URBAN CLIMATE RISK PROFILE FOR KAPENGURIA MUNICIPALITY

2026 - 2031

PREPARED BY:

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APPROVAL

CERTIFICATION

I Certify that this Climate Risk Profile has been prepared in accordance with the Climate Change Act of 2016 (as amended in 2023), the National Climate Change Framework Policy (2017) and the National Climate Change Action Plan (NCCAP) 2023 – 2027.

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Signature ..... Date 6/2/2026

MR. KIPTUM YATOR
MUNICIPAL BOARD CHAIR

Signature ..... Date 6/2/2026

HON. ESTHER CHELIMO
COUNTY EXECUTIVE COMMITTEE MEMBER (CECM) LANDS, PHYSICAL PLANNING, HOUSING & URBAN DEVELOPMENT.

Signature ..... Date .....

APPROVED BY

.....

County Executive Committee Minutes No.

COUNTY SECRETARY
COUNTY GOVERNMENT OF WEST POKOT
17 FEB 2026
P. O. Box 222-30600,
KAPENGURIA

.....
Jonathan Siwanyang
County Secretary, West Pokot

17/2/2026
.....
Date:

.....
H.E. Simon Kitalei Kachapin, EGH
Governor, West Pokot County

WEST POKOT COUNTY
GOVERNOR
17 FEB 2026
Sign
P. O. Box 222-30600, KAPENGURIA

17/2/2026
.....
Date:

MESSAGE FROM CECM LAND, HOUSING, PHYSICAL PLANNING AND URBAN DEVELOPMENT

Kapenguria Municipal Climate Risk Profile is a comprehensive blueprint that will guide the Municipality and development partners in the municipality development engagement in the realization of the social- economic transformation of its residents.

Climate change continues to affect land use, infrastructure and settlement patterns across our Municipality. Increasing cases of flooding, drought, soil erosion and land degradation pose serious risks to development, livelihoods and the safety of our communities.

This Climate Risk Profile has been developed to help us better understand these risks and guide informed planning and decision- making. The document highlights key climate hazards, vulnerable areas and priority actions needed to strengthen resilience in land management, physical planning and urban development.

As the Department responsible for Lands and Physical Planning, we are committed to integrating climate risk considerations into development control, land use planning and infrastructure development. This will ensure that future developments are safe, sustainable and responsive to both current and projected climate impacts.

I encourage all stakeholders to use this Climate Risk Profile as a reference tool in planning, implementation and investment decisions. Through coordinated action, we can protect our land resources and build a resilient and sustainable Municipality for present and future generations.

HON. ESTHER CHELIMO LOUKOTUM
CECM -LANDS ,PHYSICAL PLANNING ,HOUSING & URBAN DEVELOPMENT

MESSAGE FROM THE CHAIRMAN, KAPENGURIA MUNICIPALITY BOARD

Management of Cities and Municipalities is placed under Boards by the Urban Areas and Cities Act, which actualizes the provisions of the Kenyan Constitution 2010 under Article 184. The main responsibility of these Boards is to ensure the provision of services within their jurisdiction. To achieve this enormous responsibility, the Boards must envision, strategize and develop key priority actions to leverage the competing scarce resources at their disposal. It is in that spirit that each Board is required to prepare Climate Risk Profile as a critical step towards building a resilient, inclusive and sustainable urban future This document provides a clear understanding of the key climate hazards facing our Municipality, the sectors and populations most at risk and the potential impacts on essential services such as water, energy, transport, health and solid waste management.

The Climate Risk Profile is not merely an assessment tool; it is a strategic guide to inform evidence-based planning, investment and decision-making. It will support the integration of climate considerations into our development planning processes, including the Integrated Development Plan, sectoral strategies and capital investment programs. Importantly, it also strengthens our ability to mobilize partnerships and climate finance to implement priority adaptation and resilience actions.

I commend all stakeholders who contributed to the development of this Profile, including municipal departments, technical experts, community representatives, national agencies and development partners. Their collective input reflects our shared commitment to safeguarding lives, livelihoods and infrastructure against current and future climate risks.

On behalf of the Municipal Board, I reaffirm our commitment to using this Climate Risk Profile as a living document one that will guide proactive action, continuous learning and coordinated responses to climate change. Together, we can build a resilient Municipality that not only withstands climate shocks but also thrives in a changing climate.

MR. DAVID YATOR KIPTUM CHAIRMAN
KAPENGURIA MUNICIPALITY BOARD

MESSAGE FROM THE MANAGER, KAPENGURIA MUNICIPALITY

Kapenguria Municipality, through the Office of the Municipal Manager, wishes to acknowledge with gratitude the immense support of the Kapenguria Municipal Board under the leadership of the Municipal Chair Mr. David Yator and members of the entire board and the staff within the Municipality, led by the Municipal Environmentalist. They supported the preparation of the Kapenguria Municipal Climate Risk Profile by providing technical assistance, assisting with project documents, mobilizing and providing useful insights into the formulation of the document.

Secondly, we recognize the support given to us in this process by the County government of West Pokot in the various departments and agencies, various county administrative structures and all stakeholders who participated in the development of this document. They have been instrumental in mobilizing the community in the stakeholders' workshops, coordinated and contributed to the identification of climate hazards and risks and provided general support for the entire process of developing the Kapenguria Municipal Climate Risk Profile.

Most importantly, I wish to acknowledge the overall support through KUSP II for supporting this process financially and by providing technical support to our staff.

Last but not least, let me thank the esteemed people of Kapenguria Municipality who contributed immensely to the identification of the key hazards for this document. I appreciate everyone for giving this process their time, support and for endorsing the final output. I hope the implementation of this plan will further enhance service provision and improve the quality of life for the residents of Kapenguria Municipality.

DONATO LONGAL
MUNICIPALITY MANAGER.
KAPENGURIA MUNICIPALITY

EXECUTIVE SUMMARY

This report presents the findings of a Rapid Climate Risk Assessment (RCRA) conducted in the three Wards, Siyoi, Mnagei and Kapenguria, which constitutes Kapenguria Municipality. The assessment aims to assess key climate hazards, exposure and vulnerabilities for each ward and propose actionable recommendations to support climate resilience at the local level. The municipality is affected by several hazards, which vary in frequency and intensity.

Kapenguria Municipality is increasingly exposed to climate-related hazards that pose significant risks to public safety, infrastructure, livelihoods and essential services. This Climate Risk Profile was developed through a combination of technical analysis and participatory community engagement across the three wards, ensuring that both data-driven evidence and lived community experiences informed the assessment.

The assessment identified flooding, heat stress, landslides and drought as the primary climate hazards affecting the municipality, while gully erosion was identified as an emerging concern. Flooding is particularly destructive in low-lying areas, where it regularly damages homes, disrupts roads, contaminates water sources, overwhelms sanitation systems and interrupts health and education services. Drought impacts are felt mainly through unreliable water supply, reduced agricultural productivity, livestock losses and food insecurity, driven by increasing rainfall variability, hence absolute water scarcity.

Critical public services and economic assets, including schools, health facilities, markets and transport infrastructure, are frequently located in high-risk zones and are not designed to withstand recurring climate shocks. As a result, climate events trigger cascading impacts across multiple sectors, such as restricted mobility, loss of income, increased disease outbreaks and reduced access to basic services.

Vulnerability within the municipality is shaped by a combination of environmental factors (poor drainage, unstable soils, erosion and aging infrastructure) and social and economic conditions (poverty, insecure land tenure, limited access to services and gender inequality). Vulnerable groups particularly women, youth, persons with disabilities and female-headed households face disproportionate impacts due to limited adaptive capacity, mobility constraints and unequal access to resources and decision-making. Access to safe and reliable water emerged as one of the most critical daily vulnerabilities, exacerbated during both flood and drought conditions. The assessment reveals strong spatial variation in risk and vulnerability across wards and within settlements. Low-lying floodplains, steep slopes and poorly serviced areas are significantly more vulnerable than others. Overall, Kapenguria settlement emerged as the most vulnerable, due to dense development, proximity to flood-prone areas and high exposure of critical infrastructure. Siyoi, while less exposed, shows notable vulnerability in its southern zones where access to services and infrastructure is limited.

The Climate Risk Profile highlights the need for integrated, climate-sensitive planning that goes beyond conventional zoning approaches. Climate risks affect interconnected systems and services, requiring cross- sectoral coordination and targeted interventions that address both physical risks and underlying social vulnerabilities.

Key recommendations include integrating climate risk considerations into all urban planning and infrastructure development, strengthening and retrofitting critical infrastructure, applying resilient design standards for public facilities, addressing indirect and cascading climate impacts and investing in local technical capacity and sustainable maintenance systems. These actions provide a practical foundation for building inclusive, long- term climate resilience in Kapenguria Municipality

LIST OF ACRONYMS

CCA:	Climate Change Adaptation
CCCF:	County Climate Change Fund
CECM:	County Executive Committee Member
CIDP:	County Integrated Development Plan
GIS:	Geographic Information System
IDEP:	Integrated Development Plan
IPCC:	Intergovernmental Panel on Climate Change
KMB:	Kapenguria Municipal Board
KMD:	Kenya Meteorological Department
KUSP II:	Kenya Urban Support Programme II
LPLUDP:	Local Physical Land Use Development Plan
M&E:	Monitoring and Evaluation
MAM:	March-April-May
NAP:	National Adaptation Plan
NCCAP:	National Climate Change Action Plan
NDMA:	National Drought Management Authority
NGO:	Non-Governmental Organizations
NEMA:	National Environment Management Authority
NMT:	Non-Motorized Transport
OND:	October-November-December
RCP:	Representative Concentration Pathway
RCRA:	Rapid Climate Risk Assessment
SSPs:	Socio-Economic Pathways
SMEs:	Small & Medium Enterprises
TWGs:	Technical Working Group
UACA:	Urban Areas and Cities Act
WRA:	Water Resources Authority

CONCEPTS AND DEFINITIONS

The Greenhouse Effect - a natural blanket for our planet. The Sun sends warmth to Earth, and some of it stays trapped by gases in the air (e.g., H2O, CO2, CH4, N2O). Human activities emit (make) more of these gases, making the blanket thicker. This extra warmth makes the Earth heat up: global warming.

Climate Change - long-term changes in the weather because of human activities. This refers to changes over several decades or longer.

Climate Hazards- physical events or trends linked to climate change, such as heat, extreme weather events (e.g., floods and droughts) and sea level rise, that may cause damage and loss.

Climate Risk- the chance of negative consequences for people and nature because of climate issues. Risks happen when climate hazards affect exposed and vulnerable people, communities or systems.

Vulnerability - the likelihood of being negatively affected by climate hazards. This can be influenced by factors like economic status, access to resources, quality of infrastructure, governance, and the ability to adapt to changes.

Exposure - the presence of people, livelihoods, assets, infrastructure, services, etc. in locations that could be adversely affected by hazards. This could include, for example, living on a flood plain, a steep slope, or in a neighborhood with poor drainage.

Risk Reduction - taking actions to make sure bad things related to disasters happen less often and cause less harm. This involves doing things to lower the chances of disasters, making sure we're less vulnerable to them, and being better prepared to handle them when they occur. the goal is to prevent new risks, lessen existing ones, and become more resilient overall.

Adaptation - making changes to cope with the actual or expected changes linked to climate change. It helps us reduce the harm and make the most of any good things that can come from it.

Mitigation & Low Carbon Development - mitigation means taking actions to reduce or absorb the emissions of greenhouse gases that cause climate change. Low-carbon development means finding ways to reduce the gases causing climate change without harming our well-being and economic growth.

Anthropogenic factors – originating due to human activities

Climate Resilience - the ability of people and nature to manage difficult situations caused by climate change. It's about ensuring that physical infrastructure, economic systems and livelihoods, human health, ecosystems, and social systems can function well, even when faced with challenges from the changing climate.

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CHAPTER 1: BACKGROUND INFORMATION

1.1 Background

Climate change poses a growing threat to sustainable development in Kenya, with increasing impacts on water resources, food security, infrastructure, ecosystems and human well-being. These impacts are already being felt at the local level, particularly in municipalities where rapid urbanization, environmental degradation and climate variability intersect. Kapenguria Municipality, the administrative and commercial Centre of West Pokot County, is increasingly exposed to climate-related hazards that threaten development gains and service delivery.

Kapenguria Municipality exhibits complex physical, environmental and socio-economic characteristics. The Municipality experiences relatively high rainfall compared to surrounding lowland areas, yet faces increasing rainfall variability, prolonged dry spells, intense rainfall events, flooding, landslides, soil erosion and gradual temperature increases. These hazards are exacerbated by deforestation in key catchment areas, cultivation on steep slopes, expansion of settlements into environmentally sensitive areas and limited climate-resilient infrastructure.

Urban growth within Kapenguria Municipality has increased pressure on land, water resources, infrastructure and ecosystems. As a result, climate risks are no longer confined to rural or agricultural areas but increasingly affect urban settlements, transport networks, water and sanitation systems, public facilities and local livelihoods. Addressing these risks requires a comprehensive, evidence-based understanding of how climate hazards interact with exposure and vulnerability across the Municipality.

1.2 Kapenguria Municipality Overview

Kapenguria Municipality is located in West Pokot County, Kenya. It serves as the capital and largest urban center of the county, situated northeast of Kitale on the A1 Road. Kapenguria Municipality generally comprises three wards, namely Kapenguria, Mnagei and Siyoi and eight locations, namely Kishaunet, Mnagei, Keringet, Kaibos, Talau, Kaisakat, Kapenguria, Kapkoris and twenty-four sublocations.

The Municipality lies at Latitude 1o 13' 48" North and Longitude of 35o 7' 12" and is 2,300 meters above sea level. It is characterized by a variety of natural features such as the Kamatira forest in the Municipality which serves as a major source of Kotoruk River that supplies water to Kapenguria town. According to the 2019 Kenya Population and Housing Census, Kapenguria Municipality had a population of approximately 96,813 people.

Developing this 2026-2031 climate Risk Profile is important because it will help the municipality understand its main climate hazards, identify who and what is most at risk and plan effective actions to reduce losses, protect lives and infrastructure and support sustainable development.

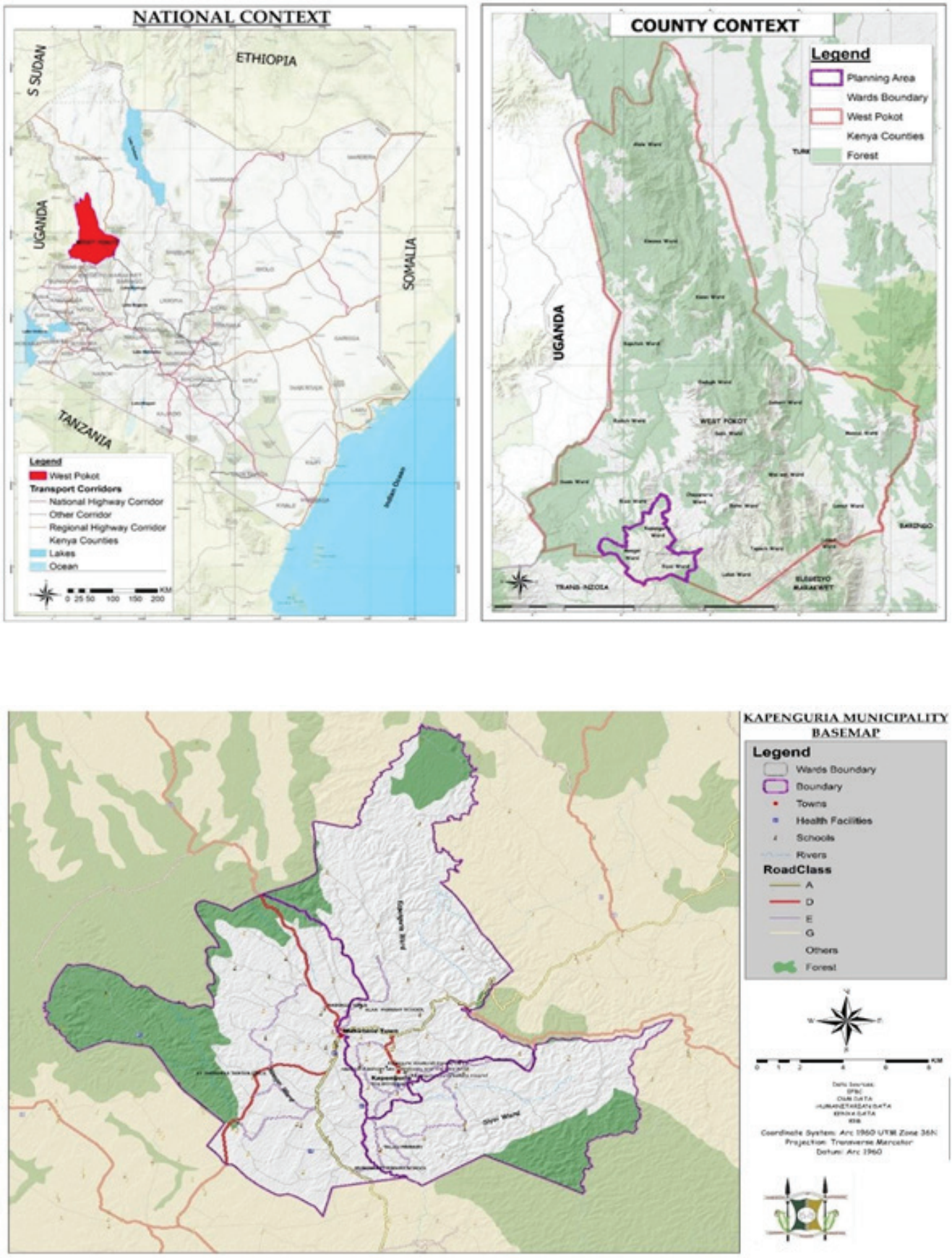


Figure 1: Kapenguria Municipal Base Map

1.3 Purpose and Objectives of the Climate Risk Assessment

The purpose of this Climate Risk Assessment (CRA) is to systematically assess climate-related hazards, exposure, vulnerability and risk across Kapenguria Municipality in order to support climate-resilient planning and decision-making. The CRA provides a municipality-wide analysis that can be used to guide spatial planning, infrastructure investment, disaster risk reduction and climate adaptation initiatives.

The specific objectives of this CRA is to:

- Identify and characterize the main climate hazards affecting Kapenguria Municipality.
- Assess exposure of populations, infrastructure, economic activities and ecosystems to climate hazards.
- Analyze social, economic, environmental and institutional vulnerabilities.
- Determine overall climate risk and identify priority risk hotspots within the Municipality.
- Provide a foundation for integrating climate risk considerations into municipal planning and development processes.

1.3.1 Scope of the Assessment

This Climate Risk Assessment covers the entire geographical area of Kapenguria Municipality. The analysis is conducted at the municipal scale and does not focus on individual settlements or neighborhoods. Instead, it identifies spatial patterns of risk and priority areas of concern within the Municipality based on physical characteristics, land use patterns, infrastructure distribution and environmental conditions.

The CRA focuses primarily on climate change adaptation and resilience. While mitigation considerations are acknowledged where relevant, the emphasis is on reducing vulnerability, managing exposure and enhancing adaptive capacity in line with Kenya's national climate change policy priorities.

1.3.2 Methodology

The methodology followed a multi-scalar and interdisciplinary approach combining secondary data review, historical and projected climate analysis, spatial mapping and extensive field engagement. Community-based participatory workshops and stakeholder interviews ensured that local knowledge and lived experiences informed the analysis.

The CRA methodology is grounded in internationally recognised climate risk assessment frameworks and aligned with Kenya's national climate policy requirements. It integrates qualitative and quantitative information, spatial analysis and planning-oriented interpretation to support climate-resilient development.

Conceptual Framework for Climate Risk Analysis IPCC Climate Risk Framework

The CRA adopts the climate risk definition developed by the Intergovernmental Panel on Climate Change (IPCC), which defines climate risk as a function of three interacting components:

Hazard – the potential occurrence of a climate-related physical event or trend that may cause adverse impacts.

Exposure – the presence of people, assets, infrastructure, livelihoods, or ecosystems in places that could be adversely affected.

Vulnerability – the propensity or predisposition of exposed elements to be adversely affected, influenced by sensitivity and adaptive capacity.

Under this framework, climate risk arises where climate hazards intersect with exposed and vulnerable systems. Reducing climate risk, therefore, requires interventions that address one or more of these components: reducing hazard impacts, limiting exposure or reducing vulnerability while strengthening adaptive capacity.

Application of the Framework at Municipal Scale

At the municipal scale, the CRA focuses on understanding how climate hazards interact with land use patterns, infrastructure distribution, socio-economic conditions and environmental systems within Kapenguria Municipality. Rather than assessing individual households or settlements, the analysis identifies spatial patterns of exposure and vulnerability across the Municipality and highlights priority risk hotspots relevant for planning and decision-making.

Thematic Scope

The CRA focuses primarily on climate change adaptation and resilience. Thematic areas covered include:

- Climate hazards (hydro-meteorological and climate-driven environmental hazards)
- Population and settlement exposure
- Infrastructure and service exposure
- Economic and livelihood exposure
- Environmental and ecosystem exposure
- Social, economic, environmental and institutional vulnerability.

Climate mitigation issues are considered only where

they intersect with adaptation and resilience objectives.

Data Sources and Information Base

The CRA draws on a combination of secondary data, spatial data and planning documents. Given the absence of municipality-specific long-term climate datasets, the assessment adopts a pragmatic approach that integrates available national, county and local-level information.

Climate Data

Climate information used in the CRA includes:

- Historical climate records and summaries from the Kenya Meteorological Department (KMD)
- National and regional climate trend analysesfrom government and development partner reports
- Observed climate variability and hazard occurrence reported in county and sectoral documents

These sources provide information on rainfall patterns, temperature trends and climate variability relevant to the highland and midland zones in which Kapenguria Municipality is located.

Physical and Environmental Data

Physical and environmental analysis draws on:

- Topographic and elevation data
- River and drainage network information
- Land cover and land use data
- Forest and catchment boundary information

These datasets support analysis of flood risk, landslide susceptibility, erosion-prone areas and ecosystem vulnerability.

Socio-Economic and Infrastructure Data

Socio-economic and infrastructure information is drawn from:

- Kapenguria Municipality Local Physical and Land Use Development Plan (LPLUDP) 2024–2034
- West Pokot County Integrated Development Plan (CIDP) 2023–2027
- Sectoral reports on water, sanitation, transport, health, education and housing
- National census and county statistical summaries

These sources provide data on population distribution, settlement patterns, economic activities, infrastructure networks and service provision.

Spatial Analysis and Mapping Approach

Role of Spatial Analysis

Spatial analysis is a central component of the CRA methodology. Climate risks are inherently spatial, as hazards, exposure and vulnerability vary across space. The CRA therefore integrates spatial information to identify patterns of risk and priority areas for intervention.

Key Spatial Layers Considered

The following spatial layers are considered in the analysis:

- Elevation and slope
- River networks and flood-prone areas
- Land use and land cover
- Settlement distribution
- Infrastructure networks (roads, water supply, public facilities)
- Environmentally sensitive areas (forests, riparian zones)
- Soil type

These layers are analysed individually and in combination to identify areas where climate hazards intersect with high exposure and vulnerability.

Identification of Risk Hotspots

Risk hotspots are identified through overlay analysis and expert judgement, focusing on areas where:

- Climate hazards are likely to occur or intensify
- Critical assets and populations are concentrated
- Environmental degradation and socio-economic vulnerability are high

Hazard Identification and Characterizations

Climate hazards relevant to Kapenguria Municipality are identified based on:

- Historical hazard occurrence
- Observed climate trends
- Physical and environmental conditions
- Stakeholder and planning document insights

The assessment focuses on the following hazard categories:

- Prolonged dry spells and drought
- Flooding and flash floods
- Landslides
- Rising temperatures and heat stress
- Ecosystem degradation linked to climate stress (Gully erosion)

Each hazard is analysed in terms of drivers, spatial occurrence and potential impacts.

Exposure Assessment Methodology

Exposure is assessed by identifying the presence of people, assets, infrastructure, livelihoods and ecosystems in areas subject to climate hazards. Exposure analysis considers:

- Population distribution and settlement patterns

- Location of critical infrastructure and services
- Economic activities dependent on climate-sensitive resources
- Environmental assets and ecosystem services

Exposure is analysed qualitatively and spatially, with emphasis on identifying concentrations of exposed assets rather than producing numerical exposure indices.

