Forum hosted by the Municipality to disseminate results and share practices with stakeholders.
3. Community scorecards & participatory monitoring to empower local feedback.
4. Digital dashboards & reports (leveraging ICT) for real-time tracking of progress and transparency.
5. Linkages with national MEL systems under the Ministry of Water & Environment to ensure data feeds into national climate reporting (NDCs, SDGs).

5.6 Reporting and communication

6. Regular reports submitted to the Town Clerk and Municipal Council
7. Annual Climate Action Progress Reports shared with stakeholders
8. Dashboards or portals for real-time tracking (to be developed)
9. Public briefings via radio, community meetings, and social media

5.7 Adaptive Management

1. Use MEL findings to revise strategies and reallocate resources
2. Identify underperforming interventions for redesign or discontinuation
3. Integrate climate projections and emerging data to update plans

5.8 Risk Management

Potential implementation risks include limited funding, political interference, climate disasters, and low community participation. Risk mitigation strategies include:

1. Diversified financing and partnerships
2. Strengthening local ownership and participation
3. Institutionalizing climate action in municipal policies
4. Regular scenario planning and adaptive management approaches

Table 16: Climate Action Monitoring, Evaluation, and Learning Framework (2026-2030)

Result Areas	Actions	Indicators	Means of Verification	Baseline (2025)	Target 2026	Target 2027	Target 2028	Target 2029	Target 2030	Responsible Officer
Energy	Install additional solar PV systems	No. of schools, health centers, and markets with functional solar PV systems	Installation records, municipal reports	5	10	15	20	25	30	Municipal Engineer
	Adopt efficient, low-emission cooking stoves	No. of households and institutions using improved stoves	Household surveys, sales records	200	500	1000	1500	2000	2500	Environment Officer
	Install lightning protection systems	No. of critical facilities with lightning arresters	Inspection reports, municipal engineering logs	2	10	20	30	40	50	Municipal Engineer
	Enforce stricter building codes	%age of new buildings meeting code standards	Building permits, compliance reports	10	30	50	70	85	100	Physical Planner
	Promote reflective roofing and tree planting	No. of reflective roofs adopted; trees planted	Inspection reports, environment dept. records	50	150	300	500	700	1000	Environment Officer
	Construct cooling shelters	No. of cooling shelters established	Engineering dept. records, site inspections	0	2	5	7	9	10	Municipal Engineer
Transport	Upgrade drainage infrastructure	Kilometers of roads climate-proofed with drainage	Municipal engineering dept. records	2	5	10	15	20	25	Municipal Engineer
	Develop non-motorized transport infrastructure	Length of walkways and bike lanes constructed (km)	Physical planning reports	0	2	5	8	10	15	Physical Planner
	Pilot low-emission municipal fleet	No. of EVs/low-emission vehicles in municipal fleet	Municipal fleet records	0	2	5	10	15	20	Municipal Engineer
	Conduct road safety and climate risk campaigns	No. of awareness campaigns conducted	Education dept. reports	2	5	10	15	20	25	Community Development Officer
	Establish community transport committees	No. of committees established and active	Committee meeting reports	0	5	10	15	20	25	Community Development Officer
	Enforce vehicle emission standards	% age of cross-border buses/trucks compliant	Inspection records, URA/Traffic police data	5	20	40	60	80	100	Environment Officer
	Upgrade market drainage	No. of markets with improved drainage and sanitation	Market committee reports	1	2	3	4	5	6	Municipal Engineer

Result Areas	Actions	Indicators	Means of Verification	Baseline (2025)	Target 2026	Target 2027	Target 2028	Target 2029	Target 2030	Responsible Officer
Trade & Industry	Promote eco-enterprises	No. of eco-enterprises supported	Trade dept. and NGO records	5	15	30	45	60	75	Commercial Officer
	Support energy-efficient machinery	No. of industries adopting efficient machinery	Industrial survey reports	2	5	10	15	20	25	Commercial Officer
	Enforce fire/building safety	% age of industries/markets compliant with safety codes	Inspection reports	10	30	50	70	85	100	Municipal Engineer
	Develop Municipal Green Business Hub	No. Of green Business Hub established and operational	Municipal trade dept. records	0	1	1	1	1	1	Commercial Officer
Agriculture	Train farmers on CSA	No. of farmers trained on CSA techniques	Training reports, attendance lists	50	200	400	600	800	1000	Agricultural Officer
	Promote urban farming models	No. of urban households adopting farming models	Extension service reports, surveys	20	100	250	400	600	800	Agricultural Officer
	Link farmers to CSA markets	No. of aggregation centers/cold stores established	Market linkage reports	0	2	4	6	8	10	Commercial Officer
	Introduce solar-powered irrigation	No. of small-scale irrigation systems installed	Engineering/agriculture dept. records	0	5	10	20	30	40	Agricultural Officer
	Facilitate access to seedlings	No. of seedlings distributed via nurseries	Seedling distribution records	5000	20000	40000	60000	80000	100000	Environment Officer
Environment	Strengthen waste segregation	% age of households practicing waste segregation	Household survey, municipal waste records	5	20	40	60	80	100	Environment Officer
	Protect wetlands and water bodies	Hectares of wetlands restored/protected	NEMA/NFA reports	50	100	150	200	250	300	Environment Officer
	Expand rainwater harvesting	No. of institutions with functional rainwater harvesting	Inspection reports	10	20	40	60	80	100	Municipal Engineer
	Tree planting along drains	No. of trees planted along drains/riparian zones	Environment dept. records	1000	5000	10000	20000	30000	40000	Environment Officer
	Invest in integrated waste/water mgmt.	Integrated waste/water facilities established	Municipal engineering dept. reports	0	1	2	3	4	5	Municipal Engineer
ICT	Establish early warning systems	No. of communities EWS platforms functional	ICT dept. records, telecom data	0	2	5	8	10	12	ICT Officer
	Develop digital climate info centers	No. of operational digital info centers	ICT dept. records	0	1	2	3	4	5	ICT Officer
	Partner with telecom providers	No. of climate alerts disseminated	Telecom reports	0	1000	5000	10000	20000	30000	ICT Officer