Vulnerability Assessment Methodology Dimensions of Vulnerability

Vulnerability is assessed across four key dimensions:

- Social vulnerability – poverty, demographics, gender inequality, access to services
- Economic vulnerability – dependence on climate-sensitive livelihoods, income insecurity
- Environmental vulnerability – ecosystem degradation, land and soil condition
- Institutional vulnerability – governance capacity, planning enforcement, access to climate finance

Approach to Vulnerability Analysis

The CRA adopts a narrative-based vulnerability assessment supported by indicative indicators drawn from available data. Given data limitations at the municipal scale, vulnerability is not scored numerically but assessed qualitatively, with emphasis on identifying key drivers of vulnerability and priority areas for intervention.

Climate Risk Analysis and Synthesis

Climate risk is analysed by synthesizing information on hazards, exposure and vulnerability. The assessment identifies:

- High-risk climate hazards
- Spatial risk hotspots
- Key systems and sectors at risk

Risk levels are expressed qualitatively (high, medium, low) to support planning and decision-making without implying false precision.

Limitations and Assumptions

The CRA is subject to several limitations:

- Limited availability of municipality-specific climate data
- Reliance on secondary data sources
- Absence of household-level vulnerability surveys

To address these limitations, the assessment adopts a conservative, planning-oriented approach that emphasizes robustness and relevance over detailed modelling

Use of the CRA for Planning and Decision-Making

The methodology is designed to ensure that CRA outputs are directly usable for:

- Spatial planning and zoning decisions
- Infrastructure design and prioritization
- Disaster risk reduction planning
- Climate adaptation and resilience programming
- Climate finance mobilization

1.4 Governance Structure

The governance structure for Kapenguria Municipality provides the institutional foundation for the development, implementation and integration of the Urban Climate Risk Profile into municipal planning and decision-making processes, particularly the Integrated Development Plan (IDP) and related sectoral plans.

Kapenguria Municipality operates under the County Government of West Pokot, in accordance with the Constitution of Kenya (2010), the Urban Areas and Cities Act (2011) and the County Governments Act (2012). The Municipality is responsible for local service delivery, development control, environmental management and urban resilience-building within its jurisdiction.

Municipal Board

The Municipal Board provides policy oversight and strategic direction for municipal development, including climate resilience initiatives. The Board ensures that climate risk considerations are mainstreamed into municipal plans, budgets and investment decisions.

The Municipal Manager serves as the chief accounting and administrative officer of the Municipality and is responsible for coordinating departments involved in the Urban Climate Risk Profile development and ensuring alignment with county-level planning frameworks.

The Board of the Municipality is responsible for overseeing, evaluating and monitoring the municipality's development and growth.

The Municipality relies on the county government for delegation of functions, budgeting and human resource capacity and its administration is linked to the county government through the CEC member in charge of Lands, Physical Planning, Housing & Urban Development.

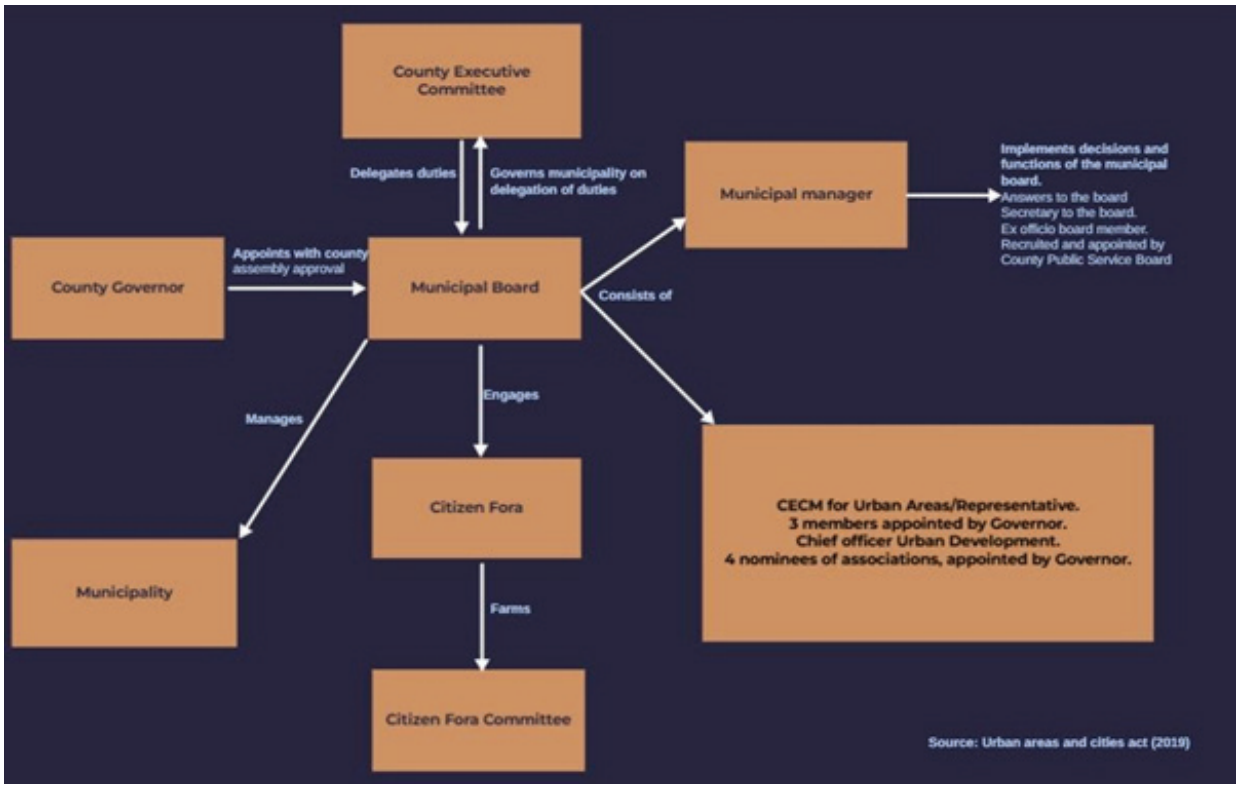


Figure 2: Municipality Organizational Structure in Kenya

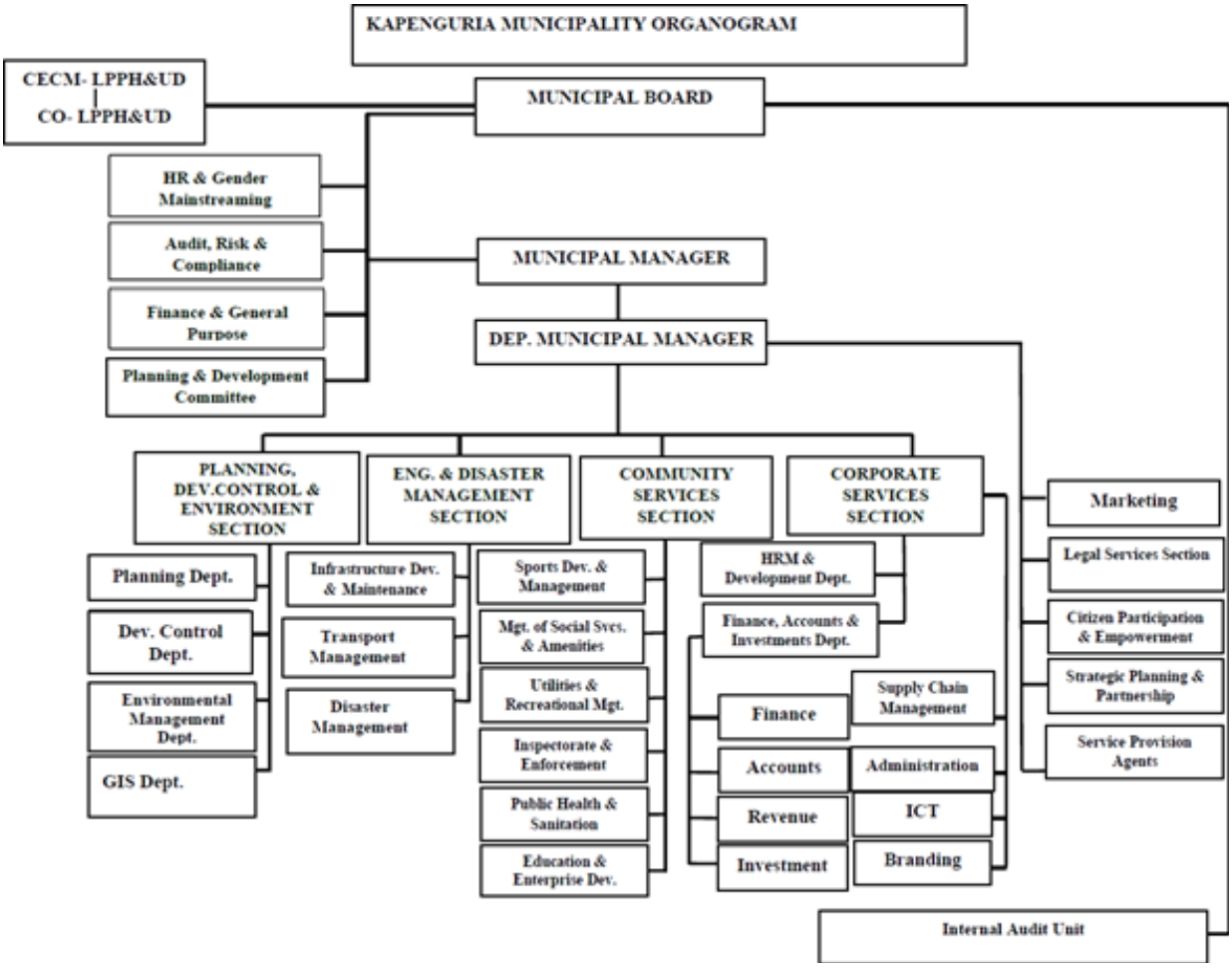


Figure 3: Kapenguria Municipality Organogram

1.4.1 STAKEHOLDERS ENGAGEMENT AND PUBLIC PARTICIPATION

1.4.1.1 Overview

Public stakeholders' consultation and Community participation were organized in phases, including sensitization, Workshops organized, and stakeholders' meetings. (Refer to annexes)

1.4.1.2 Stakeholder Mapping Approach

Stakeholder Influence–Interest Matrix for Kapenguria Municipality

High Influence – High Interest

These stakeholders have both the authority and a strong interest in climate risk management and play a central role in decision-making and implementation.
Engagement approach - Continuous engagement, joint planning and active participation.

High Influence – Low Interest

These stakeholders have decision-making power but may not be directly involved in climate risk activities daily.
Engagement approach - Periodic briefings, policy-level consultations and targeted sensitization.

Low Influence – High Interest

These stakeholders are directly affected by climate risks and have strong interest but limited power to influence decisions.
Engagement approach: Community consultations, focus group discussions, participatory mapping.

Low Influence – Low Interest

These stakeholders have limited direct involvement in climate risk issues.
Engagement approach: General awareness and information sharing.

In Kapenguria Municipality, stakeholder engagement ensures that the Urban Climate Risk Profile is inclusive, accurate and implementable. Mapping stakeholders by influence and interest helps the municipality engage each group appropriately and strengthens climate risk management from planning to implementation.

Table 1: Stakeholders Matrix Table

High Influence – Low Interest • County Executive Committee Members (CEC) • County Treasury and Economic Planning • County Governor	**High Influence – High Interest** • Kapenguria Municipal Board- chairman • Municipal Manager, Kapenguria Municipality • County Department of Environment and Climate Change • County Department of Physical Planning and Urban Development • County Disaster Risk Management Unit, health, fire • Department of environment, municipality • KEWASES • Health • Agriculture
Low Influence – Low Interest • General public not directly affected by priority hazards-Kamuino residents • Institutions with minimal interaction with climate-sensitive sectors - IREP Foundation	**Low Influence – High Interest** • Residents of flood-prone and water-stressed wards: Siyoi, Mnagei and Kapenguria ward • Informal settlement residents - Mathare and Aramaket slums • Farmers, livestock keepers, traders and small business owners • Women, youth, elderly persons and persons with disabilities • Community-based organizations (CBOs) and local NGOs - Ripple Effect

1.4.2 Technical Coordination for the Urban Climate Risk Profile

The development of the Urban Climate Risk Profile is coordinated through a Municipal Technical Working Group (TWG), constituted by officers drawn from relevant municipal sections Environmental department taking the lead and county departments. The TWG was responsible for:

- Coordinating data collection and validation
- Identifying and prioritizing climate hazards
- Undertaking risk and vulnerability analysis
- Reviewing technical outputs such as hazard maps and risk matrices
- Ensuring consistency with the Kapenguria Integrated Development Plan (IDP) and Spatial Plan

Key Departments and Units Involved are;

1. Department of Environment, Climate Change and Natural Resources

- Lead technical department for climate risk assessment
- Coordinates climate data, vulnerability analysis and adaptation measures
- Liaises with national agencies such as NEMA and the Kenya Meteorological Department (KMD)

2. Department of Physical Planning, Lands and Urban Development

- Provides spatial data and planning frameworks
- Integrates climate risk findings into land use plans, zoning and development control
- Supports hazard mapping and spatial risk analysis using GIS

3. GIS Department

The Geographic Information Systems (GIS) Department plays a critical technical role in the development of a Municipal Climate Risk Profile by providing spatial analysis, mapping and data integration required to identify, assess and communicate climate-related risks within the urban area. GIS enables evidence-based planning by translating climate hazards, exposure and vulnerability data into actionable spatial information.

- Spatial Data Management and Integration.
- Climate Hazard Mapping
- Exposure Analysis
- Vulnerability and Sensitivity Mapping.
- Risk Profiling and Hotspot Identification
- Support to Climate Risk Prioritization and Decision-Making
- Integration with Municipal Planning Instruments
- Monitoring, Reporting and Updates
- Stakeholder Communication and Visualization
- Data Sharing and Institutional Coordination

4. Department of Roads, Transport and Public Works

- Assesses climate risks to infrastructure such as roads, drainage systems and public facilities
- Identifies infrastructure adaptation and resilience measures

5. Department of Water

- Leads assessment of climate hazards related to flooding, drought, water scarcity and sanitation
- Supports identification of priority adaptation interventions in water and sanitation services

6. Department of Public Health Services

- Assesses climate-sensitive health risks, including airborne, waterborne and heat-related illnesses
- Integrates climate risk considerations into public health planning and emergency response

7. Department of Disaster Risk Management and Emergency Services

- Coordinates preparedness, response and early warning mechanisms
- Uses climate risk outputs to strengthen disaster risk reduction strategies

8. Department of Agriculture

- Crop development and management
- Irrigation and drainage infrastructure
- Livestock productivity and resilience
- Livestock disease management and control

9. Finance and Economic Planning Unit

- Supports costing of adaptation actions
- Facilitates integration of climate priorities into municipal budgeting and resource mobilization.

1.4.3 Stakeholder engagement and vertical coordination

The governance structure emphasizes vertical coordination between the Municipality, West Pokot County Government and relevant national institutions (e.g. KMD, NEMA, Water Resources Authority). Horizontal coordination is achieved through inter-departmental collaboration at the municipal level. Community representatives, civil society organizations, private sector actors and vulnerable groups are engaged through stakeholder consultations and public

participation forums, ensuring that local knowledge and priorities inform the climate risk profile.

1.5 PHYSIOGRAPHY

1.5.1 Overview

This section explores the natural resource base and climatic conditions of Kapenguria Municipality and its surrounding areas, with a focus on supporting development and addressing existing challenges.

1.5.2 Topography

Kapenguria Municipality falls within the Cherangani Hills, which forms part of the greater Rift valley. Its diverse topography includes hills such as Kopoch Hills,

Chemwochoi and Kamatira Hills, as well as rocky outcrops. Steep-sides hills (see cross section in (plate 1) serve as catchment for the rivers such as the Suam River which is a key watercourse that feeds into the Turkwel Dam before discharging into Lake Turkana. The municipality is located between 2487 and 1388 meters above sea level.(Figure 4)

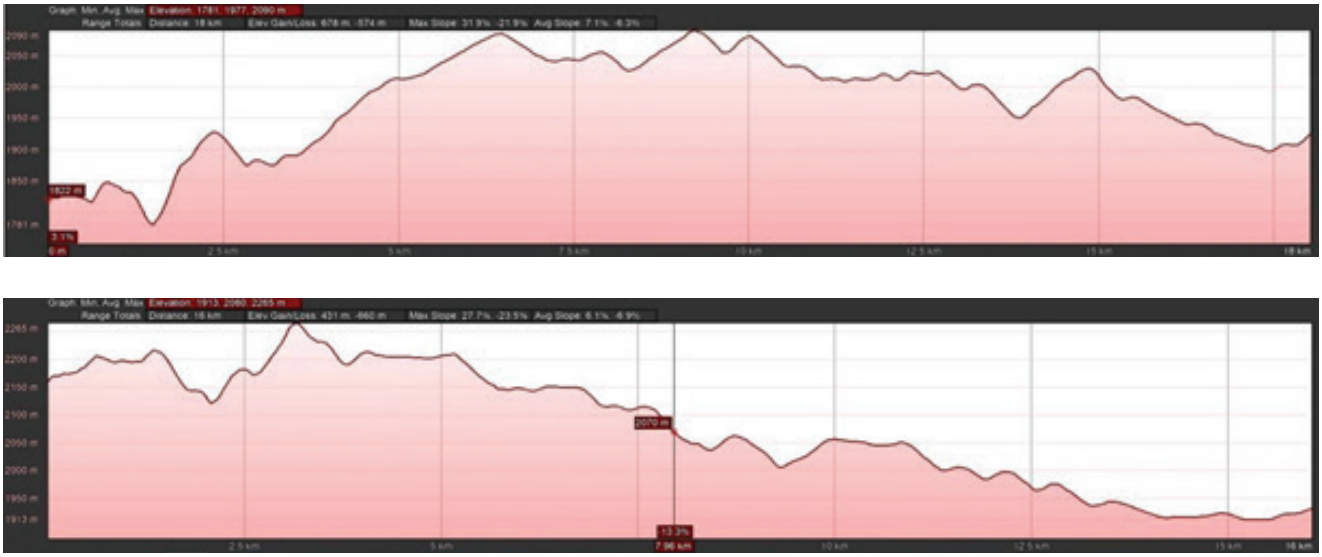


Plate 1: Cross sections (1) A-A (2) B-B

1.5.3 Slope

Kapenguria municipality is formed by varied topography with slope ranging from gentle to steep terrain. The municipality lies within a hilly region, with slopes primarily influenced by Cherangany Hills. The highest point is at 76% slope, see Figure 4. This slope affects land us patterns, with steeper areas being unsuitable for intensive agriculture or urban development due to soil erosion and soil instability, see Table 2: Slope.

Table 2 : Slope

Slope	Description	Agriculture	Urban development	Infrastructure
Slight	Optimum	0-6%	0-6%	0-6%
Moderate	Satisfactory	6-12%	6-12%	6-12%
Severe	Marginal	12-50%	12-50%	12-50%
Very Severe	Unsatisfactory	Above 50%	Above 50%	Above 50%

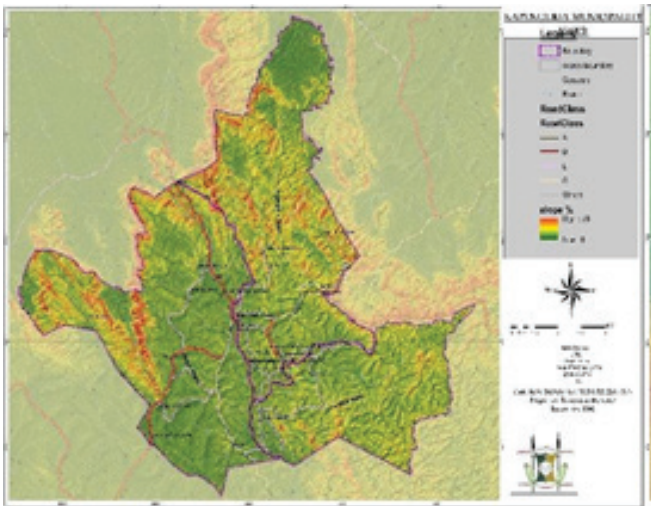
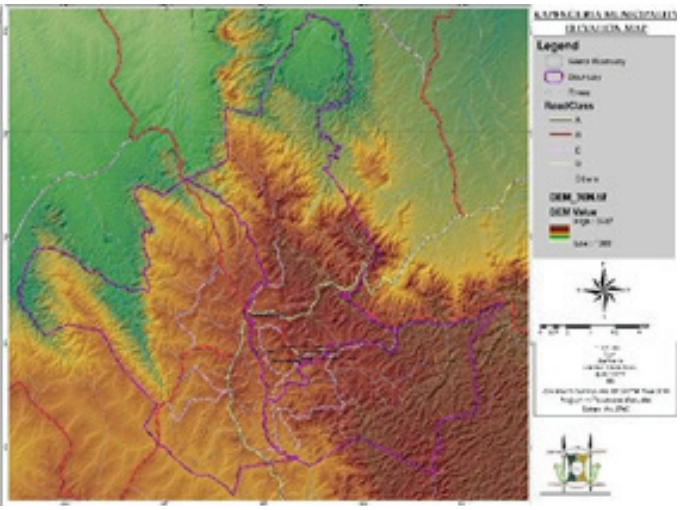


Figure 4: Slope Map



Elevation Map

1.5.4 Geological and Soil Characteristics

Kapenguria Municipality is dominated by Precambrian basement rocks, with some sedimentary layers. These basement rocks are covered by a thin layer of loam soil and pebble-sized angular quartzites. The primary rocks include highly fractured and jointed quartzite gneisses and biotite gneisses, which can lead to structural instability in steep areas and present challenges for building construction and infrastructure development. The soil cover primarily consists of loams and pebbly quartzites. However, the soils along the riparian reserves are clay-based and unsuitable for development due to their proximity to watercourses.

1.5.5 Landcover

Kapenguria Municipality is characterized by diverse land cover, see Figure 5. The area is dominated by agricultural land, which includes small-scale farms for subsistence and cash crop farming, see Table 3. Forested areas include areas around the Cherangani Hills which play a vital role in water catchment and biodiversity conservation. Urban development has been expanding, with residential, commercial and industrial areas increasingly encroaching on agricultural lands. Other land cover types include rivers, which support ecological balance and provide essential ecosystem services.

Table 3: Land Cover

Land cover	Bare land	Built-up	Farmland	Forest
%	6.7	3.4	74.7	15.3

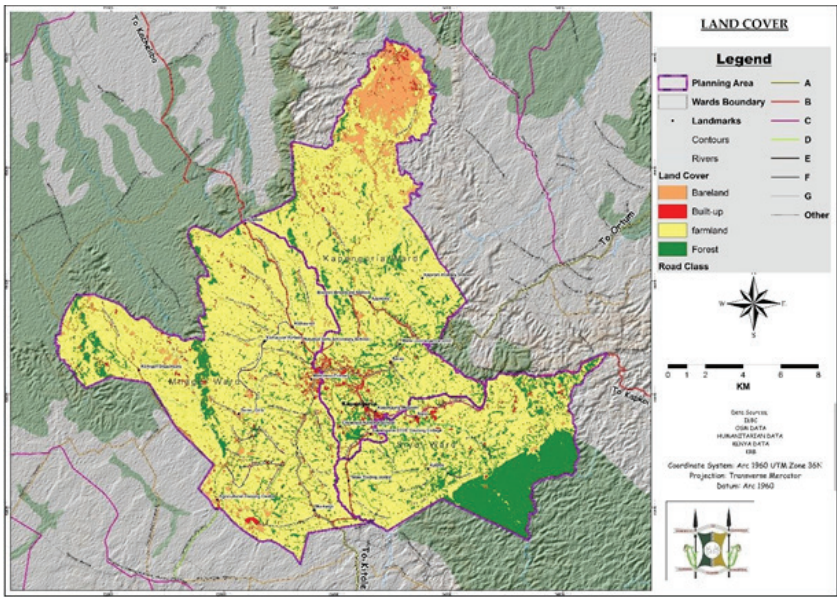


Figure 5: Land Cover

1.6 Climatic Conditions

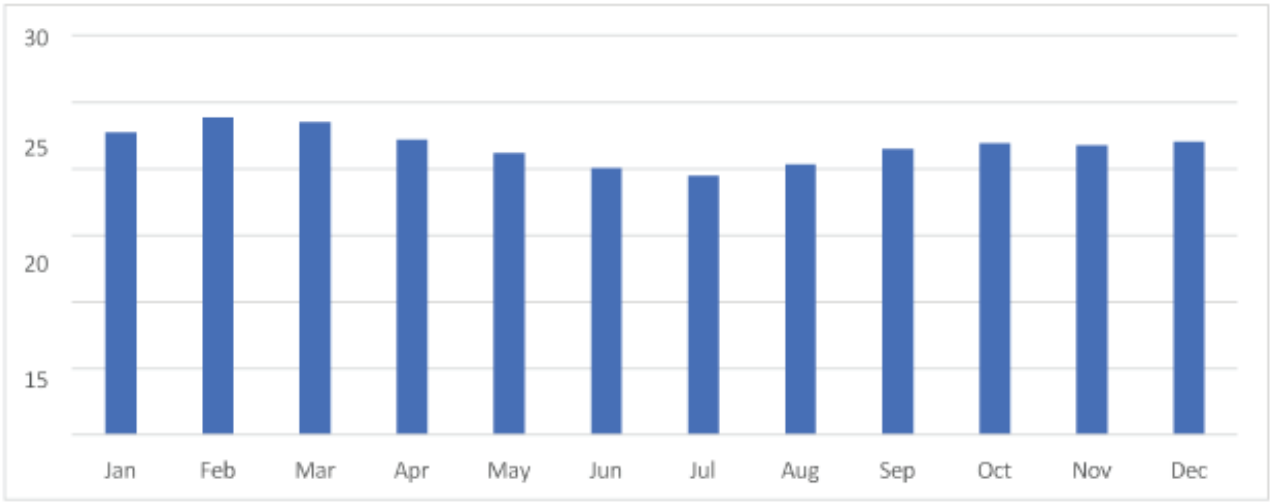
1.6.1 Rainfall

Kapenguria Municipality receives an average annual rainfall of 1,500 mm, in contrast to the typical bimodal pattern of West Pokot County. The peak of the long rains is expected from March to May and the short rains occur from October to December. January experiences the least rainfall, averaging 21 mm, while May receives the highest, with an average of 171 mm.

1.6.2 Temperature

Kapenguria has a Tropical wet and dry or savanna climate. It has a warm, temperate climate, primarily influenced by its elevated location. The average annual temperature is 21.66°C, while maximum and minimum temperatures are 26°C and 11°C, respectively, see Figure 6. February to March is the warmest month with an average temperature of 23.66°C, while July is the coldest (19.44°C). The moderate temperatures create favorable conditions for agricultural activities in the surrounding highlands.

Figure 6: Average Temperatures per month



1.6.3 Sunshine and Solar Radiation

Kapenguria benefits from year-round sunshine, averaging 10 hours per day. The ample sunshine presents a significant opportunity for harnessing solar energy for street lighting and domestic use.

1.6.4 Wind Run

Kapenguria experiences an average annual wind run of 196 km per day, which decreases with increasing altitude. Despite this slight decrease, the wind resource remains suitable for potential wind energy generation, particularly at locations like the peak of Kapkoris Hills.

1.6.5 Environment

Kapenguria Municipality is bordered by temperate rainforest, including Kamatira and Cherangany, which are increasingly threatened by human encroachment. Kamatira Forest, primarily covered by pine trees, is particularly at risk, as pine is an endangered species. Cherangany Forest is home to giant cedar, podo and other indigenous tree species, while Kamatira Forest is primarily composed of pines, cypress, eucalyptus and a limited number of indigenous trees.

Field survey identified several factors negatively impacting the environment in the area. The most significant factor was the cutting down of trees for charcoal, firewood and timber, which poses a major threat to forest ecosystems. This was followed by sewage pollution, mainly from the use of pit latrines which accounted for 27% of the reported environmental issues. Other factors included solid waste mismanagement, pesticide use, mining activities, household waste and automobile exhaust, see Figure 7.

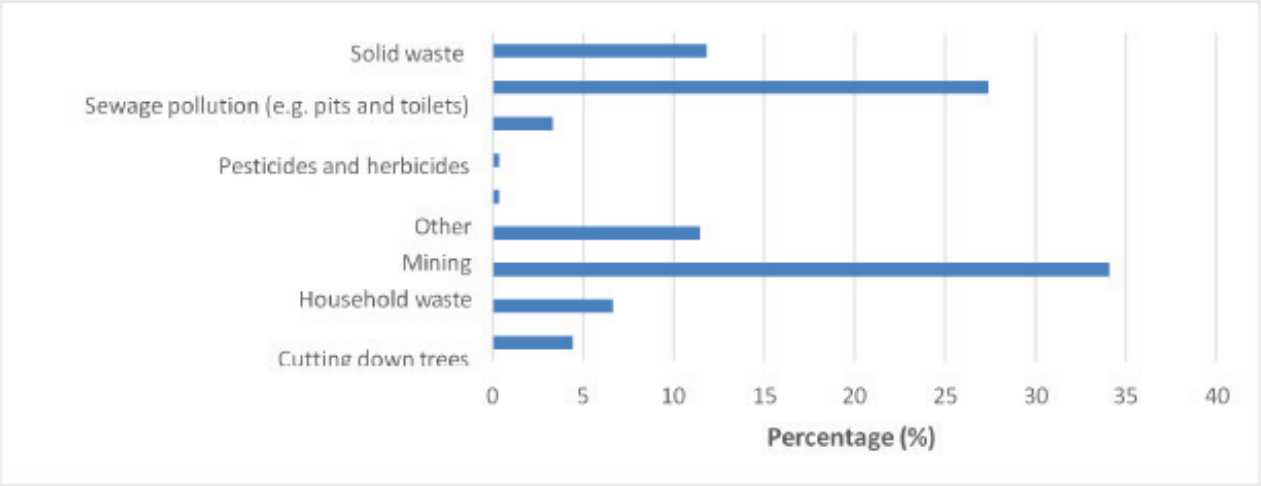


Figure 7: Environmental Issues

1.6.6 Hydrology and Drainage Systems

Kapenguria Municipality is characterized by a diverse hydrological feature, including rivers, streams, dry valley (collecting storm water or runoff) and groundwater sources The region has two perennial rivers: Kapenguria and Kotoruk. Kapenguria River flows southward joining the Nzoia River, while the Kotoruk River flows southwest, then to northward to merge with the Suam River.The Muruny River and Siyoi are also vital water source, supporting the Muruny Water Supply Project which is intended to provide clean water to the municipality and surrounding areas. Streams include: Cereal, Chewoyet, Kaprech and Kaibos, feed into these two rivers.

The municipality's hydrological system faces several challenges including:

- Pollution of rivers impacts water intake at the water supply station.
- In the Cherangany Hills and Kamatira forest, deforestation reduces groundwater recharge, increases surface runoff, accelerates soil erosion and leads to river sedimentation.
- Agricultural runoff and pesticide use contaminate water sources, particularly those used for domestic purposes.
- The seasonal nature of many rivers, coupled with erratic rainfall patterns, results in periodic water shortages, especially during dry spells.

1.6.7 Agro-Ecological Zones

Kapenguria Municipality falls within the Upper Highland, Lower Highland, and Lower Midland agroecological zones, each zone offering distinct conditions for agricultural activities.The Lower Highland Zone, found in areas around Kaibos, Kapkoris, Kaprom and Karas and Talau, is characterized by cooler temperatures and high rainfall. The zone supports crops such as tea, pyrethrum and maize alongside dairy.

The Upper Midland Zone features moderate temperatures and rainfall, making it suitable for maize, beans and horticultural crops(sunflower) and livestock. This zone is located in regions around Keringet, Tartar, Murkwijit and Talau. In contrast, the Lower Midland Zone is located around Longonot Dispensary and experiences warmer temperatures and relatively lower rainfall.

These zones provide favorable conditions for mixed farming, though challenges such as soil erosion on steeper slopes and inconsistent rainfall patterns indicate the need for sustainable land management practices to enhance productivity and mitigate environmental degradation.

1.6.8 Emerging issues

- Steep slopes limit development due to soil erosion and instability, increasing infrastructure costs.
- Fractured rocks and thin soil cover pose construction challenges
- Deforestation in Cherangany Hills and Kamatira Forest, driven by illegal logging, threatens biodiversity and water quality.
- Seasonal rivers and erratic rainfall lead to water shortages.
- Irregular rainfall patterns impact water availability and agricultural productivity.
- Urbanization and agriculture encroach on natural and agricultural lands, disrupting the environment and land cover.
- Soil erosion and inconsistent rainfall in agricultural zones reduce crop productivity.
- Pollution from human activities degrades water quality.

1.7 POPULATION AND DEMOGRAPHIC DYNAMICS

1.7.1. Overview

Understanding the population size, composition, trends, socio-economic profile and spatial distribution is crucial for preparing the Kapenguria Municipality Climate Risk Profile. Demographic analysis not only provides insights into population dynamics but also helps identify future growth patterns and inform infrastructure planning.

1.7.2 Population Size and Distribution

Kapenguria Municipality has witnessed population growth since its establishment as an urban center in 1907. According to the 2019 census, the municipality's population was 96,813 compared to 82,057 in 2009 and 13,000 in the year 1999. Despite this growth, much of the population is still considered rural in character.

Kapenguria ward has the highest population, followed by Mnagei ward. Siyoi ward has the least number of populations (Map, population per ward)

In terms of locality, Kapengeria location has the highest population of 19,847, Kishaunet location has 19,105, while Keringet location has the least population of 4,014. (Population by location)

Table 4: Kapenguria Municipality Locality Population (Source: KNBS, 2019)

Locality	Male	Female	Total	No. of Household
Chemwochoi	2,928	3,113	6,041	859
Kaibos	2,739	2,246	4,985	954
Kaisakat	4,867	4,663	9,530	1760
Kapenguria	9,794	10,053	19,847	4,933
Kapkoris	6,848	6,987	13,751	3,028
Keringet	1,981	2,033	4,014	819
Kishaunet	9,538	9,567	19,105	4,141
Mnagei	9,076	9,169	18,245	3,243
Talau	3,250	3,139	6,389	1,185
TOTAL	**51,021**	**50,970**	**96,813**	**20,922**

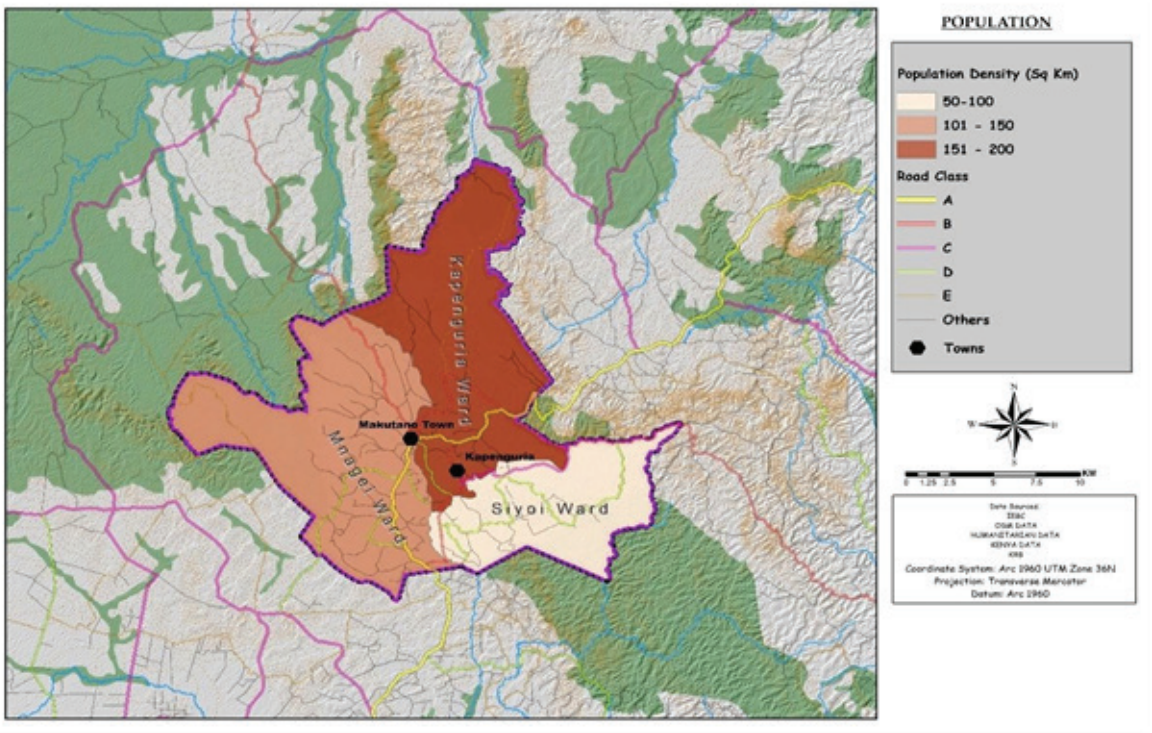


Figure 8: Population Density

1.8 Population Projection

Using a growth rate of 2.22%, the municipality's population is projected to reach 144,923 in 2035. Table 5 and Table 6 show the population projection by location and age group, respectively.

Table 5: Projection by Location

	2019			2035		
Locality	Male	Female	Total	Male	Female	Total
Chemwochoi	2,928	3,113	6,041	4,160	4,423	8,584
Kaibos	2,739	2,246	4,985	3,892	3,191	7,083
Kaisakat	4,867	4,663	9,530	6,916	6,626	13,542
Kapenguria	9,794	10,053	19,847	13,917	14,285	28,201
Kapkoris	6,848	6,987	13,751	9,731	9,928	19,659
Keringet	1,981	2,033	4,014	2,815	2,889	5,704
Kishaunet	9,538	9,567	19,105	13,553	13,594	27,147
Mnagei	9,076	9,169	18,245	12,896	13,029	25,925
Talau	3,250	3,139	6,389	4,618	4,460	9,078
TOTAL	**51,021**	**50,970**	**101,907**	**72,497**	**72,425**	**144,923**

Table 6: Population projection by Age group

	2019			2035		
Age group	Male	Female	Total	Male	Female	Total
0 – 4	5183	5287	10470	7365	7512	14878
5 – 9	4840	4937	9777	6878	7015	13893
10 -14	4431	4519	8950	6296	6421	12717
15-19	3424	3492	6916	4865	4962	9827
20-24	2631	2684	5315	3739	3814	7552
25-29	2193	2237	4430	3116	3178	6294
30-34	1868	1906	3774	2655	2708	5363
35-39	1197	1221	2417	1700	1734	3435
40-44	1020	1040	2060	1449	1478	2927
45-49	934	953	1887	1328	1354	2682
50-54	591	603	1194	840	857	1696
55-59	445	453	898	632	644	1276
60-64	393	401	795	559	570	1129
65-69	288	294	582	409	417	827
70-74	230	235	465	327	334	661
75-79	102	104	206	145	148	292
80-84	61	62	123	86	88	175
85-89	29	29	58	41	42	82
90-94	11	12	23	16	17	33
95-99	6	6	12	8	8	17
100+	5	5	10	7	7	14

1.9 Settlement Patterns and Vulnerable Groups

The municipality contains a mix of formal and informal settlements. Some households, particularly low-income groups, are located in areas with limited infrastructure and services.

Key vulnerable groups within Kapenguria Municipality include:

- Children and elderly persons
- Low-income households
- Residents of informal and poorly serviced settlements

These groups often have limited capacity to cope with climate impacts such as floods, water shortages and heat-related illnesses.

1.10 Economic Activities and Livelihoods

1.10.1 Overview of the Local Economy

Kapenguria Municipality functions as a service and commercial hub for West Pokot County. Key economic activities include:

- Trade and commerce
- Public administration and services
- Small-scale manufacturing and informal enterprises
- Agriculture and livestock production in peri-urban areas

The local economy is closely linked to climate-sensitive sectors, particularly agriculture and natural resource-based livelihoods.

1.10.2 Agriculture and Livestock

Agriculture remains an important livelihood activity, particularly in peri-urban and surrounding rural areas. Crop production and livestock keeping are largely rain-fed, making them highly sensitive to rainfall variability, dry spells and extreme weather events.

Climate hazards such as drought, flooding and erosion directly affect agricultural productivity, food security and household incomes.

1.10.3 Informal Sector

The informal sector plays a critical role in employment and income generation. Informal enterprises are often highly vulnerable to climate shocks due to:

- Limited capital and savings
- Exposure to weather extremes
- Lack of insurance and social protection
- Disruptions caused by flooding or prolonged dry spells can have immediate and severe impacts on livelihoods.

1.10.4 Infrastructure and Basic Services

1.10.4.1 Transport Infrastructure

Kapenguria Municipality is served by a network of roads connecting it to other parts of West Pokot County and neighboring regions. While the main roads are relatively well established, many secondary and access roads are unpaved and vulnerable to damage from flooding, erosion and landslides.

Effective transportation networks are vital for regional development. They facilitate the efficient movement of people and goods, which is essential for economic growth and effective governance. As Kenya aims for rapid socio-economic development under Vision 2030, it is anticipated that transportation demands will increase significantly, potentially growing by three to four times over the next two decades. Climate impacts on transport infrastructure disrupt mobility, access to markets and delivery of essential services leading disruptions of services.

Plate 2 : Left_Is the Status of roads in Bendera Town. Right_ is a road in Makutano town lacking other road elements.

The Municipality lacks a bypass despite being located along the major A1 international road. In peri- urban areas, most roads are unclassified murram roads, see Plate 4 that are impassable during the rainy season. Additionally, road encroachments have reduced their capacity and further influenced accessibility.

Plate 3: Left - Paraywa-Lotepa Road in Stotwo village. Right - road to Takar village

Plate 4: Right - Siyoi ward kapchila kapkecha bridge. Left - Murkwijit - Kamorou/Meshach tumkou

1.11 Water Supply and Sanitation

Water supply systems in Kapenguria Municipality depend on surface water sources, springs and boreholes. These systems are vulnerable to:

- Reduced flows during dry spells
- Contamination during floods
- Damage to infrastructure from erosion and landslides

Sanitation facilities, particularly in informal settlements, are often inadequate and highly vulnerable to flooding, increasing public health risks.

The municipality currently lacks a water reticulation plan, resulting in limited water coverage, which stands at only 30%. The monthly water supply capacity is 14,421m³, which is below the estimated monthly. While main piping is complete in some areas, incomplete distribution lines hinder last-mile implementation and customer connections.

1.11.1 Water Sources

The household survey shows disparities in access to water sources within the region. A majority of households, 53% (see Figure 9), rely on rivers and streams for their domestic water needs, indicating a heavy dependence on natural, untreated water sources (see Plate 5. 25% of households use boreholes and wells and only 14% of households have access to piped water, with connections primarily concentrated in the town center. This limited access to piped water suggests underdeveloped water infrastructure, particularly in rural and peri-urban areas.

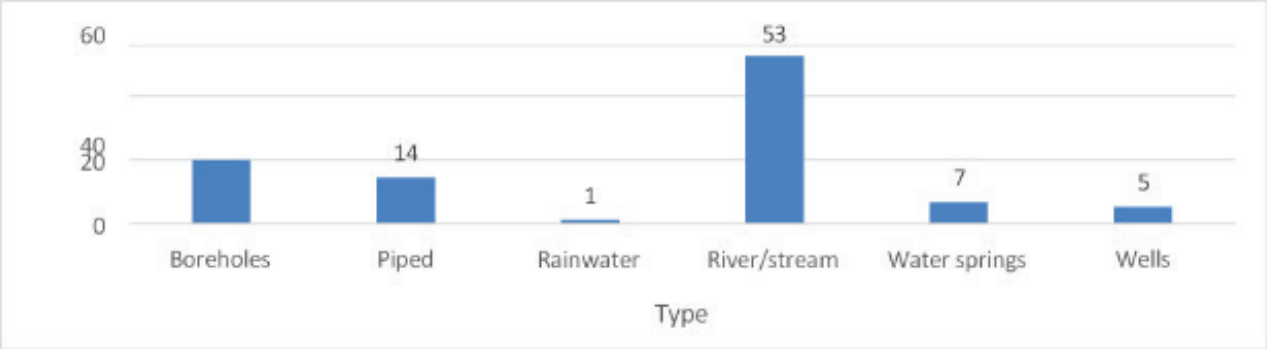


Figure 9: Sources of water

Plate 5: One of the water sources for the households. To the right a water source where the community of Keringet and Kangulikwan gets water.

1.11.2 Existing water supply systems

Existing water supply system in Kapenguria municipality include; Kapenguria water supply scheme (public), Tartar water supply scheme, Makutano water supply scheme and Karas water supply scheme. Below are explained water supply systems with their capacity.

1.11.3 Makutano Water Supply

The Makutano Water Supply system, constructed in 1972, serves both Makutano and parts of Kapenguria Municipality. The water intake is located at River Kotoruk and the system has a design capacity of 432 m^3/day, though it currently produces 200 m^3/day. Raw water is pumped from the river to a treatment plant near the intake and the treated water is stored in a 90 m^3 tank at Makutano. A small branch line also serves Kishaunet Centre and Nasokol Girls' Primary and Secondary Schools. The service area covers about 2 km^2.

1.11.4 Kapenguria water supply

Kapenguria River is the primary source of water for the municipality. The water supply scheme, established in the 1950s, covers an area of approximately 3 km^2. Raw water is drawn from the river and pumped 1.1 km to the main treatment plant. The current production is 167 m^3/day, just under the system's design capacity of 360 m^3/day. The treated water is then pumped into elevated storage tanks for distribution within the municipality.

1.11.5 Karas water supply and Tartar water supply scheme

The Karas Water Supply system and Tartar water supply scheme are other schemes that serve parts of Karas and Tartar within Kapenguria Municipality. The current production for Karas and Tartar are 47 m^3/day (1421 m^3/month) and 66.7 m^3/day (2000 m^3/month), respectively.

1.11.6 Muruny water systems

Muruny Water Supply Project, currently 70% complete, see Plate 6 has 12 storage tanks with a combined capacity of 17,865 million liters. It is designed to serve the entire Kapenguria municipality. The project includes a conventional Water Treatment Plant (WTP) at Kabichbich Center, capable of treating 38,800m^3 daily. The water supply project is designed to provide safe, treated water to residents

Plate 6: Muruny water supply project (under construction)

1.11.7 Water-related issues

Kapenguria Municipality faces a range of water-related challenges, primarily due to the absence of a reticulation plan and an over-reliance on traditional water sources such as shallow wells, boreholes, unprotected springs and rainwater catchment. These issues are intensified by seasonal water scarcity, high piping costs, river pollution during the rainy season, illegal connections, insufficient funding for necessary infrastructure upgrades and the lack of a functioning sewerage system.

The water distribution system also encounters structural problems, including outdated, rusted, or stolen pipes, poor plumbing methods and frequent damage from road construction activities. The terrain poses additional difficulties for water pumping systems, while inadequate drainage systems and soil pollution contribute to the degradation of water sources.

Plate 7: Left_ is an unused borehole in Keringet village. Right_ a drying water source in Kaprech

Local authorities are engaging communities through sensitization programs to promote good water management practices and reduce vandalism. They are also exploring gravity-fed water systems to minimize reliance on costly electricity for pumping.

1.12 Energy and Other Services

1.12.1 Energy Sources

Energy is a key driver of economic growth in towns, with urban areas consuming significant amounts of fuel. In the municipality, the primary energy sources are electricity (60% coverage, petroleum fuels, solar and biomass.

The use of renewable energy sources, such as solar, wind, biogas, which has 0.03% coverage within the whole county and geothermal power, remains minimal, despite their lower environmental impact. Uses of energy include: lighting; Cooking; and businesses (welding, juakali, milling, water pumping).