Result Areas	Actions	Indicators	Means of Verification	Baseline (2025)	Target 2026	Target 2027	Target 2028	Target 2029	Target 2030	Responsible Officer
	Equip schools/community hubs with ICT	No. of schools/community hubs with ICT tools	Inspection reports	5	20	40	60	80	100	Education Officer
	Digitalize municipal systems	No. of municipal services digitalized	ICT dept. records	0	2	5	7	10	12	ICT Officer
Land & Housing	Enforce zoning regulations	No. of zoning violations stopped	Municipal planning dept. reports	2	5	10	15	20	25	Physical Planner
	Promote resilient housing designs	No. of resilient houses constructed	Inspection reports	10	50	100	200	300	400	Physical Planner
	Train builders in climate-proof construction	No. of builders trained	Training reports	10	50	100	150	200	250	Municipal Engineer
	Create municipal green buffers	Hectares of green buffer created	Planning dept. records	0	2	5	8	10	12	Environment Officer
	Regularize informal developments	% age of informal settlements integrated in plans	Planning reports	5	20	40	60	80	100	Physical Planner
Social Development	Establish CCACs	No. of CCACs functional	Community Devt. reports	0	5	10	15	20	25	Community Development Officer
	Create alternative green livelihoods	No. of households benefiting from green livelihoods	Community Devt. & NGO reports	20	100	200	400	600	800	Community Development Officer
	Strengthen VHTs	No. of trained and active VHTs	Health dept. reports	20	50	100	150	200	250	Health Officer
	Support VSLA/SACCOs	No. of functional VSLA/SACCO groups	CDO reports	10	30	50	70	90	120	Community Development Officer
	Inclusive awareness campaigns	No. of campaigns conducted	Media reports, Community Devt. dept.	5	15	30	45	60	75	Community Development Officer
	Implement greening in schools	No. of schools with eco-gardens and tree planting	Inspection reports	5	20	40	60	80	100	Education Officer
	Incorporate climate change education	No. of schools with curricula updated	MoES reports	0	5	10	20	30	40	Education Officer

Result Areas	Actions	Indicators	Means of Verification	Baseline (2025)	Target 2026	Target 2027	Target 2028	Target 2029	Target 2030	Responsible Officer
Education & Sports	Train teachers	No. of teachers trained	Training records	10	50	100	150	200	250	Education Officer
	Upgrade sports grounds	No. of climate-proofed sports grounds	Inspection reports	0	2	5	8	10	12	Municipal Engineer
	Promote water-saving & energy efficiency	No. of schools practicing water/energy efficiency	Inspection reports	5	20	40	60	80	100	Education Officer
	Organize climate awareness events	No. of school-based climate awareness events	Education dept. reports	2	10	20	30	40	50	Education Officer
Health	Upgrade WASH in health centers	No. of health centers with climate-resilient WASH	Inspection reports	2	5	10	15	20	25	Health Officer
	Install lightning protection systems	No. of facilities with lightning arresters	Inspection reports	2	10	20	30	40	50	Municipal Engineer
	Train VHTs and health workers	No. of trained frontline health workers	Health dept. training records	20	50	100	150	200	250	Health Officer
	Establish early warning for health	No. of health early warning systems functional	MoH reports	0	2	5	7	10	12	Health Officer
	Conduct climate-health education sessions	No. of households reached with health education	Community health reports	100	500	1000	2000	3000	4000	Health Officer
	Develop disaster response plans	No. of health facilities with response plans	Health dept. reports	0	5	10	15	20	25	Health Officer

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