1.12.2 Energy sources for lighting

The field survey revealed that the majority of respondents rely on electricity and solar power as their primary sources of lighting, with 41% and 31% of households, respectively (see Figure 10). Approximately 4% still rely on paraffin, while 16% use firewood for lighting. Particularly, the adoption of renewable energy sources, such as solar power, is minimal, with less than 1% of the population utilizing it. The choice of energy sources is influenced by factors such as accessibility, affordability, security considerations and the unavailability of electricity in certain areas.

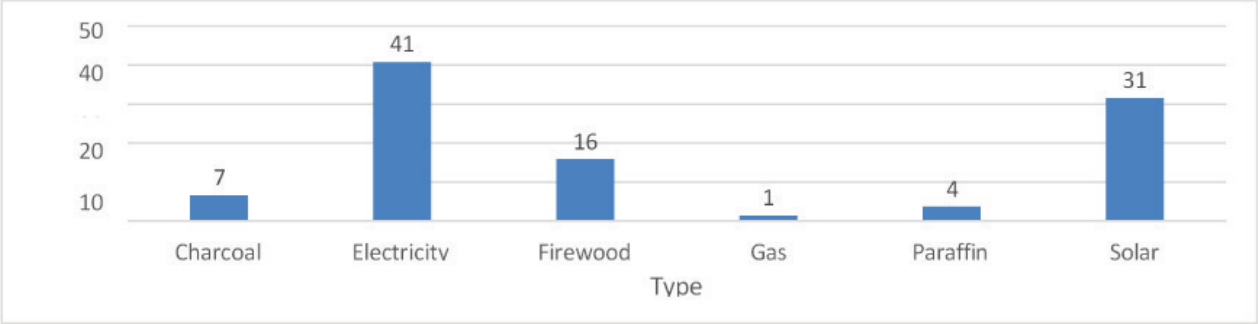


Figure 10: Sources of Energy

1.12.3 Energy sources for cooking

The primary sources of cooking energy in Kapenguria municipality are non-renewable. Firewood is used by 61.11% of households, while 22.22% rely on charcoal. Firewood is predominantly used in rural areas and informal settlements like Mathare, Eastleigh and Aramget. Additionally, 10.37% of households use gas for cooking, 2.59% use electricity and approximately 0.37% use paraffin (see Figure 11). The field survey also revealed that most people prefer firewood because it is available, accessible, affordable (often free) and convenient.

The findings indicate that non-renewable energy sources dominate cooking practices in the town. The continued reliance on wood fuel contributes to deforestation and environmental degradation. To address this, it is crucial to promote tree planting and encourage a shift towards renewable energy alternatives, such as solar and biomass, to reduce the environmental impact.

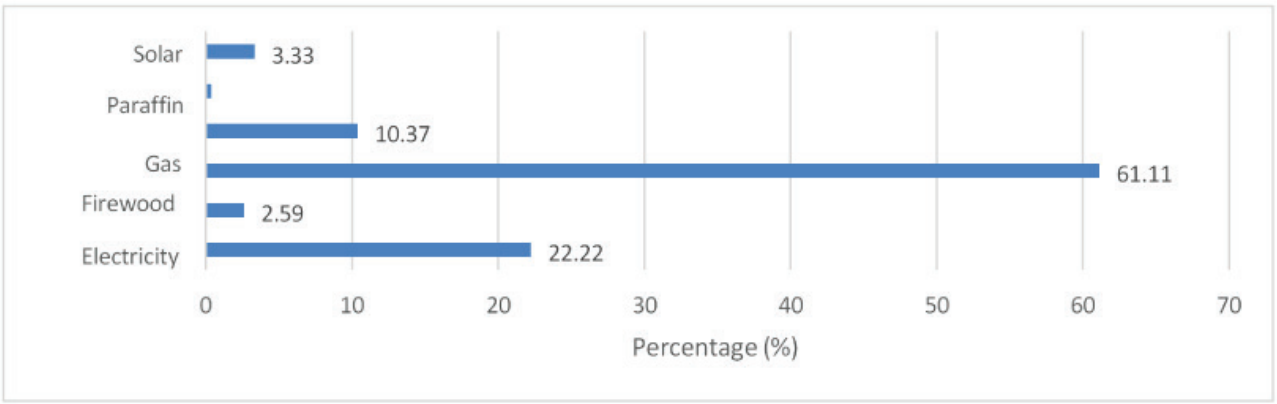


Figure 11: Source of Energy (Cooking)

1.13 SOCIAL INFRASTRUCTURE

Social infrastructure plays a critical role in shaping the quality of life. As the municipality grows, the demand for essential services such as education, healthcare, public amenities and recreational spaces has increased. This chapter examines the current state of social infrastructure in Kapenguria, identifying key strengths and opportunities for improvement. It explores the distribution and accessibility of health services, education facilities and critical community facilities while assessing their capacity to meet the needs of a growing population.

1.13.1 Distribution of Health Facilities

Access to healthcare in Kapenguria is hindered by both staff shortages and inadequate physical distribution. The municipality have one hospital, health centers and18 dispensaries, but this existing infrastructure proves insufficient to meet the demands of a growing population.

The distance to health facilities is a critical factor influencing healthcare access. While 53% of respondents, primarily in urban areas, travel less than one kilometer to reach a facility, 17%, mainly in rural areas, must travel over 5 kilometers.

1.13.2 Education

Access to quality education and functional infrastructure is a cornerstone of development in any society. Under Kenya Vision 2030, the country aims to provide globally competitive quality education and training to enhance the well-being of citizens. There is a 30% dropout rate with majority of this percentage being male.

The sector faces significant challenges, including an estimated illiteracy rate of 60%, which contributes to retrogressive cultural practices such as early marriages, female genital mutilation (FGM) and cattle rustling. Low literacy rates are attributed to nomadic lifestyles, negative cultural practices and limited educational infrastructure.

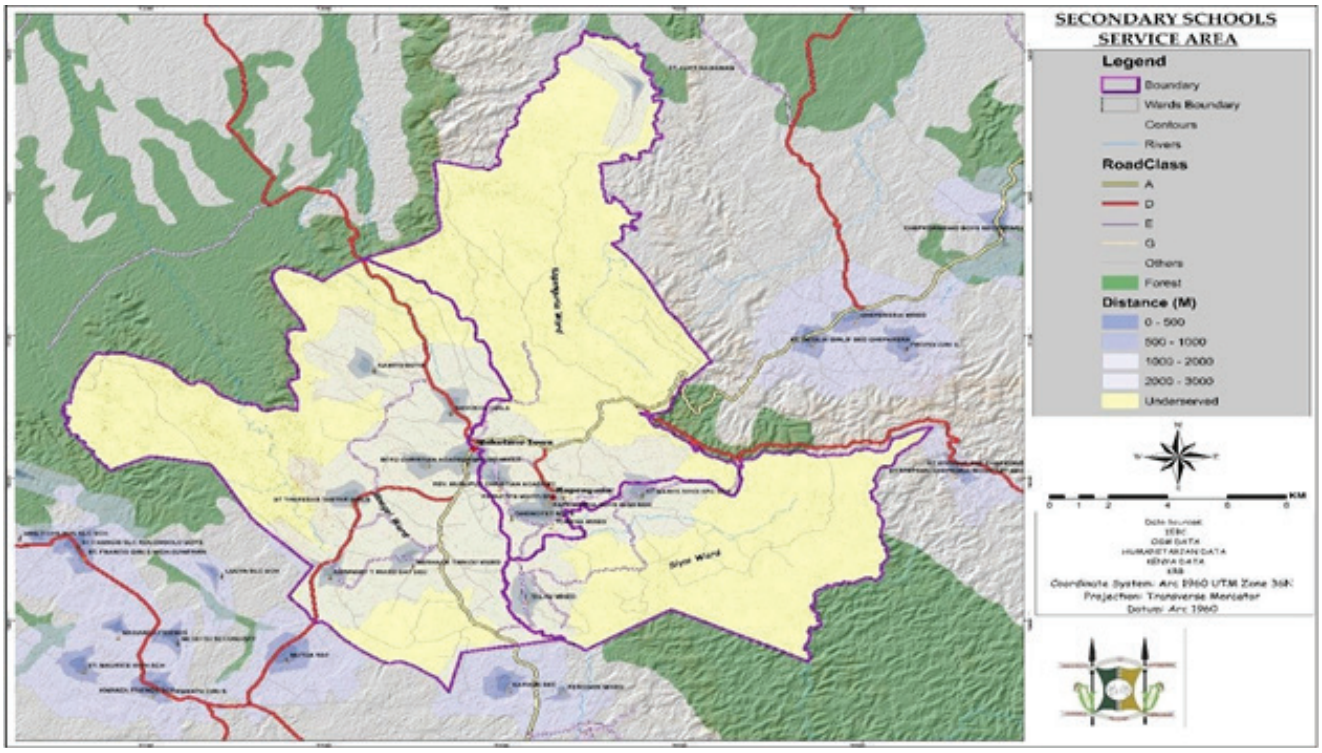


Figure 12: Secondary Schools Service Area

1.13.3 Social development centers

Kapenguria hosts a number of social development centers. These facilities serve as hubs for social interactions, skills development and knowledge sharing, catering to diverse groups, including youth, women and the public. Among them is Kapenguria

Social Hall, which is widely used for public meetings, community events and training sessions.

Kapenguria Museum also stands as a significant cultural landmark. The museum preserves the town's rich history, particularly its role in Kenya's struggle for independence and serves as an educational resource for both locals and visitors. Additionally, youth and women empowerment initiatives are supported by centers such as the Kapenguria Youth Empowerment Center and the West Pokot Women Development Center offer training in entrepreneurship, vocational skills and leadership development

1.13.4 Information Communication Technology (ICT)

1.13.4.1 Telecommunication

Kapenguria Municipality hosts key communication and information institutions such as the Huduma Centre, a youth empowerment centre, social hall and four post offices in Keringet, Siyoi, Kaibos and Makutano, among other institutions. The primary modes of communication is mobile phone (84%), with other channels like radio, television and online platforms (see figure 13).

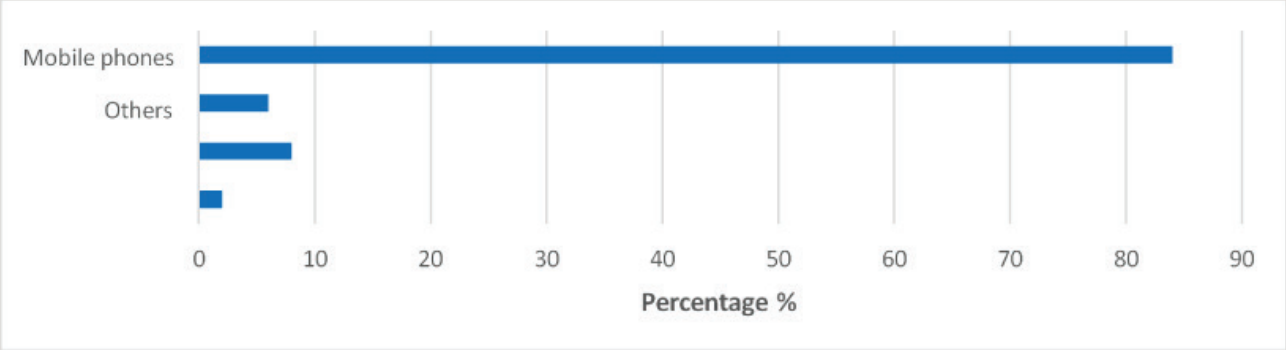


Figure 13: Mode of communication

In terms of mobile communication, all major cell phone networks, including Safaricom and Airtel serve the area. However, internet access remains limited, with only about 8% of residents having reliable internet service. Many respondents cited slow internet speeds as a major concern.

1.14 Poverty, Inequality and Social Vulnerability

1.14.1 Poverty and Livelihood Insecurity

Poverty levels remain high in parts of Kapenguria Municipality, particularly among households dependent on climate-sensitive livelihoods. Limited income diversification and savings reduce the ability of households to cope with and recover from climate shocks.

1.14.2 Gender and Vulnerable Groups

Women, children, the elderly and persons with disabilities are disproportionately affected by climate hazards due to social and economic inequalities. Gender disparities in land ownership, access to credit and decision-making further increase vulnerability.

1.15 ECONOMIC ANALYSIS

Kapenguria Municipality's economic growth is anchored in key sectors, including agriculture, construction, retail trade, tourism and business services. Agriculture and livestock are the primary sources of income and employment, contributing significantly to the county's revenue. Strategically located along the A1 International Highway, the municipality serves as a regional commercial hub for the North Rift, facilitating trade and travel.

This chapter discusses the current state of the municipality's economy, identifying important sectors, growth drivers and exploring avenues for future development, including industrial growth, value chain development in existing sectors and human capital development.

1.15.1 Employment

Employment in Kapenguria municipality is sourced from: the county government, which employs 15% of the population; the national government employs 15% and small and medium-sized enterprises (SMEs), which contribute 70% of local employment, (see Figure 14)

Self-employment opportunities is also common with many residents working in trade, transport services and informal sectors such as the Jua Kali, which provides opportunities for skilled artisans and craftsmen.

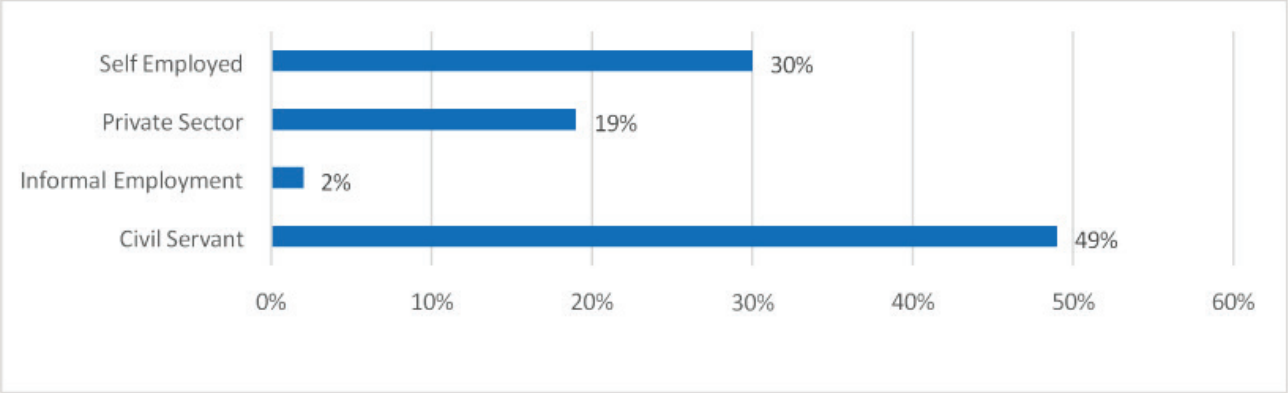


Figure 14:Types of employment

1.16 Trade and Commerce

1.16.1 Banking and Financial Services

Kapenguria municipality has a well-established banking sector, featuring branches such as Kenya Commercial Bank (KCB), Barclays Bank, Equity Bank, K-REP Bank and the Kenya Women Finance Trust. These institutions provide financial services to local businesses and entrepreneurs, supporting both agricultural and commercial activities. The presence of several insurance companies, such as Biashara Mashinani Fund, which provides affordable credit to 300 traders, further strengthens the financial services landscape.

1.16.2 Markets

Markets play a critical role in Kapenguria's local economy by facilitating trade and generating revenue for the county government. The municipality have one market at Makutano, which is under construction. Despite efforts to improve market infrastructure, the demand for market spaces still exceeds supply. Many vendors continue to operate outside the formal stalls, occupying public spaces and road reserves to sell their goods.

Other proposed markets include: new fresh produce markets in Siyoi and Bendera and satellite markets in Kirenget, Murkwijit and Masol shopping center.

The municipality's economy is primarily driven by agricultural trade, with many products being sold directly at the farm gate or to local hotels and small businesses. Additionally, Kapenguria features a blend of large and small-scale retail operations and the liberalization of the petroleum sector has contributed to an increase in fuel outlets strategically located along major transport routes.

1.16.3 Market Accessibility

Data from the household questionnaire indicates that approximately 60% of households reside within 5 km of the nearest market, suggesting relatively convenient market access (see Figure15). However, households located between 10 km and 50 km from the nearest market face challenges in accessing markets, particularly for perishable goods. The longer distances to market centers highlight potential geographic, infrastructural, or logistical barriers to efficient market access.

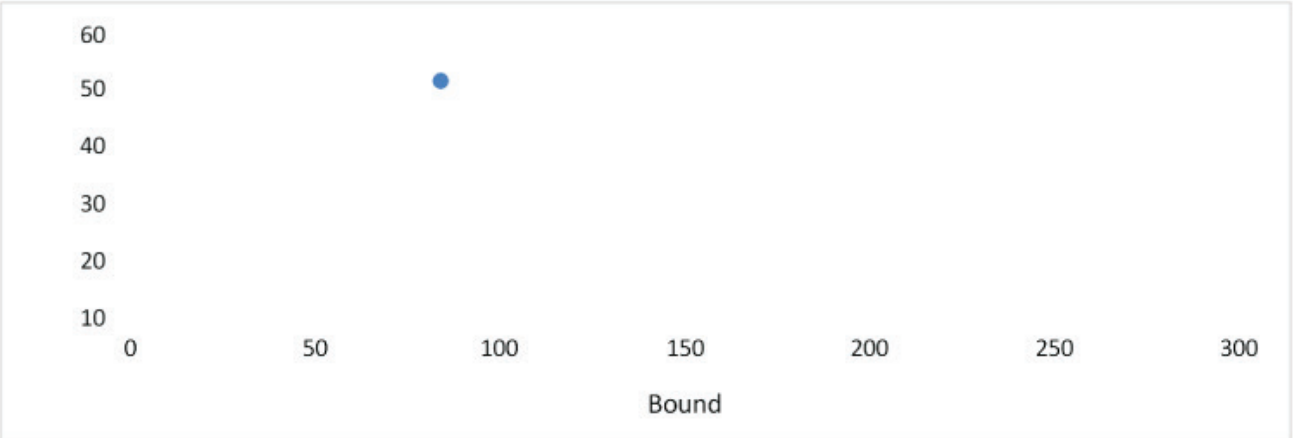


Figure 15: Market Connectivity

1.16.4 Informal Sector

Informal trade forms a critical component of Kapenguria's economy, with vendors, tailors, mechanics, hawkers and vegetable sellers significantly contributing to the commercial landscape (see Plate 8). Hawkers, in particular, play a key role in distributing goods and services across the Central Business District (CBD) and peri- urban areas.

However, the expansion of informal businesses within the CBD has resulted in congestion, emphasizing the need for designated spaces to accommodate these activities.This state highlights the growing demand for infrastructure that supports the informal economy while maintaining an organized urban environment.

Plate 8: Informal activities In Kapenguria Municipality.

1.16.4 Small and Medium Enterprises

Kapenguria Municipality comprises 60% of the population. However, only 20% (50 out of all groups) are formally registered, limiting their access to support. Key challengeshindering SME growth include limited funding, inadequate budget allocation, lack of awareness, political differences and poor infrastructure, especially sanitation. To address these challenges, the municipality has partnered with NGOs to provide training programs and facilitate collaborations aimed at capacity building. Additionally, upcoming projects such as the National Youth Towards Advancement (NYOTA) and the Kenya Jobs Economic Transformation (KJET) initiative seek to enhance employment opportunities and economic empowerment. The long-term vision for SMEs in Kapenguria is to achieve 99.9% registration of groups, leading to improved livelihoods and broader economic transformation.

1.16.5 Industries

Industries within the municipality include: cottage industries (e.g., Jua Kali, tailoring), a sunflower aggregation point (see plate 9), dairy processing plants (Makutano), small- scale maize milling and a coffee plant. Honey is packaged locally, however sourced outside the municipality. Small and medium-sized enterprises (SMEs) operate in sectors like motor vehicle repair and carpentry and furniture manufacturing by sawmill operators (small scale). Sand harvesting is a potential, but it requires sustainable practices.

Currently, the municipality is underutilizing its agricultural output (maize, beans, horticultural crops) for value addition, which presents a significant opportunity for agro- processing development.

Plate 9: Sunflower plantation and un-operational sunflower factory.

1.17 Land-use

According to the spatial plan survey, land use varies within the municipality, ranging from residential, mixed use, commercial and agricultural use. Mixed use include agriculture cum residential, commercial cum residential, among other mixed uses. Agricultural use covers the highest percentage of 58.6%, see Figure 16. This shows the municipality's rural setting and reliance on agricultural activities.

Land use determines where people live, where economic activities take place and which areas are exposed to climate hazards such as flooding, erosion, heat stress and water scarcity.

Current Land-use Patterns in Kapenguria Municipality

Kapenguria Municipality comprises a mix of land uses, including:

- Residential areas (both formal neighborhoods and informal settlements)
- Commercial and business zones within the town Centre
- Public and institutional land (schools, hospitals, administrative offices)
- Transport corridors and road reserves
- Agricultural and peri-urban farming areas
- Open spaces and natural areas, including river corridors and riparian zones

These land uses are unevenly distributed across wards, with more intensive development concentrated around the town Centre and main roads, while peripheral areas retain agricultural and low-density uses.
Some existing settlements and economic activities are located close to rivers, low- lying areas, or steep terrain, which increases exposure to flooding, erosion and stormwater impacts.

Urban Expansion and Land-use Pressure

Kapenguria Municipality is experiencing gradual urban expansion driven by population growth and increased demand for housing and services. This has resulted in:

- Expansion of residential areas into peri-urban zones
- Increased pressure on agricultural land
- Encroachment into riparian areas and natural drainage corridors in some locations

Unplanned or poorly controlled land-use change can increase climate risk, particularly flood risk and environmental degradation.

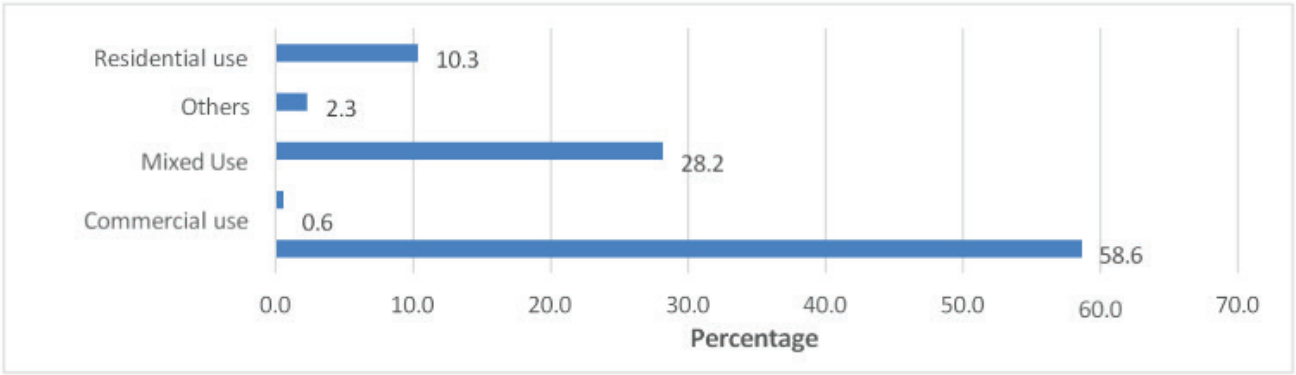


Figure 16: Land Use

Future Planned Land-use Changes

According to the Kapenguria Municipal Spatial Plan, future land-use changes include:

- Designated areas for residential and commercial expansion
- Planned infrastructure developments and road improvements
- Protection of environmentally sensitive areas such as riparian reserves and open spaces

If future development follows the Spatial Plan and avoids high-risk areas, climate exposure can be reduced. If not, climate risks may increase as the municipality grows.

Link between Land Use and Climate Hazards

Land-use patterns in Kapenguria Municipality influence climate risk in several ways:

- Built-up areas reduce natural drainage, increasing flood risk
- Loss of vegetation increases surface runoff, erosion and heat stress
- Development near rivers increases flood and water pollution risks
- Preserved green spaces help manage stormwater and reduce heat

Understanding these linkages helps identify high-risk land-use zones within the municipality.

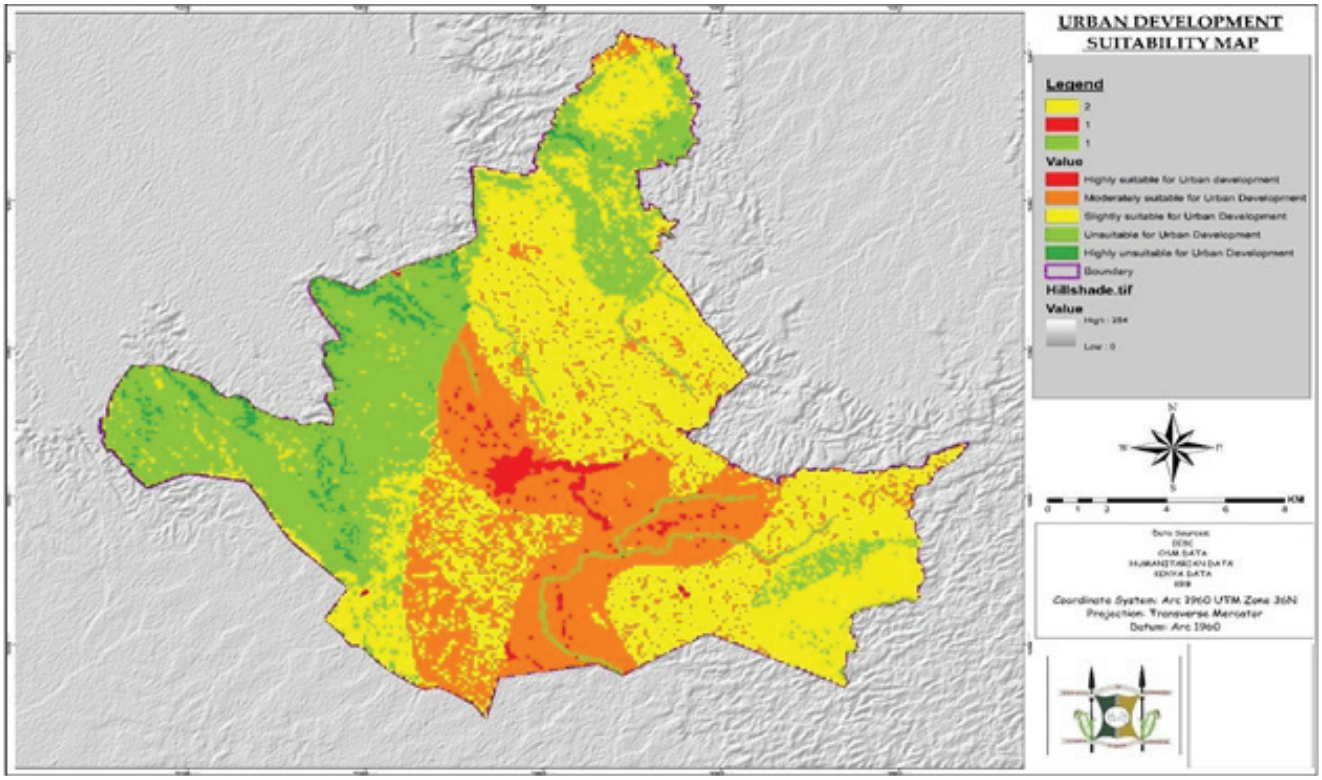


Figure 17: Suitability Map

1.18 HOUSING AND SETTLEMENT

1.18.1 Housing Infrastructure

Plate 10:Semi-permanent structures

1.18.2 Flats

Flat houses in Kapenguria are concentrated in urban areas, primarily in Makutano, Kapenguria, Bendera and parts of Siyoi. These multi-story buildings cater to the growing population and typically range from two to four stories, providing rental units for middle-income earners.

Plate 11: Flats in Kapenguria Municipality

1.18.3 Informal Housing

Informal settlements within the municipality include Kambi Moto, Kambi Samaki, Aramaget and Mathare slums. These settlements comprise approximately 36% of the municipality (see Figure 17) and are characterized by a range of housing types, often constructed using mud, timber and iron sheets.

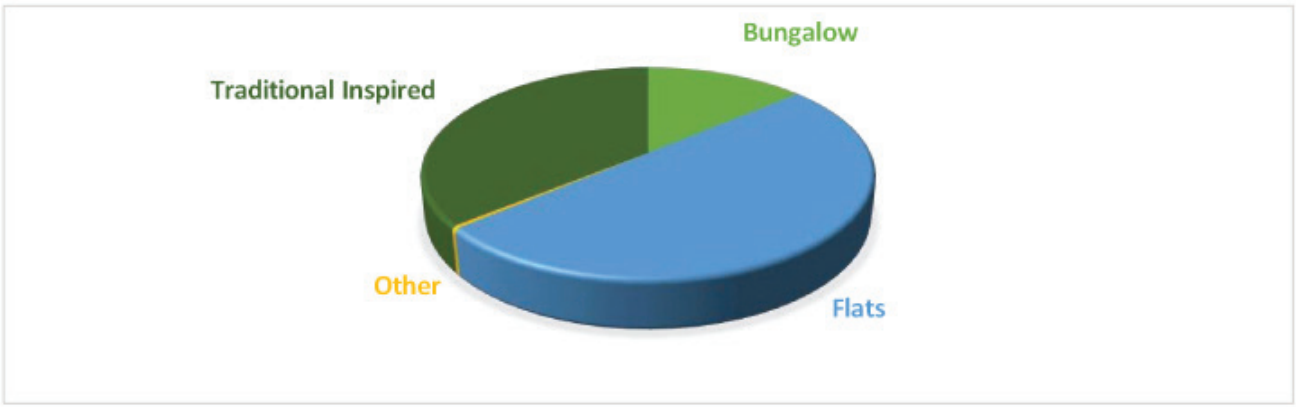


Figure 18: Housing Topologies

Plate 12:Informal settlements in Mathare & Aramaket

1.19 Waste Management and Solid Waste Management

Solid waste primarily consists of household garbage, commercial waste from businesses, agricultural byproducts from markets and farms, glass, metal scrap from garages and fabricators and plastic and polythene bags from bars, hotels and restaurants. The waste stream is largely composed of inorganic materials such as bottles, paper, plastic containers, polythene bags and old clothes, as well as organic waste like food scraps and vegetable peels.

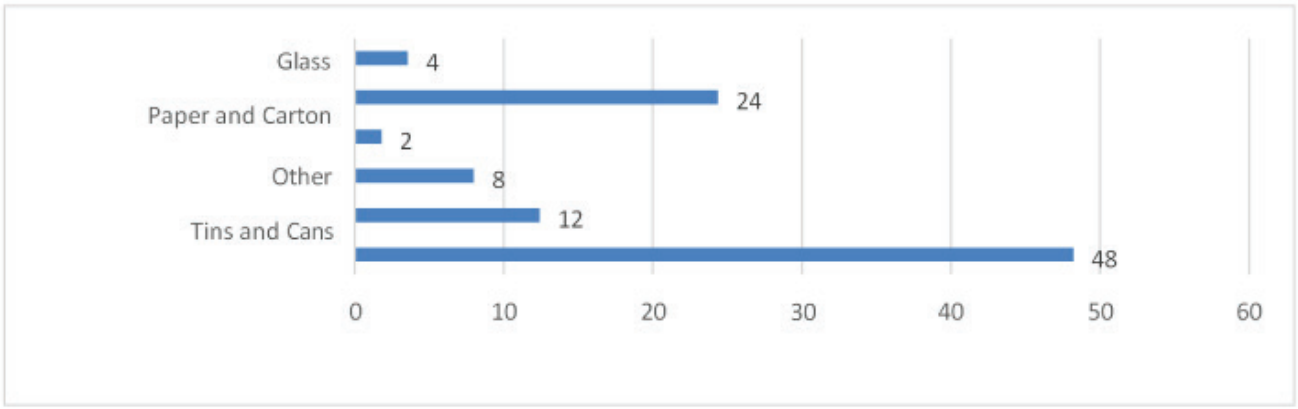


Figure 19: Types of waste generated at the household

Plate 13: Kapenguria municipal garbage collection

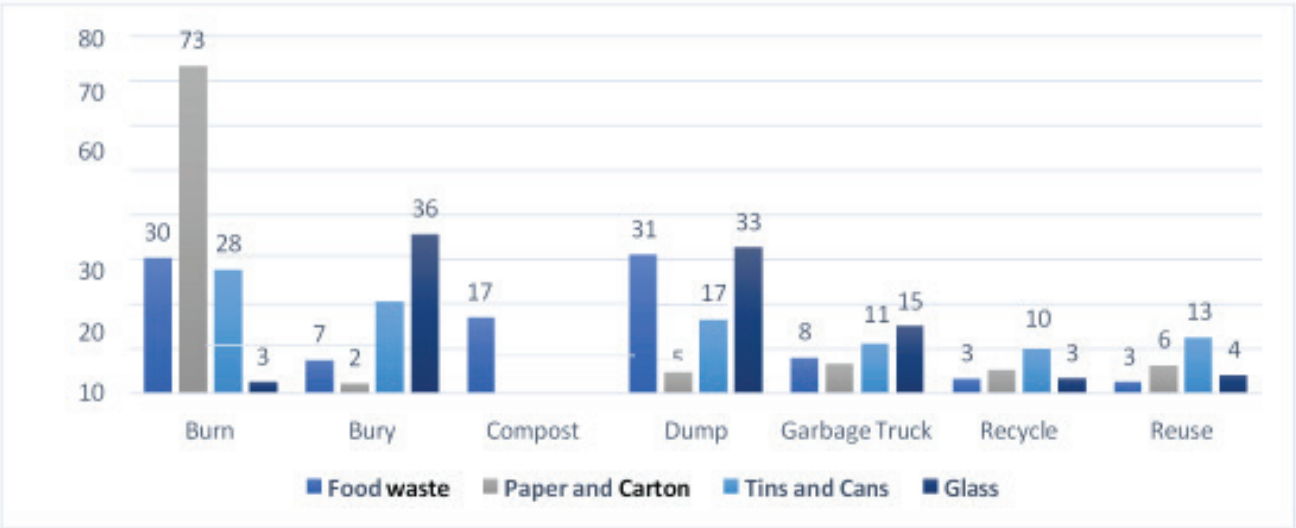


Figure 20: Household Solid Waste Disposal

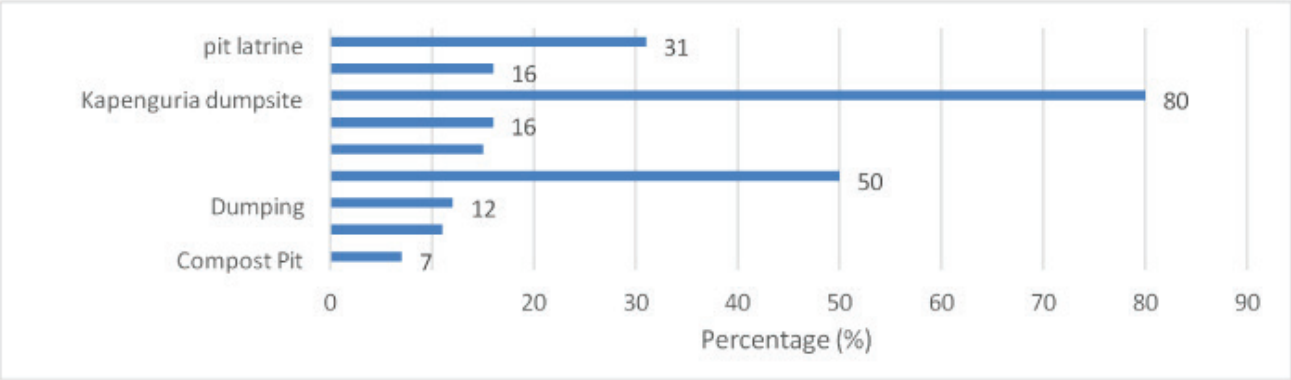


Figure 21: Ways of waste disposal

Plate 14: Kapenguria Municipality Open Dumpsite. Source: Field Survey, 2023

Plate 15: Kapenguria Dumpsite, existing fence. Source: Field Survey, 2023.

1.20 Liquid Waste Management

Kapenguria Municipality lacks wastewater treatment facilities and relies on exhauster truck services provided by both the county government and private providers. These trucks, with a capacity of 6 m³, primarily serve the urban population. Untreated waste is often dumped in forests, posing significant environmental and public health risks.

The sewerage system is currently 70% complete (see Figure 22) and residents rely on other sanitation methods. Currently, 68% of residents use pit latrines, 29% rely on septic tanks and 2% dispose of waste in the bush. These practices pose a significant risk of contaminating local rivers, which are key water sources.

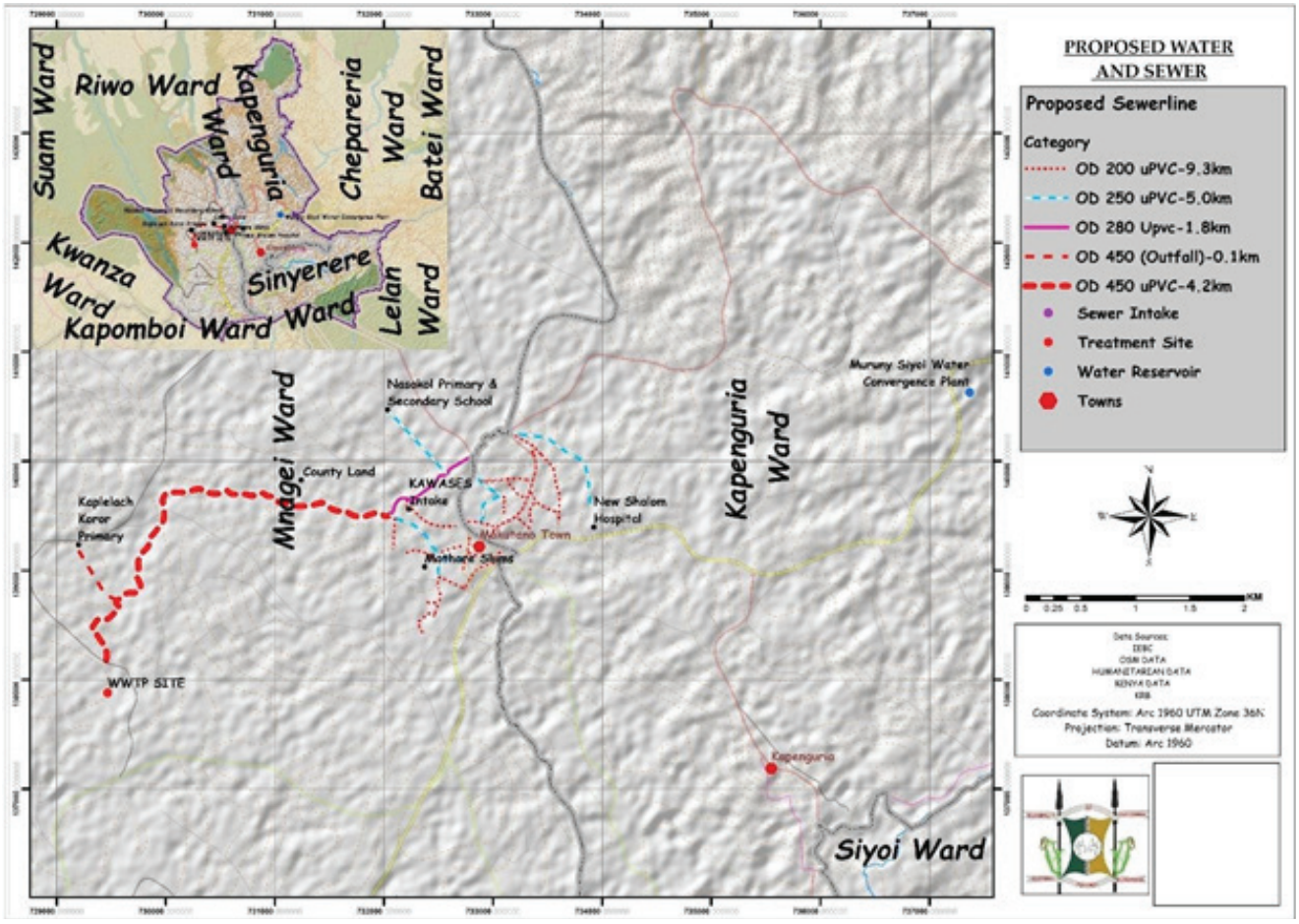


Figure 22: Proposed sewer system

CHAPTER 2: HAZARD ASSESSMENT

Climate hazards are climate-related physical events or trends that may cause adverse impacts on human systems, infrastructure, ecosystems and livelihoods. In Kapenguria Municipality, climate hazards are shaped by both climatic factors (rainfall variability, temperature changes) and non-climatic factors such as topography, land use change, environmental degradation and urban expansion.

This chapter identifies and analyses the major climate hazards affecting Kapenguria Municipality, describes their drivers and spatial characteristics and examines their observed and potential impacts. The analysis provides the foundation for subsequent assessments of exposure, vulnerability and climate risk.

Overview of Major Climate Hazards in Kapenguria Municipality

Based on historical records, observed climate trends, physical characteristics and planning documents and Stakeholders judgement the main climate hazards affecting Kapenguria Municipality include:

- Windstorms
- Lightning strike
- Drought
- Flash floods
- Extreme heat
- Extreme cold
- Landslides
- Gully erosion

These hazards vary in frequency, intensity and spatial distribution, but collectively pose significant risks to development and service delivery.

2.1 Key Climate hazards

Climate hazard screening is a systematic, preliminary process designed to identify, analyze and evaluate the potential impacts of current and future climate-related risks on a project, policy, or investment at an early stage. It serves as a,"first pass" check to determine if a project is likely to be affected by climate hazards (such as floods, droughts) and helps to integrate adaptation measures into project design to build resilience.

Key hazards were identified using a pair matrix and hazard likely, significant impact and high priority method table as shown below.

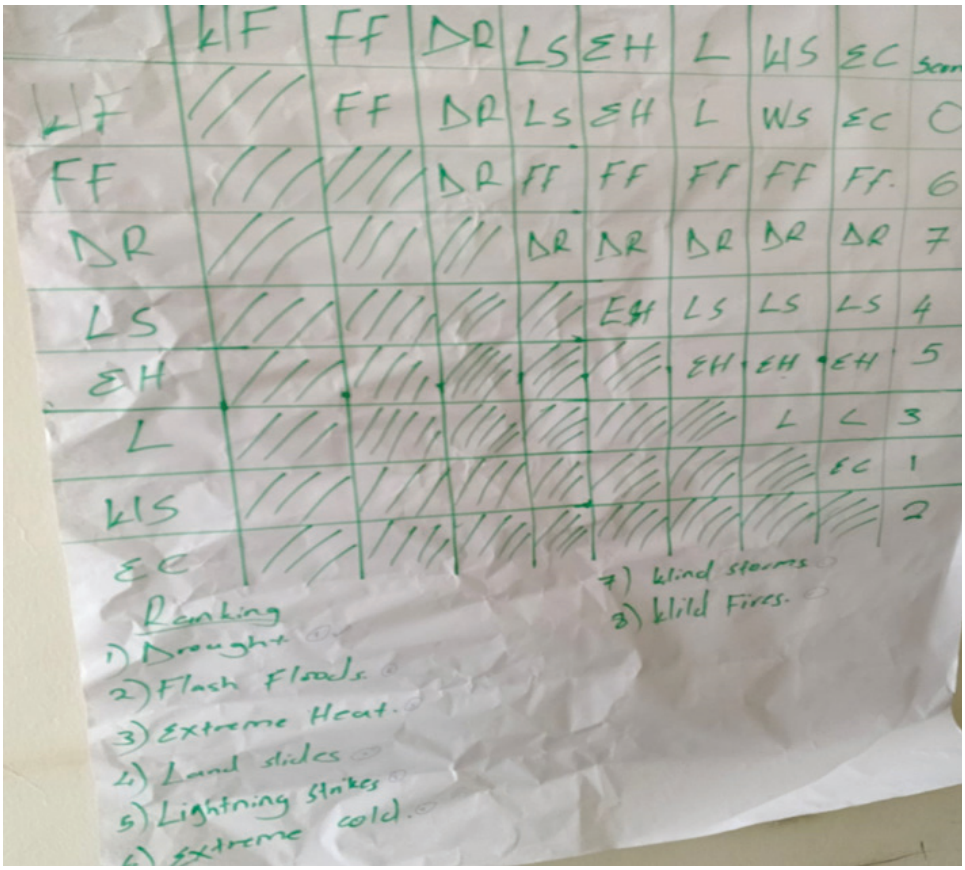


Plate 16: Pair matrix table

From this method the hazards were ranked as follows in terms of priority;

1. Drought
2. Flash floods
3. Exteme heat
4. Landslides
5. Lightening strikes
6. Extreme cold
7. Windstorms
8. Wild fires

Table 7: Hazard screening for Kapenguria Municipality

Hazard	Hazard Likely (Y/N)	Significant Impact (Y/N)	High Priority (Y/N)	Key Hazard (Y/N)
Heat Stress				
Average surface temperature increase	Y	Y	Y	Y
Average ocean temperature increase	N/A	N/A	N/A	N/A
Extreme heat	Y	Y	Y	Y
Marine heatwaves	N/A	N/A	N/A	N/A
Cold Stress				
Average surface temperature during Winter	Y	N	N	N
Extreme cold (e.g., cold spells, frost)	Y	N	N	N
Snowfall and ice storms	N/A	N/A	N/A	N/A
Flooding				
Changes in precipitation patterns	Y	Y	Y	Y
Pluvial (surface level) flooding, including flash flooding and urban flooding	Y	Y	Y	Y
Fluvial (river) flooding	Y	Y	Y	Y
Sea level rise	N/A	N/A	N/A	N/A
Coastal flooding, including storm surges	N/A	N/A	N/A	N/A
Waterlogging	N	N	N	N
Water Stress				
Drought (meteorological, hydrological)	Y	Y	Y	Y
Groundwater salinization	N/A	N/A	N/A	N/A
Saline intrusion	N/A	N/A	N/A	N/A
Wildfire				
Wildfires & bushfires	N/A	N/A	N/A	N/A
Storms				
Extreme wind	Y	Y	N	N
Tropical cyclones	N/A	N/A	N/A	N/A
Sand and dust storms	Y	Y	N	N
Hailstorms	Y	N	N	N
Mass Movement				
Landslides	Y	Y	Y	Y
Coastal erosion	N/A	N/A	N/A	N/A
Gully erosion	Y	Y	N	N

Marine Conditions				
Ocean acidification	N/A	N/A	N/A	N/A
Geophysical*				
Subsidence	N	N	N	N
Earthquakes	N	N	N	N
Volcanos	N	N	N	N

From hazard likely, significant impact and high priority, we found out that the key hazards affecting our municipality are;

- Heat stress- (average surface temperature increase and extreme heat)
- Flooding – (changes in precipitation patterns, fluvial flooding and river flooding)
- Drought
- Landslides

These hazards were found to have impacts and risks on various urban elements as indicated below.

Table 8: Drought Hazard

Category	Hazard – Drought					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**Mitigation measures**
Infrastructure & Services						
Storm water Drainage	Y – Open drains, culverts, Retention ponds, Roadside drains and Flood Channels	Structural damage and cracking Blockage due to sediment waste build-up	Storm water drainage system	Drainage cleaners Business premises next to storm drains	Routine drainage cleaning emergency response funds	Nature-based drainage designs Resilient infrastructure

Water & Waste water Manage ment	Y – Water treatment plants pipelines boreholes Sewers lines wastewater treatment works	Sewer blockages and overflows Environmental pollution of soil and surface water Higher operation and maintenance costs Increased wear on pumps and pipelines due to over-abstraction and longer operating hours Pipeline stress and leakage caused by soil shrinkage and ground movement Damage to treatment infrastructure from shock loading after drought	Water treatment plants pipelines boreholes Sewers lines wastewater treatment works	Plumbers Engineers Water and waste water management staff Municipality	Emergency drought funds Early warning systems	Investment in water storage infrastructure borehole drilling water reuse and recycling catchment and watershed protection rainwater harvesting water rationing plans drought contingency planning public awareness and livelihood diversification

Category	Hazard – Drought					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**Mitigation measures**
Solid Waste Management	Y – Collection points transfer stations disposal sites waste trucks	Fires at dumpsites air pollution Breeding space for rodents Increased vehicle wear and tear Reduced efficiency of transportation trucks.	Collection points transfer stations disposal sites waste trucks nearby residents solid waste management personnel.	Municipal cleaners PWDs Children Elderly	Emergency response funds	Upgraded disposal sites waste-to energy improved landfill design public awareness
Transport and Mobility	Y – Roads bridges footpaths public transport routes Air strips Non Motorized Transport Bus stops and stage	Surface damage increased maintenance cost Reduced visibility Road cracks Tear and wear Disruptions of routes and accidents Cracking and deformation of pavements Lower passenger comfort and safety	Unpaved roads and corridors Poorly constructed transport routes and bus stops	Drivers Pedestrians and cyclists Children PWDs	Dust suppression and routine maintenance Emergency response funds	Climate-resilient transport and mobility infrastructure

Category	Hazard – Drought					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**Mitigation measures**
Energy	Y – Hydro-Power substations, transformers transmission lines fuel supply systems generators firewood	Power shortages system overloads higher energy costs	Hydro-Power substations, transformers transmission lines fuel supply systems generators firewood	Energy workers KPLC Community relying on this energy sources	Electricity load management Emergency response funds Early warning system	Renewable energy diversification Energy resilient infrastructure

Category	Hazard – Drought					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**Mitigation measures**
Economic Infrastructure	Y Industrial zones warehouses shops MSME premises Markets & sale yards Business premises, informal economy	Business interruptions income loss job insecurity	Economic assets	Business community Marginalized groups	Alternative water sources Emergency response funds	Resilient economic infrastructure Business continuity planning

Category	Hazard – Drought					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**Mitigation measures**
Social Infrastructure	Y Schools Recreational centers Rescue centers Churches corporate societies health facilities	Damage to social infrastructure Stress levels Increased absenteeism to schools Reduced access to essential services Overcrowding and strain on limited resources services Loss of social cohesion and community wellbeing Increased stress and mental health challenges	School children Patients Faith communities	School children Patients Faith communities	Emergency response funds	Resilient social infrastructure Civic education

Category	Hazard – Drought					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**Mitigation measures**
Emergency services	Y – Fire stations ambulances emergency operation center police posts emergency personnel	Delayed response Increased fire damage Damaged emergency infrastructure	Fire brigades Emergency vehicles Rescue teams	Emergency personnel Rescue teams	Pre-positioned water tankers Emergency response funds Trained personnel Operational Toll -free number Operational emergency Centre	Emergency water reservoirs Emergency resilient infrastructure
Population						
Urban Residents	Y Housing units Households	Damage to housing units Stress to households Outbreak of heat related diseases Higher water costs disease outbreaks	Households using communal taps vendors shallow wells Non resilient housing units	Elderly Children People with chronic illness Women PWDs	Household conservation rainwater harvesting Emergency response funds	Resilient housing infrastructure Green rooftops

Category	Hazard – Drought					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**Mitigation measures**
Informal Settlement Residents	Y – Informal housing Units Informal dwellers	Increased fire risk due to dry conditions and use of open flames Dust and poor air quality from unpaved roads and open spaces Structural stress on weak housing materials from extreme heat Heat stress due to overcrowded housing and lack of ventilation Poor sanitation Increased prevalence of respiratory and skin infections	Informal housing units Informal dwellers	PWDs Children Elderly People living with chronic illnesses	Emergency water provision Emergency response funds	Upgrading the informal settlements

Category	Hazard – Drought					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**Mitigation measures**
Vulnerable and Marginalized Groups	Y – Elderly persons children persons with disabilities women- headed households Low income households	Health deterioration Service exclusion Greater exposure to heat and physical strain Reduced access to clean water Sanitation and nutrition	Elderly persons Children Persons Living with disabilities Women-headed household s Low- Income earners Minority groups	Children Elderly PWDs	Emergency response funds	Land use planning Involvement in decision making Civic education Livelihood diversification
Natural Assets						

Category	Hazard – Drought					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**Mitigation measures**
Urban Green Infrastructure	Y – Parks Street trees Green belts Urban forests	Loss of ecosystem services and increased heat Damage to the infrastructure	Parks Street trees Green belts Urban forests	Gardeners Urban residents	Water- efficient landscaping Emergency response funds Regular maintenance	Drought- resistant vegetation Resilient urban infrastructure designs Afforestation programs Civic education
Urban Blue Infrastructure	Y – Rivers streams wetlands retention basins	Loss of biodiversity Loss of water Drying up of rivers and springs	Rivers Streams Wetlands Retention basins	People living along river banks. PWDs Children Elderly	Adherence to catchment regulations	Catchment restoration Forest protection Land use planning Policy enforcement

Category	Hazard – Drought					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**Mitigation measures**
Peri- urban and Agricultural Systems	Y – Kitchen gardens Dairy farms	Food insecurity income loss Loss of livelihoods Destruction of urban farms Kitchen gardens and dairy farms Outbreak of diseases Loss of crops and livestock	Rain-fed farms and surface irrigation Livestock Soil Kitchen gardens	Peri-urban farmers	Plant drought-tolerant crops	Climate-smart agriculture Resilient peri - urban infrastructure

Table 9: Pluvial and River Flooding Hazard

Category	Hazard – Pluvial and River Flooding					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**Mitigation measures**
Infrastructure & Services						
Stormwater Drainage	Y Open drains Culverts retention ponds, roadside drains, flood channels	Damages storm water drainages Breaking of drainages Washing of drainage systems	Businesses next to storm water drainage systems Urban infrastructure	Elderly Children Women PWDs Urban dwellers Motorists	Emergency response funding Capacity building personnel	Resilient urban infrastructure Permeable pavements Routine maintenance Awareness creation Green rooftops on buildings Collection and storage of stormwater

Category	Hazard – Pluvial and River Flooding					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**Mitigation measures**
Water & Wastewater Management	Y Sewer lines Water lines Manholes Treatment sites	Contamination of portable water Damages to infrastructure Washing of the infrastructure Reduced efficiency of the infrastructure Interruption of the service System failure Pollution – soil, water, air Waterborne diseases	Water sources Treatment Plants	Elderly Children Women PWDs Urban dwellers Motorists Businesses Water & Wastewater Management personnel	Emergency response facilities Personnel Funding	Resilient water and wastewater infrastructure Flood control structures such as dams and water pans. Capacity building & awareness creation Recycling of wastewater

Category	Hazard – Pluvial and River Flooding					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**Mitigation Measures**
Solid Waste Management	Y Transfer stations Dumpsites	Damage to the Waste carrying trucks and receptacles Mixing of different kind of waste leading to pollution of land, water and soil Outbreak of diseases Damage to urban infrastructure due to blockages Straining of urban resources such as funds and emergency response facilities	Business owners Urban dwellers Waste management infrastructure	Elderly Children Women PWDs Urban dwellers Motorists Businesses Waste handlers	Emergency response funds Capacity Building of Personnel Early warning systems	Resilient solid waste infrastructure Policy enforcement

Category	Hazard – Pluvial and River Flooding					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**Mitigation measures**
Transport and Mobility	Y Roads Bus stops NMT Bus parks Airstrip Bridges	Damages infrastructure Washes of infrastructure Accidents Traffic	Goods and services Roads Bus stops Bus parks Airstrip Bridges	PWDs Elderly Children Women Pedestrians Motorists Cyclists	Emergency response facilities Personnel Emergency response Funds	Resilient transport and mobility infrastructure Policy formulation Routine maintenance Awareness creation

Energy	Y Electricity Firewood Solar Charcoal Biogas Transformers Substations	Damages to energy infrastructure Blackouts Lack of cooking fuel Increase in insecurity at night Increase in accidents Interrupted supply of urban services such as water	Urban Households Business premises Security apparatus Emergency services Food storage facilities	Urban dwellers Business premises Elderly Children Low- income groups Women Digital economy	Early warning systems Backup systems Policy enforcement Emergency response Emergency funds	Routine maintenance Resilient energy infrastructure Adoption of modern energy sources such as biogas, energy-saving and low-emission.

Category	Hazard – Pluvial and River Flooding					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**Mitigation measures**
Economic Infrastructure	Y Markets & sale yards Business premises Informal economy	Destruction of market infrastructure Loss of economic livelihoods Increased cost of maintenance	Revenue streams Consumers Transporters Traders Economic assets	Elderly PWDs Children Business people Consumers	Early warning systems Policy enforcement Emergency response Emergency funds Embracing Digital Services such eCitizen	Climate-proofed market infrastructure Policy formulation

Category	Hazard – Pluvial and River Flooding					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**Mitigation measures**
Social Infrastructure	Y Schools Recreational centers Rescue centers Churches Health facilities Social Hall	Interrupted learning activities Destruction of the institution's infrastructure Outstretched service delivery Overstrained government services Outbreak of diseases Early pregnancies Stressed society	Hospitals Churches Rescue centers Schools	Children Patients Elderly PWDs Women	Early warning systems Policy enforcement Emergency response services Emergency funds	Resilient and climate-proofed social infrastructure Capacity building & awareness creation Insurance to cushion losses Land use planning Environment al education

Category	Hazard – Pluvial and River Flooding					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**Mitigation measures**
Emergency Services	Y Firefighting Ambulance services Trauma centers Evacuation routes Emergency Operation Centers Police facilities	Overstretched resources both human and financial Strained emergency response infrastructure Injuries and loss of emergency personnel's lives during rescue Exposure to diseases Disrupted services	Emergency response personnel Equipment and machines	Emergency response personnel	Toll-free number Set up Assembly areas Emergency preparedness Early warning systems	Enhance multi-agency response coordination during flooding Compliance with development standards Enhance emergency operation centers Land use planning
Populations						

Category	Hazard – Pluvial and River Flooding					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**Mitigation measures**
Urban Residents	Y Urban Dwellers Housing units	Injuries and loss of lives Destruction of homesteads Disease outbreaks Stress and anxiety Acceleration of crime rates	Urban dwellers	Elderly Children Women PWDs	Emergency preparedness Early warning systems Policy enforcement	Capacity building & awareness creation Land use planning
Informal Settlement Residents	Y Informal settlements	Injuries and loss of lives Destruction of informal homesteads Disease outbreaks Stress and anxiety Acceleration of crime rates	Informal settlers	Elderly Children Women PWDs	Emergency preparedness Early warning systems Policy enforcement	Upgrading of informal settlements

Vulnerable and Marginalized Groups	Y Women and girls Children and youth Older persons (the elderly) Persons with disabilities Low-income households / the poor Informal settlement residents / slum dwellers Indigenous peoples and minority ethnic groups Pastoralists and small- scale farmers People with chronic illnesses Migrants, internally displaced persons and migrants	Physiological trauma Disruptions of livelihood Increased health risk and diseases Injuries	Assets Vulnerable and marginalized groups Households	People with chronic illnesses PWDs Elderly Children Low-income households	Early warning systems Emergency response	Awareness creation Resilient infrastructure Livelihood diversification Land use planning Training and capacity building

Category	Hazard – Pluvial and River Flooding					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**Mitigation measures**
	Female- headed households Unemployed or underemployed youth					
Natural Assets						
Urban Green Infrastructure	Y Urban parks Boulevards' Green rooftops	Destruction of urban green infrastructure Infrastructural loss	Urban dwellers	All urban dwellers	Emergency response funds	Resilient urban green infrastructure Land use planning Adherence to development standards

Category	Hazard – Pluvial and River Flooding					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**Mitigation measures**
Urban Blue Infrastructure	Y Wetlands Rivers Swamps Springs Lagoons	Soil erosion Loss of aquatic life Destruction of blue infrastructure	Dwellers along riparian areas	Elderly Women Children PWDs	Capacity building and creation awareness Environment al practices such as planting trees	Land use planning
Peri-urban and Agricultural Systems	Y Kitchen gardens Urban farms Dairy farms Agricultural aggregation Centres	Food insecurity Loss of livelihoods from farming Loss of aquatic live Destruction of urban farms and kitchen gardens and dairy farms Outbreak of diseases Loss of crops and livestock	Urban farms such as dairy gardens and pasture fields	Urban farmers Women	Climate-resilient crops and livestock Diversification of urban agriculture	Climate resilient urban and peri- urban agriculture

Table 10: Hazard - Heat Stress

Infrastructure & Services						
Category	**Hazard – Heat stress**					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**Mitigation measures**
Stormwater Drainage	Y Open drains Culverts Retention ponds Roadside drains Flood channels	Expansion causes breakages causing dysfunctionality Long-term structural degradation Reduced lifespan due to abnormal heat stress Open drains may lead to breeding grounds for vectors	Storm water drainages system	Elderly Children PWDs Business owners next to storm water drainage systems	Urban greening Continuous maintenance Improved emergency response	Resilient stormwater drainage infrastructure such as green infrastructure Appropriate designs such as permeable pavements and detention basins

Category	Hazard – Heat stress					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**Mitigation measures**
Water & Wastewater Management	Y Sewer lines Water lines Manholes Treatment sites Inspection chambers	Degrades water and wastewater infrastructure Interrupted services due to system failure Pollution of air, sludge and bad smell issues. Treatment Plant inefficiencies	Water treatment plants pipelines boreholes Sewers lines wastewater treatment works	Elderly Children Women PWDs Waste and water management personnel	Early warning systems	Resilient water and wastewater infrastructure Heat control structures – carbon sinks, urban greening Capacity building & awareness creation

Solid Waste Management	Y Collection points transfer stations disposal sites waste trucks	Corrosion of trucks Foul smell from transfer stations Fire outbreaks from disposal sites	Solid waste infrastructure Informal dwellers Urban dwellers Waste handlers	Elderly Children Women PWDs Urban dwellers Waste handlers	Emergency response funds	Resilient solid waste management infrastructure Heat control structures – carbon sinks, urban greening Capacity building & awareness creation Proactive Monitoring Adoption of Environment-friendly waste disposal measures e.g. 3Rs

Category	Hazard – Heat stress					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**Mitigation measures**
Transport and Mobility	Y Roads Attendant facilities NMT routes Bus stops Bus parks Airstrip	Accelerates the degradation of infrastructure. Increased accidents and deaths. Increased wear and tear of motors. Reduced air density, hence lower payload. Increased overhead costs due to higher maintenance. Increased cost of construction	Pedestrians Motorists Cyclists Travelers	PWDs Elderly Children Women Motorists	Emergency response facilities along corridors	Resilient transport and mobility infrastructure Policy formulation Routine maintenance Awareness creation Capacity building of personnel

Category	Hazard – Heat stress					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**Mitigation measures**
Energy	Y Electricity Firewood Solar Charcoal Biogas Transformers Substations	Higher energy consumption and cost due to cooling Accelerates the degradation of energy infrastructure Power rationing results in system inefficiencies	Households Business premises Security apparatus Emergency services Powerlines Generators Substations	Business premises Elderly Children Low-income groups Women Digital economy	Emergency backup systems	Reducing fossil fuel usage Land use planning Embracing green infrastructure and green energy Embracing Heat-Sensitive Urban Design Urban greening
Economic Infrastructure	Y Markets & sale yards Business premises informal economy	Destruction of infrastructure. Increased cost of construction Loss of economic livelihoods Increased costs Disrupted value chain system	Informal settlers Urban dwellers Revenue Economic assets Traders	Elderly PWDs Children Business people Municipality	Early warning systems Emergency funds Embracing Digital Services	Climate- proofed market infrastructure Policy formulation Value addition and processing Resilient economic infrastructure

Category	Hazard – Heat stress					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**Mitigation measures**
Social Infrastructure	Y Schools, Recreational centers Rescue centers Religious institutions Health facilities	Disrupted service delivery due to damaged facilities Physical damage to infrastructure Increased Pressure on the green spaces during heat spike seasons Increased pressure on emergency services	School-going children Patients Social Facilities	PWDs Elderly Children Urban dwellers	Surge Capacity and Training for emergency response personnels Establishment of more cooling areas. GIS mapping of heat wave hot spots.	Reduction in the usage of fossil fuels Enhancing cooling facilities in urban areas and all social infrastructures

Category	Hazard – Heat stress					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**Mitigation measures**
Emergency Services	Y Firefighting Ambulance services Trauma Centers Evacuation routes Emergency call centers Police facilities	Increased maintenance and operation costs Operational delays and system strains Injuries and deaths of emergency response personnel during Rescue Damage of emergency equipment's	Emergency response personnel's Equipment and machines	Emergency response personnel Medical staffs PWDs Elderly Children	Early Warning Systems Equipping of the emergency operation Centers Using modern equipment and machinery Emergency response funds Urban greening	Awareness creation Urban greening Resilient emergency infrastructure system
Populations						

Category	Hazard – Heat stress					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**Mitigation measures**
Urban Residents	Y Urban dwellers Housing units	Health complications such as fainting and dermatitis Mental stress Reduced productivity at work Strained health facilities Interruption of daily routines Damaged housing units	Urban dwellers	Urban dwellers Elderly Children PWDs People with chronic illnesses	Provision of urban shading, cooling facilities Enhance emergency response time Install hydration points	Reduce fossil fuel usage Green rooftops in housing units

Category	Hazard – Heat stress					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**Mitigation measures**
Informal Settlement Residents	Y Informal dwellers	Health complications such as fainting and dermatitis Mental stress Reduced productivity at work Strained health facilities Interruption of daily routines	Informal dwellers	Informal dwellers Elderly Children PWDs People with chronic illnesses	Provision of shading and cooling facilities Enhance emergency response time	Climate-smart buildings with vents Reduce fossil fuel usage Continuous civic education Install basic services like water and sewerage Upgrade informal settlements

Category	Hazard – Heat stress					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**Mitigation measures**
Vulnerable and Marginalized Groups	Y Elderly Infants People with chronic illnesses PWDs especially Albinos	Health complications such as fainting and dermatitis Mental stress Reduced productivity at work Strained health facilities Interruption of daily routines	Vulnerable and marginalized	PWDs especially Albinos Children People with chronic illnesses	Enhance emergency response funds Provision of shading and cooling facilities	Friendly urban infrastructure accommodating the vulnerable and marginalized Policy formulation that enhance involvement in decision making processes
Natural Assets						

Category	Hazard – Heat stress					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**Mitigation measures**
Urban Green Infrastructure	Y Urban parks Boulevards' Green rooftops Urban forests	Destruction of the urban ecosystem Degradation and corrosion of urban green infrastructure Vegetation Decline Increased cost of maintenance	Urban dwellers Urban Green Infrastructure	Urban dwellers Elderly Infants Children PWDs People with chronic illnesses	Enhance emergency response funds Provision of heat-resistant infrastructure	Resilient urban green infrastructure Policy formulation Land Use planning
Urban Blue Infrastructure	Y Wetlands Rivers Swamps Springs Lagoons Ponds	Destruction of the urban ecosystem Destruction of blue urban infrastructure Increased evapotranspiration Reduced water volumes	Dwellers along riparian areas Urban Blue Infrastructure	Elderly Women Children PWDs	Capacity building and creation awareness Environment al practices such as planting trees	Land use planning Resilient urban blue systems

Category	Hazard – Heat stress					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**Mitigation measures**
Peri-urban and Agricultural Systems	Y Kitchen gardens Urban farms Dairy farms	Food insecurity Loss of livelihoods from farming Destruction of urban farms, kitchen gardens and dairy farms Outbreak of diseases Loss of crops, livestock	Urban farms Dairy gardens pasture fields	Urban farmers Women PWDs Elderly	Diversification of urban agriculture	Climate- resilient peri- urban agriculture system Climate- resilient crops and livestock

Table 11: Hazard - Landslides

Category	Hazard – Landslides					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**mitigation measures**
Infrastructure & Services						
Stormwater Drainage	Yes Culverts Retention ponds Open drainage channels	Physical Damage to Drainage Infrastructure Blockage and Reduced Hydraulic Capacity Alteration of Natural Drainage Paths Accelerated Sedimentation Increased Flooding Risk	Drainage system Drainage personnel	Business premises next to storm water drainage system	Early warning systems Emergency preparedness	Storm water resilient infrastructure Protection of catchment areas Land use planning Awareness creation to keep drains clean Community initiatives on management of drainage systems

Category	Hazard – Landslides					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**mitigation measures**
Water & Wastewater Management	Y Sewer lines Water lines Water tanks Treatment plants.	water tanks, Pipes and sewer line destruction. Pollution of air, land and water Loss of lives Outbreak of diseases	Pipes Tanks Treatment plants Water and waste water management personnel	Plumbers Children PWDs Elderly	Emergency response funds Early warning systems	Land use planning and enforcement Routine maintenance Resilient infrastructure
Solid Waste Management	Y Transfer station Dumpsites	Damage of transfer stations and dumpsites Wastes swept away Pollution Outbreak of diseases	Transfer stations Dumpsites Waste equipment	Waste workers Transfer stations neighborhood	Emergency response fund Early warning systems	Resilient infrastructure Solid waste Policy enforcement Routine equipment maintenance

Category	Hazard – Landslides					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**mitigation measures**
Transport and Mobility	Y Bus parks Air strips Roads Non-Motorized Transport	Damage to transport and mobility infrastructure Delay in transport Accidents	Bus parks Air strips Non- Motorized Transport Roads	Pedestrians Business people Travelers	Emergency response funds Early warning systems	Routine maintenance Resilient infrastructure Policy enforcement Land use control and planning
Energy	Y Powerlines Solar panels Powered Generators	Damage to this poles, solar panels and generators Disruption of electricity, black outs, theft, and fire outbreaks, loss of lives economic loss Digital economy loss	Powerlines Solar panels Generators	All urban dwellers	Emergency Reponses and funding Back up energy systems	Resilient energy infrastructure Policy enforcement Land use control

Category		Hazard – Landslides				
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**mitigation measures**
Economic Infrastructure	Y Markets & sale yards Business premises Informal economy	Destruction of market infrastructure Loss of economic livelihoods Increased costs	Revenue Traders Economic assets	Elderly PWDs Children Business people	Early warning systems Emergency funds Embracing Digital Services	Climate- proofed market infrastructure Policy formulation and enforcement

Category	Hazard – Landslides					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**mitigation measures**
Social Infrastructure	Y Learning institutions Recreational centers Rescue centers health facilities Social halls	Interrupted learning activities Destruction of the institution's infrastructure Outstretched service delivery Overstrained government services Outbreak of diseases Early pregnancies Stressed society	School-going children Patients Social facilities	Children Patients Elderly PWDs Social workers	Early warning systems Emergency response services Emergency funds	Resilient and climate-proofed social infrastructure Capacity building & awareness creation Insurance to cushion losses Land use planning Environmental education Policy enforcement

Category	Hazard – Landslides					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**mitigation measures**
Emergency Services	Y Fire fighting Ambulance services Trauma centers Evacuation routes Emergency call centers Police facilities Assembly points	Overstretched resources both humanand financial Strained emergency response infrastructure Injuries and loss of emergency personnel's lives during rescue Exposure to diseases Disrupted services Congestion in assembly points Theft, defilement cases	Emergency response personnels Equipment and machines Police posts Assembly points	Emergency response staff	Toll-free number Emergency preparedness Early warning systems Emergency funds Emergency response services	Enhance multi-agency response coordination during landslides Compliance with development standards Enhance emergency operation centres Land use planning Set emergency assembly camps

Category	Hazard – Landslides					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**mitigation measures**
Populations						
Urban Residents	Y Residents Housing units	Injuries and loss of lives Interrupted Destruction of homestead s Disease outbreaks Stress and anxiety Acceleration of crime rates	Urban dwellers	Elderly Children Women PWDs	Emergency preparedness Early warning systems	Capacity building & awareness creation Land use planning Policy enforcement

Category	Hazard – Landslides					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**mitigation measures**
Informal Settlement Residents	Y Informal settlements	Injuries and loss of lives Destruction of informal homesteads Disease outbreaks Stress and anxiety Acceleration of crime rates	Informal structures Informal residents	Elderly Children Women PWDs	Emergency preparedness Early warning systems	Upgrading of informal settlements Policy enforcement Resilient infrastructures Land use planning (zoning)
Vulnerable and Marginalized Groups	Y Elderly Infants People with chronic illnesses PWDs	Loss of lives Loss of assets	Vulnerable and marginalized groups	Elderly Children Women PWDs	Emergency response funds	Involvement in decision making Set up a resilient infrastructure system
Natural Assets						

Category	Hazard – Landslides					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**mitigation measures**
Urban Green Infrastructure	Y Urban parks Boulevards' Green rooftops	Destruction of urban green infrastructure Infrastructural loss	Urban parks Boulevards Green rooftops	All urban dwellers	Emergency response funds Early warning systems	Resilient urban green infrastructure Land use planning Adherence to development standards Regular maintenance Awareness creation
Urban Blue Infrastructure	Y Wetlands Rivers Swamps Springs Lagoons	Soil erosion Loss of aquatic life Destruction of blue infrastructure Dam /stream Sedimentation River diversion	Urban dwellers along riparian areas	Elderly Women Children Land owners	Capacity building and awareness creation Environmental practices – planting trees	Adoption of resilient urban blue infrastructure Land use planning

Category	Hazard – Landslides					
	Impact (Y/N)	**Risks**	**Exposure**	**Vulnerability**	**Adaptation**	**mitigation measures**
Peri-urban and Agricultural Systems	Y Kitchen gardens Urban farms Dairy farms Irrigation systems Aggregation centers	Food insecurity Loss of livelihoods Destruction of urban farms, kitchen gardens and dairy farms Outbreak of diseases Loss of crops and livestock Disruption in food value chain Escalating of food prices Loss of land Loss of productive top soil	Urban farms Dairy Gardens Pasture fields	Urban farmers Women Elderly Children	Emergency response funds Early warning systems	Climate- resilient urban and peri-urban agricultural systems Diversification of urban agriculture

2.2 Climate indicators and hazard thresholds

This section introduces the key climate indicators and hazard thresholds used to assess current and future climate risks. Climate indicators are measurable variables such as temperature, precipitation and drought indices that describe changes in the climate system, while hazard thresholds define the levels at which these variables translate into adverse impacts on people, infrastructure and ecosystems. By linking observed and projected climate indicators to established thresholds, this assessment provides a consistent and evidence-based basis for identifying the onset, severity and escalation of climate hazards and for comparing risk levels across time periods and emissions scenarios.

The climatic hazards should be interpreted as high, medium and low, as shown in the table below.

Table 12: Hazard Interpretation

Level	Interpretation
High	Hazard events that are likely to occur with high frequency and/or intensity
Medium	Hazard events that are likely to occur with moderate frequency and/or intensity
Low	Hazard events that are likely to occur with low frequency and/or intensity

The tools/sources of climatic data are mainly from the World Bank Climate Knowledge Portal and SPEI database, Kenya Meteorological Department, local news outlets and field observations.

Table 13: Climate indicators and hazard thresholds selected for the assessment

Key Hazard	Climate indicator	Data source	Threshold
Pluvial flooding	No. of days with precipitation >50mm	https://climateknowledgeportal.worldbank.org/country/kenya/era5-historical	High
Extreme heat	Average Mean Surface Air Temperature	https://climateknowledgeportal.worldbank.org/country/kenya/era5-historical	Medium
Extreme precipitation pattern	Number of days per year with precipitation >100mm. 3 consecutive rainfall events with a total precipitation of 150mm	https://climateknowledgeportal.worldbank.org/country/kenya/era5-historical	High
Drought- Prolonged dry spell	10 days without rainfall, with <10mm; SPEI value of 2.1.	Kenya Metrological Department, SPEI data	Medium
Gully Erosion	Topographical threshold, soil, anthropogenic	Field observations	High

2.3 Current Hazard Levels and Climate Projections

2.3.1 Introduction

Kapenguria Municipality is currently exposed to multiple climate-related hazards, including recurrent droughts, intense rainfall events leading to flash flooding and gully erosion and rainfall-triggered landslides in surrounding highland and escarpment areas. Periods of water stress associated with below-average rainfall and rising

temperatures affect water supply, agriculture and livelihoods, while episodic heavy storms cause localized flooding, soil erosion and infrastructure damage. Climate projections for Kapenguria indicate continued increases in mean temperatures under both moderate and high-emissions scenarios, alongside greater rainfall variability during the long and short rain seasons. These projected changes are expected to intensify evapotranspiration and increase the frequency and severity of drought conditions, even where total rainfall does not decline substantially, while also raising the likelihood of extreme rainfall events that exacerbate flooding, erosion and landslide risks. Overall, climate change is projected to amplify existing hazards in Kapenguria by increasing climate extremes rather than altering average conditions alone.

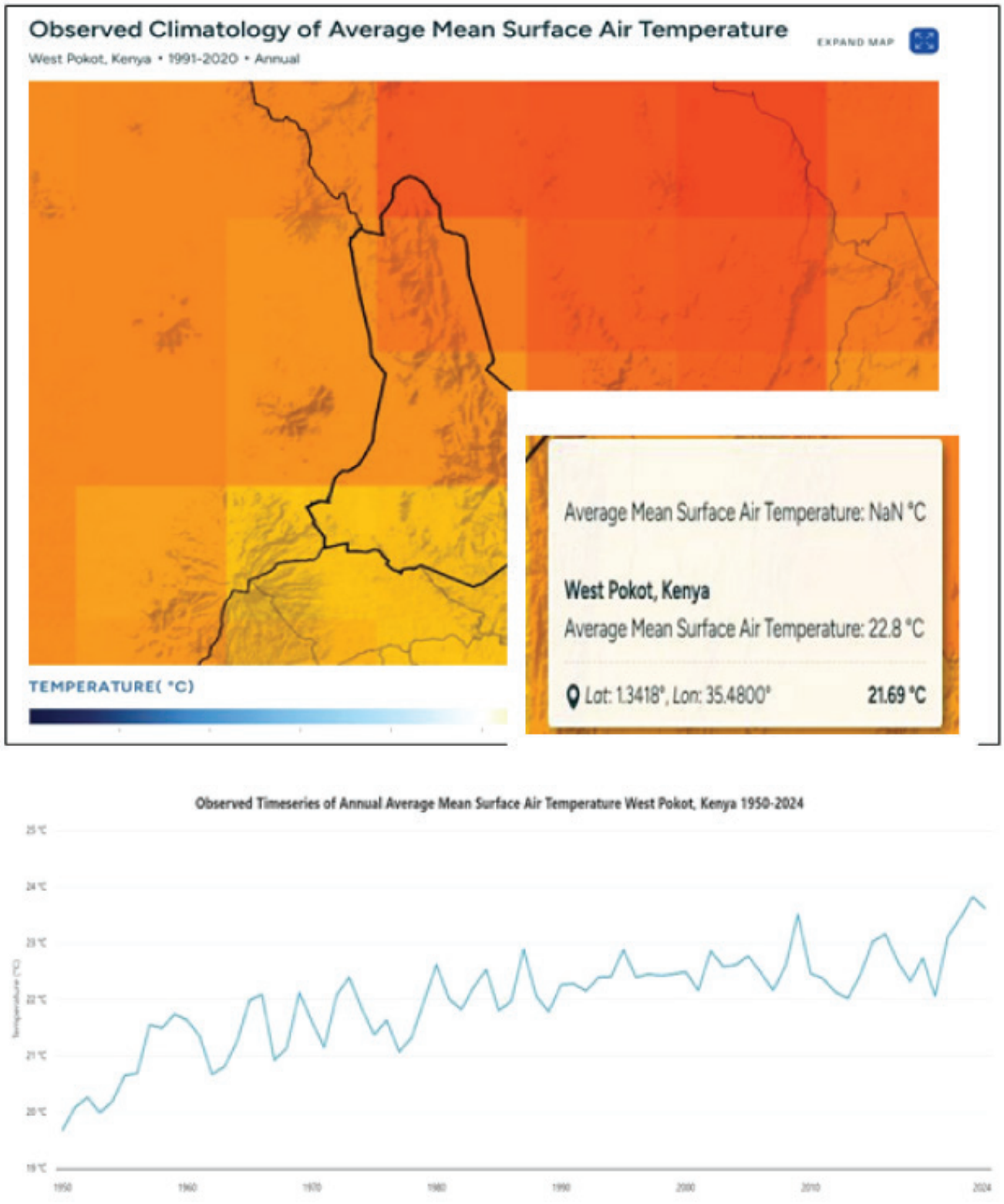


Figure 23: Average Mean Surface Air Temperature

Mean surface temperatures over the years shoes steady increase. The sustained increase in mean temperature intensifies heat stress, particularly in built-up urban areas and raises evapotranspiration rates, thereby exacerbating drought risk even in years with near-normal rainfall. Higher temperatures also amplify the impacts of rainfall extremes by increasing soil dryness before storms, which contributes to flash flooding, gully erosion and landslide susceptibility when intense rainfall occurs. Overall, the observed warming captured in the figure demonstrates that temperature rise is a cross-cutting driver that is already amplifying drought, heat stress and rainfall-related hazards and it provides a critical baseline for understanding how these risks are likely to worsen under future climate change.

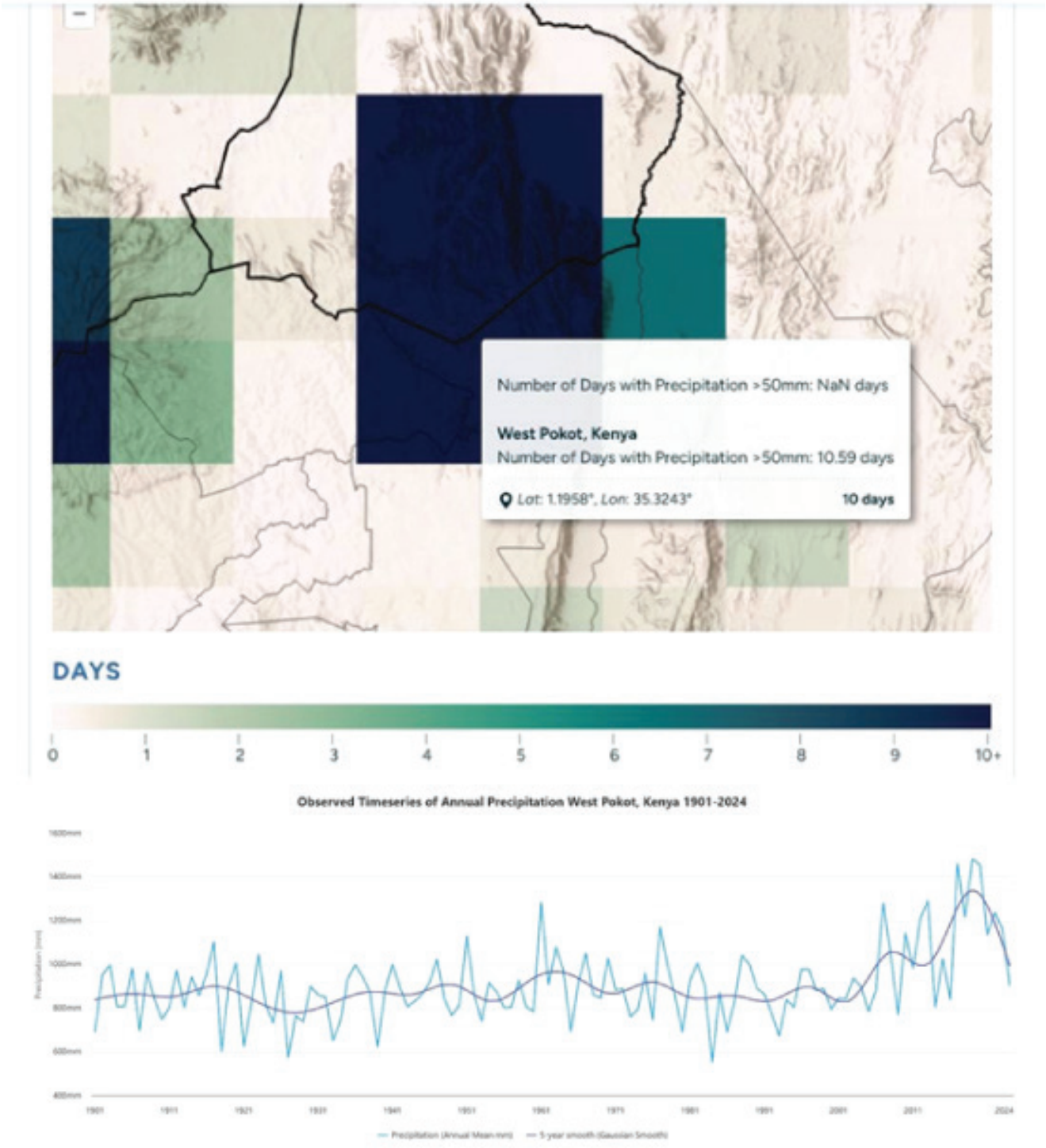


Figure 24: Annual Precipitation 1901-2024

The observed precipitation over the years shows increasing variability between 2011 and 2021 and a sharp decline from 2021-2024. These variations have been occasioned by extreme events such as landslides and flash floods.

2.3.2 Climatic hazard projections

Future climate hazard projections were assessed using a set of internationally accepted climate indicators that capture changes in temperature, moisture balance and rainfall intensity under different emissions pathways. For heat stress, projections rely on mean surface air temperature, which reflects long-term warming trends that directly influence human thermal comfort, health risks and urban heat accumulation. Rising mean temperatures are associated with increased frequency and intensity of heat stress conditions, particularly in urban areas where built surfaces amplify warming.

Shared Socioeconomic Pathways (SSPs) are meant to provide insight into future climates based on defined emissions, mitigation efforts and development paths. Under the moderate emissions (SSP2-4.5) scenario, mean surface air temperatures are projected to increase steadily by mid-century (~2050) and further by end-century (2100), while under the high emissions scenario (SSP5-8.5), substantially larger temperature increases are expected, significantly elevating heat stress risks by 2100.

Drought projections are assessed using the Standardized Precipitation– Evapotranspiration Index (SPEI), which integrates changes in precipitation and temperature-driven evapotranspiration to capture water balance deficits. SPEI is particularly suitable for climate change analysis because it reflects the intensifying effect of rising temperatures on drought severity. Future drought risk is expressed through changes in the frequency, duration and severity of negative SPEI values rather than single index values. Under SSP2-4.5, SPEI projections indicate a gradual increase in drought stress by mid-century, driven mainly by higher evapotranspiration even where rainfall changes are modest. Under SSP5-8.5, stronger warming leads to more frequent and severe drought conditions by 2100, with prolonged periods of negative SPEI indicating heightened risk to water resources, agriculture and ecosystems.

Projections of flash flooding and heavy erosion are primarily based on precipitation indicators, particularly changes in rainfall intensity, variability and extreme precipitation events. These hazards are less influenced by annual rainfall totals and more by short-duration, high-intensity rainfall that generates rapid surface runoff, overwhelms drainage systems and accelerates soil erosion. Climate projections indicate that under SSP2-4.5, rainfall variability and the occurrence of intense storm events are likely to increase by mid-century, raising the risk of localized flash floods and erosion. Under the SSP5-8.5 scenario, these extreme rainfall events are projected to become more intense and more frequent by 2100, substantially increasing flood peaks, gully erosion and landslide susceptibility, particularly in areas with steep slopes or degraded land cover.

Table 14: Current and future hazard levels for Kapenguria Municipality

			Hazard Level		
Hazard	Current (Baseline)	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
Drought	Medium	Low	High	Low	High
Flash floods	High	Medium	High	Low	High
Extreme heat	Medium	Low	High	Low	High
Landslides	High	Low	High	Medium	High
Gully erosion	Medium	Low	High	Low	High

Table 14 summarizes how the severity of key climate hazards evolves from current conditions to mid-century (2050) and end-century (2100) under moderate (SSP2-4.5) and high-emissions (SSP5-8.5) scenarios. Under current baseline conditions, Kapenguria Municipality faces medium drought and extreme heat risk, alongside high exposure to flash floods and landslides, reflecting existing rainfall variability and terrain-related vulnerabilities. By 2050, hazard levels diverge by scenario: under the moderate pathway (SSP2-4.5), most hazards temporarily reduce to low or medium levels, suggesting that emissions stabilization and moderate warming could limit near-term risk escalation; however, under the high-emissions scenario (SSP5-8.5), drought, extreme heat, gully erosion, flash floods and landslides intensify to high levels, driven by stronger warming and more extreme rainfall.

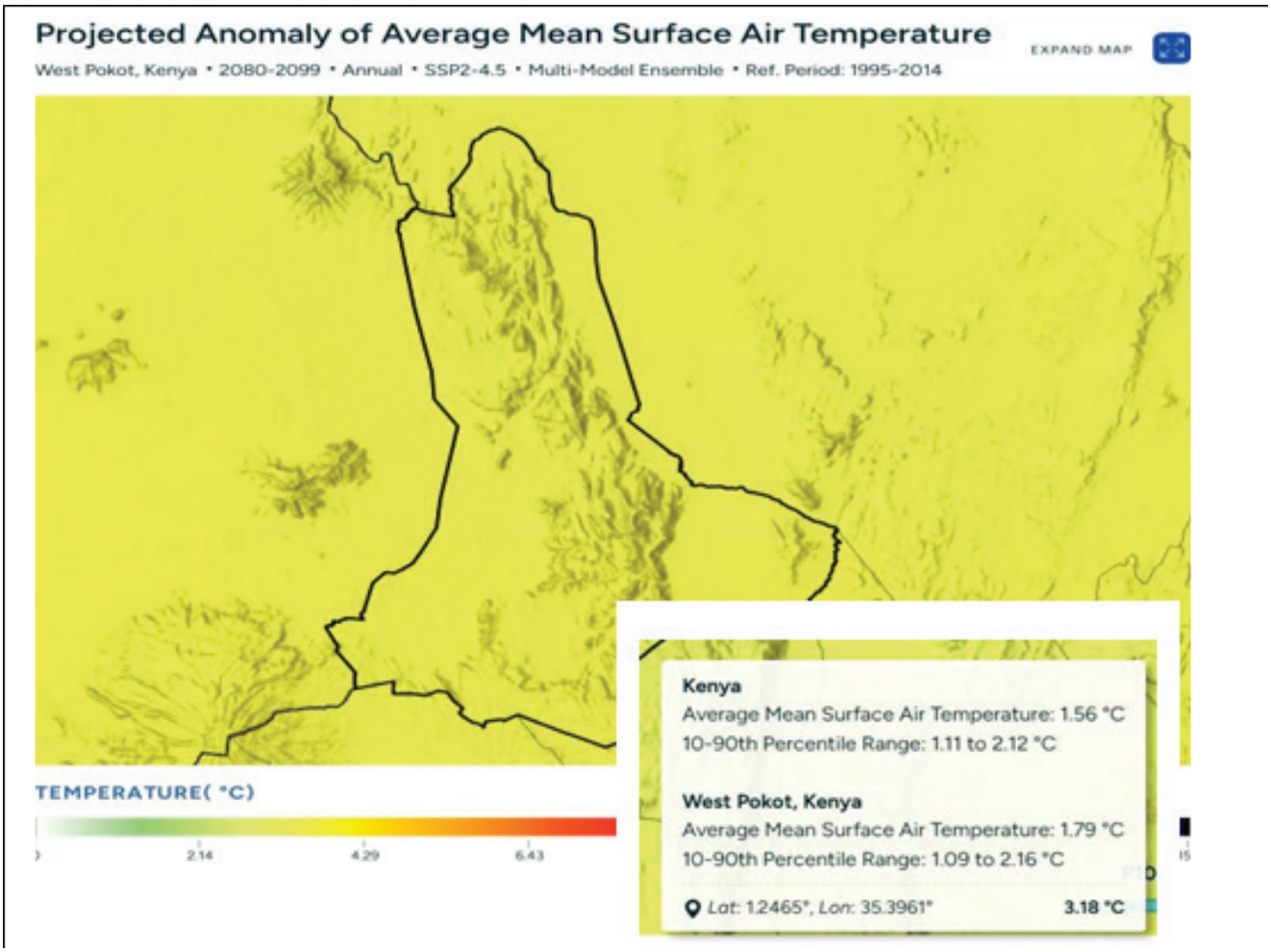


Figure 25:Temperature changes under SSP2(4.5) by the year 2100

By the year 2100, this contrast becomes more pronounced: SSP2-4.5 maintains generally low to medium hazard levels, while SSP5-8.5 shows consistently high risk across all hazards, indicating substantial amplification of heat stress, water deficits and rainfall-triggered impacts.

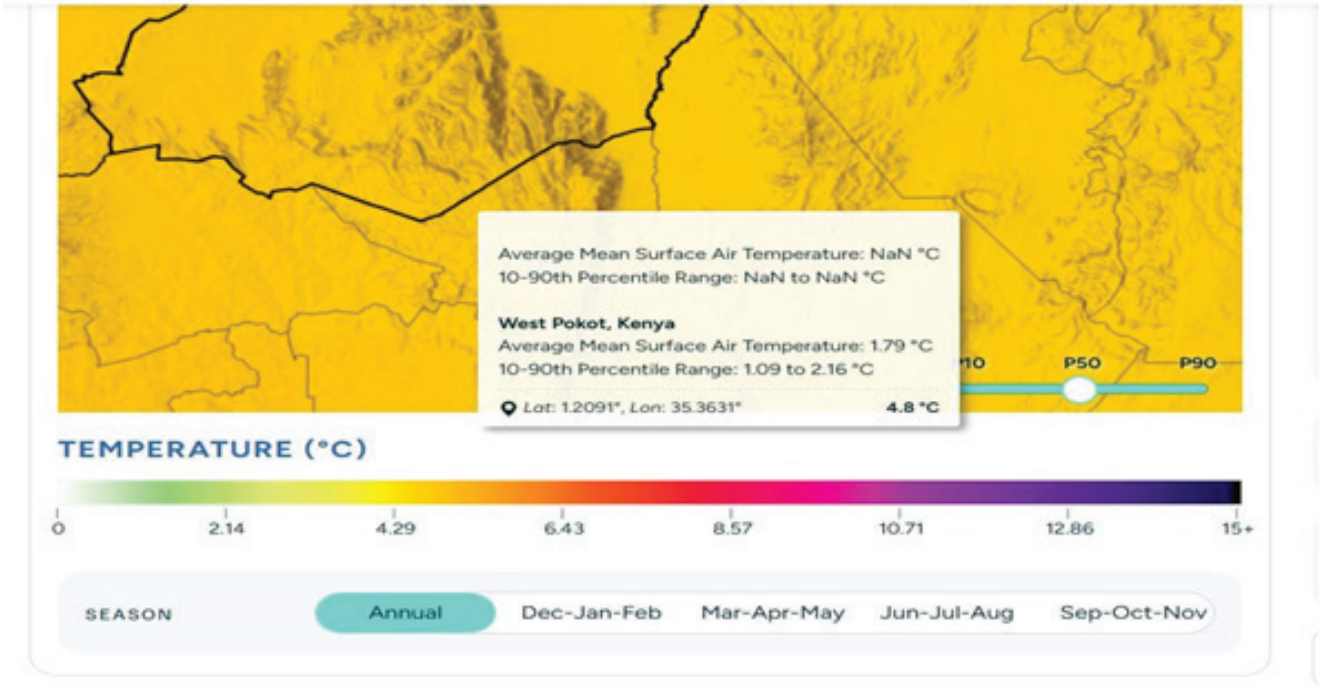


Figure 26:Temperature changes under SSP5-8.5 by the year 2100

The chart below illustrates projected temperature time series indicating that the Municipality will experience a continued and accelerating increase in mean surface air temperature from present day to 2100, with warming remaining relatively moderate under the SSP2-4.5 scenario but becoming substantially more pronounced under the high-emissions SSP5-8.5 pathway, particularly after mid-century, resulting in significantly higher average temperatures by 2100 compared to the historical baseline and implying a marked escalation of heat stress and climate-related risks over time.

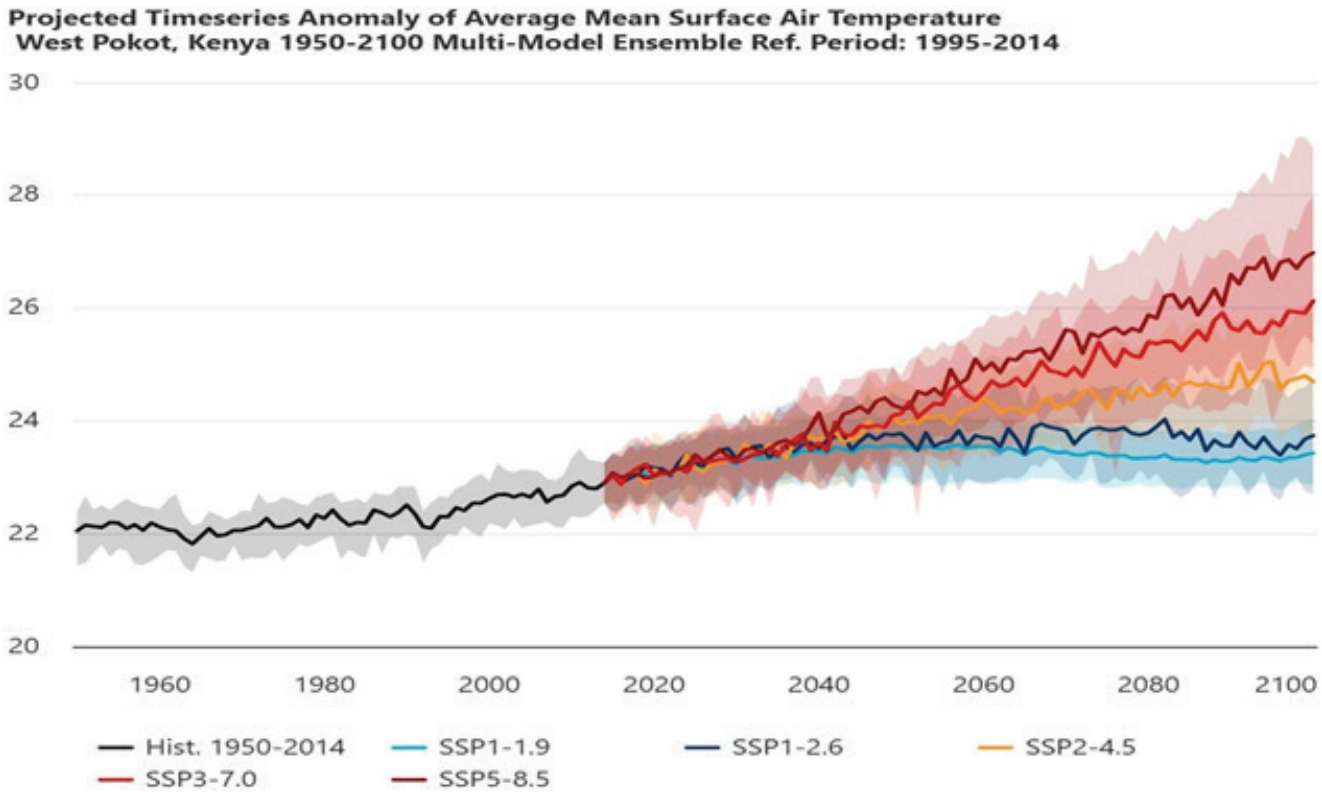


Figure 27: Average Mean Surface Air Temperature Projected Timeseries Anomaly

Overall, the projection illustrates that future hazard severity is highly sensitive to the emissions pathway, with strong mitigation significantly reducing long-term climate risks, while continued high emissions lead to widespread and severe hazard escalation

2.4 Current and Future Hazard Impact Areas

This section describes the spatial distribution of areas currently affected by climate- related hazards and how these impacts are expected to change under future climate conditions. It identifies locations that are already experiencing climate stresses, as well as areas likely to face increased hazard intensity, frequency, or spatial extent due to climate change.

Below are mapped areas according to hazard susceptibility in Kapenguria Municipality

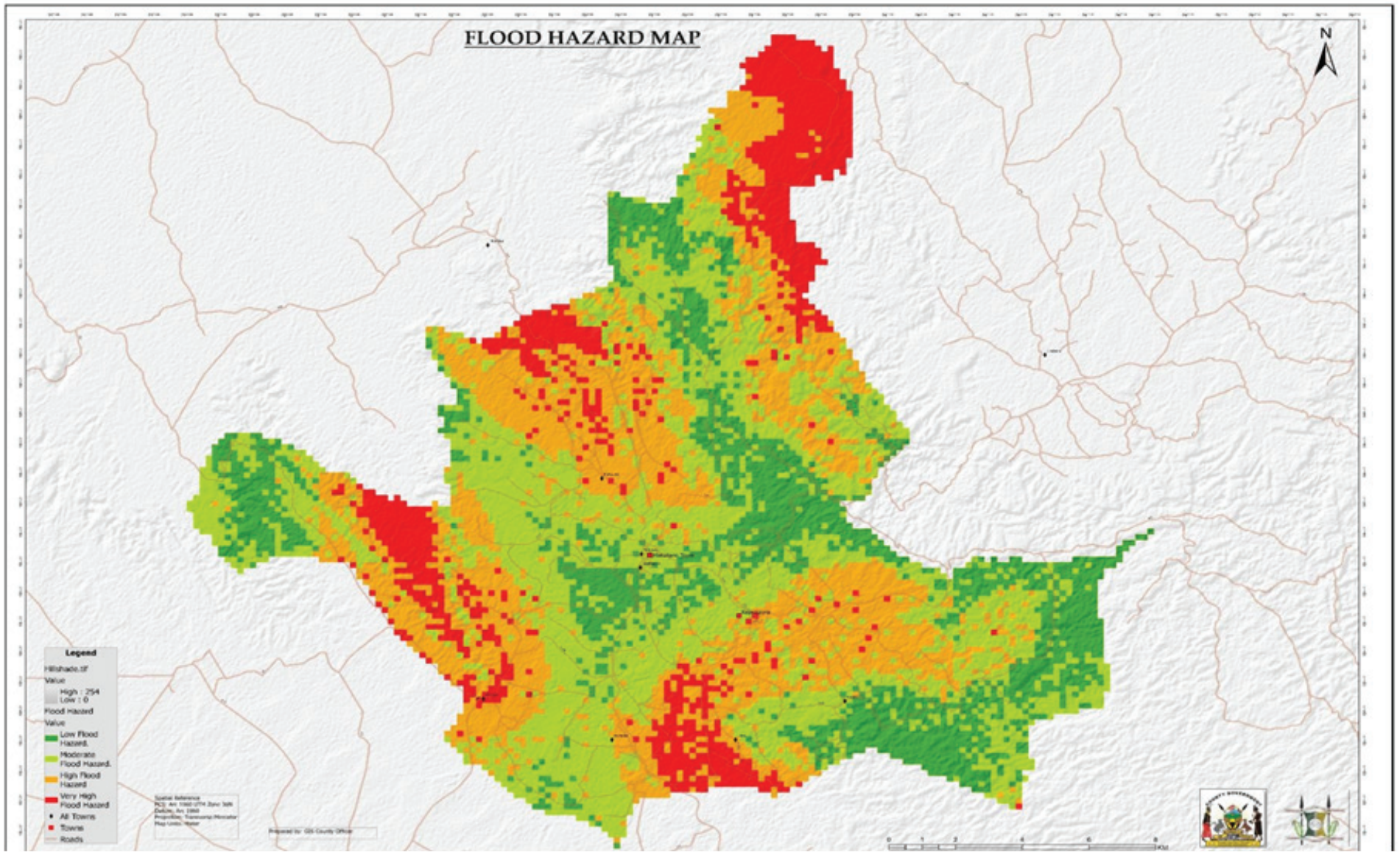


Figure 28: Floods Hazard Map

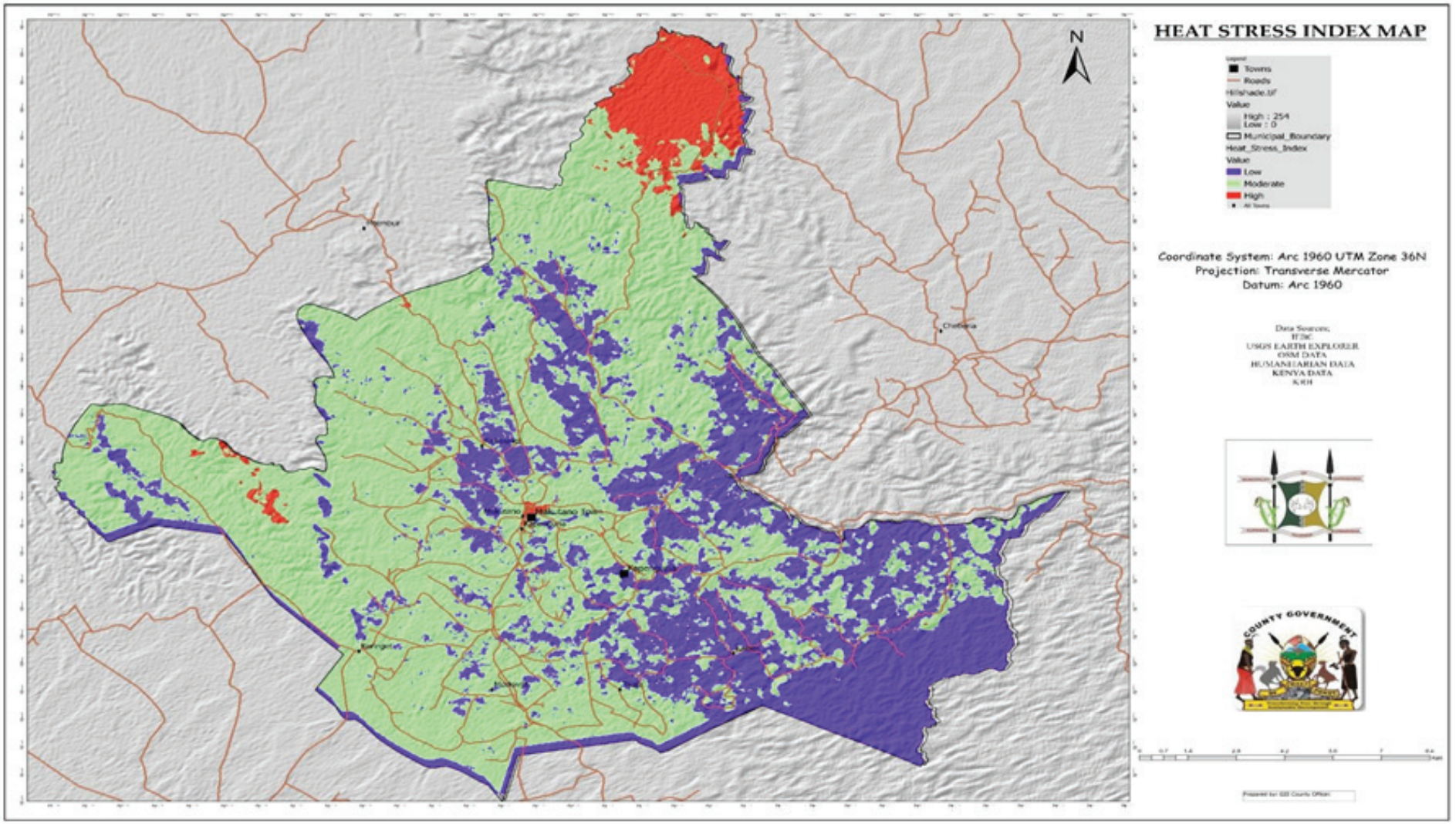


Figure 29: Heat Stress Index Map

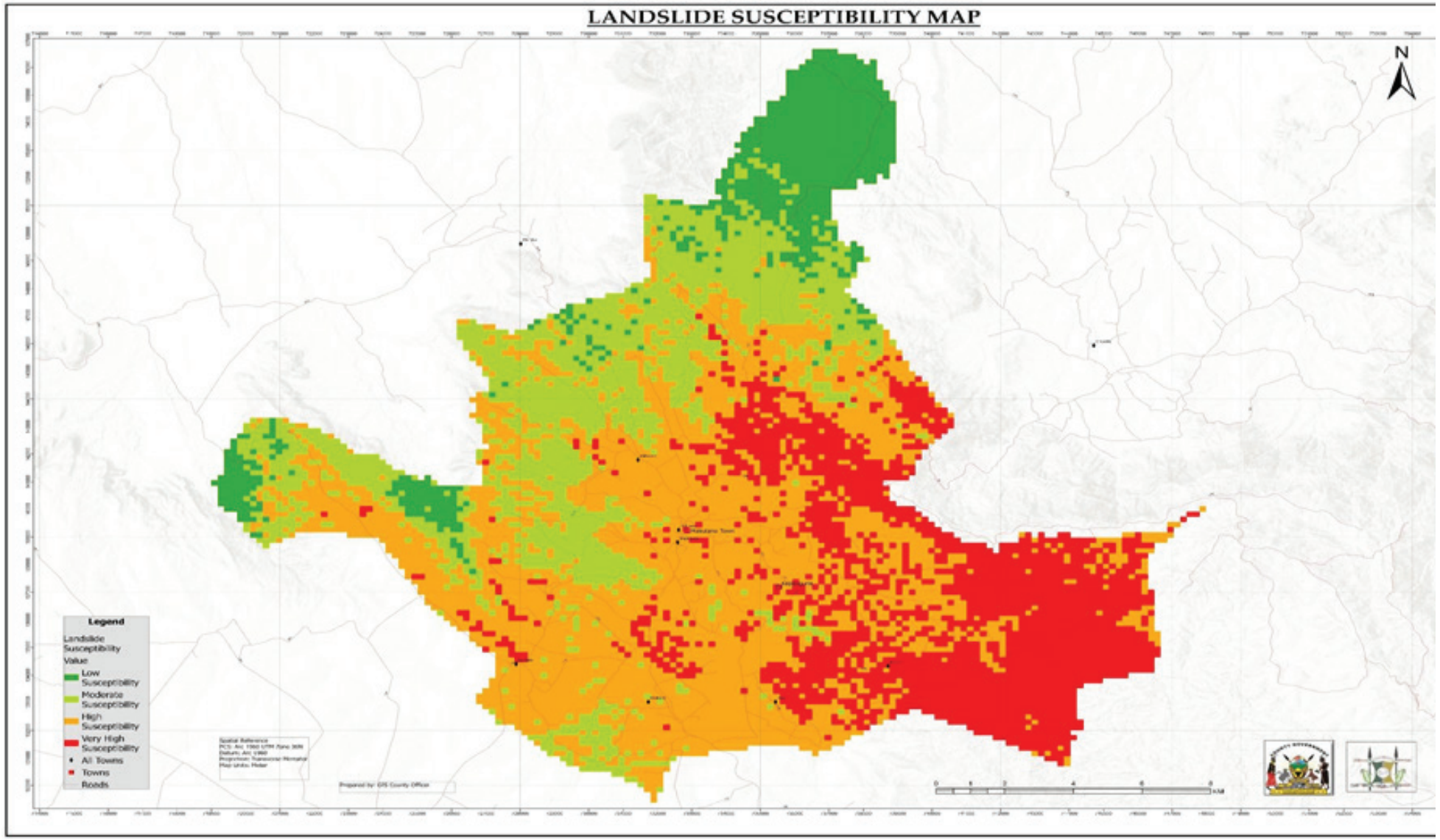


Figure 30: Landslide Susceptibility

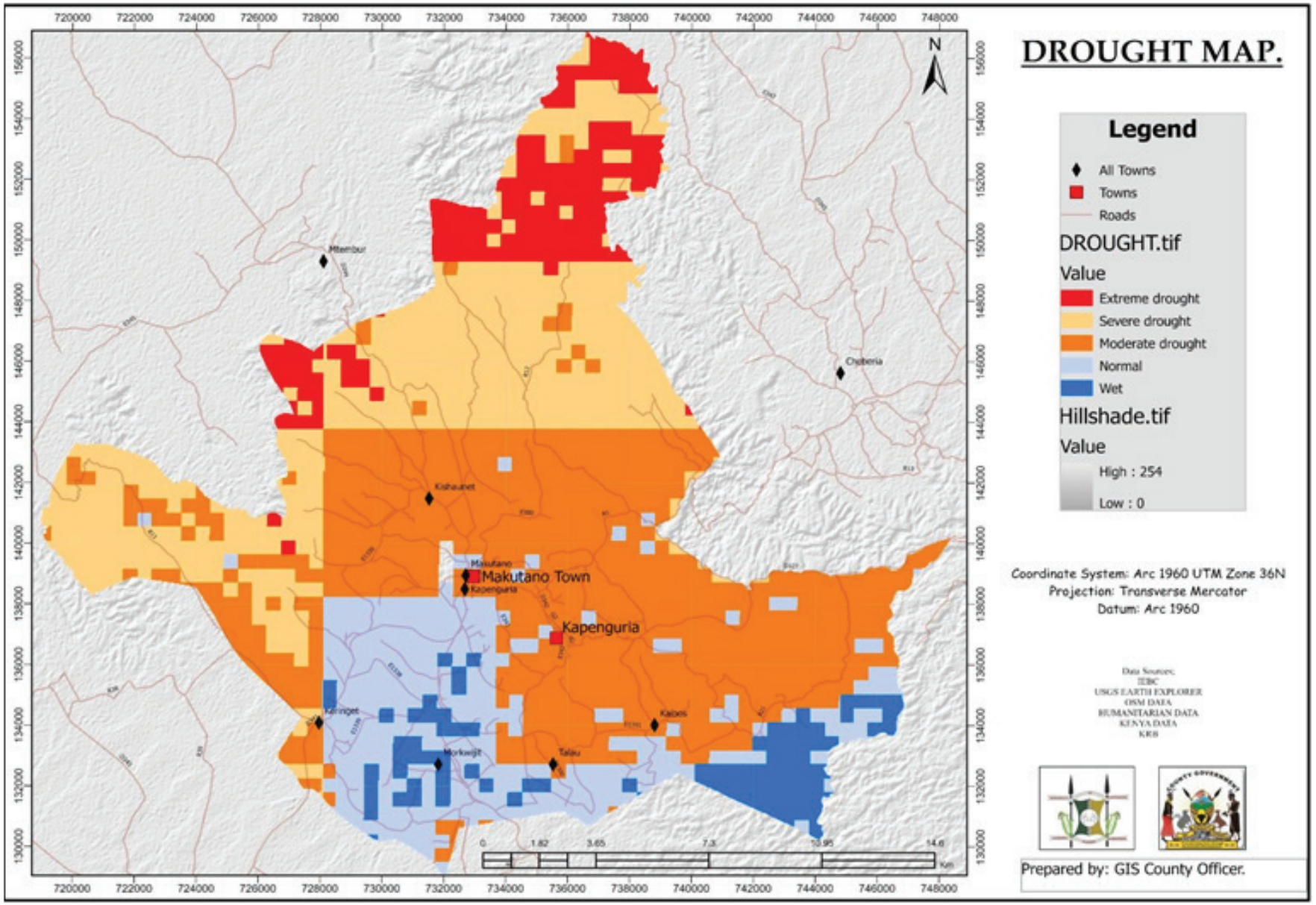


Figure 31: Drought Map

2.5 Exposure & Vulnerability Assessment

The ability of systems, institutions, or individuals to adjust to potential damage, take advantage of opportunities, or respond to consequences. High adaptive capacity (e.g., wealth, education, or technology) reduces overall vulnerability. This chapter examines the exposure and vulnerability of urban elements, i.e., people, infrastructure and key systems, to previously identified climate hazards, building on the hazard and climate projection analysis presented earlier. Exposure describes the presence of populations, assets and services in areas subject to climate hazards, while vulnerability reflects the degree to which these elements are susceptible to harm due to their physical characteristics, socio-economic conditions and adaptive capacity. The chapter jointly examines exposure and vulnerability by identifying which locations and sectors are most at risk under current conditions and how climate change may exacerbate existing sensitivities or create new vulnerabilities over time, thereby providing a basis for prioritizing targeted and effective adaptation measures.

2.5.1 Urban Elements

Urban elements in this case are all elements found in the urban ecosystem, including biotic and abiotic elements. At the center of it all, is the 'people'. The table below seeks to establish urban inventory in relation to climate change risk and whether they have been considered in Rapid Climate Risk Assessments (RCRA), which normally happen from time to time. The inventory also seeks to establish whether the elements have been mapped accordingly using the current technology such as Geographical Information System, while describing their names/ locations.

Table 15: Urban elements inventory

Category	Subcategory	Included in the RCRA (Y/N)	Available in GIS format (Y/N)	Description
Infrastructure & Services				
Stormwater Drainage	Stormwater drainage conveyance Network	Y	Y	Located within the municipality and more concentrated around Makutano town.
	Stormwater Storage	Y	N	Proposed areas ;Emboasis,Lokornoi
Water & Wastewater Managemen t	Pumping stations	Y	Y	Kotoruk, Talau, Karas,Psigirio,Chewoyet
	Groundwater abstraction	Y	Y	Entire Municipality,more on the lower sides
	Water treatment Facilities	Y	Y	Kotoruk, Kapenguria boys
	Water supply networks	Y	Y	From Tomena -Kapenguria boys-Chewoyet Kotoruk-Bendera Chepunpun -karas
	Sewer networks	Y	Y	Ongoing -Cereal-mawingo road -Nasokol-BCFC-Kaplelach Koror Proposed -Kapenguria KCRH -County headquarters -Chewoyet -Kamuino

Category	Subcategory	Included in the RCRA (Y/N)	Available in GIS format (Y/N)	Description
	Wastewater treatment Facilities	Y	Y	Ongoing Kaplelach koror Proposed- Kamuino
Solid Waste Management	Transfer facilities	Y	Y	Existing -Lutheran, Makutano primary, Mathare,Kcb ,Panama,Sunflower,Samaraitan ,Superfoam , Benera, Ngombemoja,Ola,024, Residence, Pillars, Kapenguria police station,KCRH.
	Landfills and dump sites	Y	Y	Next to KCRH (Non-desighnated)
	Recycling centers	Y	N	Proposed -Kopoch
	Collection fleet	Y	N	Serve the areas within Makutano town,Colletion trucks are parked in the department
Transport and Mobility	Road networks	Y	Y	Entire municipality
	Bridges	Y	Y	Along river Kotoruk -Cereal-Samaritan -Siyoi -Kaibos
	Public transport networks (rail, bus, mini-bus, etc.)	Y	Y	A-Kitale -Lodwar A1 Network ,Kapenguria -Alale road B-Tartar junction -kitale,Kamatiar -cheptongei road C-Murkwijit -Kaibos,Cereal-Chewoyet,Horizon-Kamuino raod D-Feeder Road;kapkoris-chemwochoi,KIwanja ndege ,kamorow- Keringet,Siyoi -Chepyomot,Siyoi-Kaprech Makutano Mini - bus stage

Category	Subcategory	Included in the RCRA (Y/N)	Available in GIS format (Y/N)	Description
	Transportation terminals	Y	Y	Kishaunet Airstrip, Keringet stage, Kapkoris stage ,Siyoi Stage, Makutano Stage ,Murkwijit stage, Aramaket stage, Bendera Stage
	Vehicle depots	Y	N	Proposed private at the Tartar junction
	Non-motorized transport networks	Y	Y	Donkey NMT, Porters, Bicycles-Entire municipality
	Freight and logistics hubs	N/A	N/A	Proposed KCRH Health and Emergency Supply Hub, Makutano Central Market, Kishaunet Airstrip.
Energy	Energy power Plants	N	Y	Outside the Municipality
	Poles and power Lines	Y	Y	From Turkwel -Kapenguria -Lessos
	Transformers and substations	Y	Y	Between shell and Rubi Transformers scattered within the municipality
	Street lighting	Y	Y	Makutano-Kishaunet Makutano-Lityei,soko mjinga,sokomoko Bendera, Mama Watoto ,Mawingo Road.
Economic Infrastructure	Markets	Y	Y	Ongoing makutano,Keringet,Kishaunet,Bendera,Cheptuya,
	Businesses and commercial hubs	Y	Y	Makutano, Siyoi, Bendera, Talau, Kapenguria, Karas, Kishaunet, Lityei, Murkwijit, Kerikeri.

Category	Subcategory	Included in the RCRA (Y/N)	Available in GIS format (Y/N)	Description
	Industrial zones/parks and logistics parks	Y	Y	Proposed Coffee factory in Psigirio,Tamkal millers, Kabesi Honey processing Hub.
Social Infrastructur e	Government buildings and service centers	Y	Y	National and County government Buildings
	Education Facilities	Y	Y	Kapenguria KMTC,Elgon view college,Murpus TTC,Proposed Kapenguria University College ,Several ECDEs,Primary and Seconadry
	Healthcare Facilities	Y	Y	Kapenguria KCRH,Ongoing Makutano Health Centre,Several Dispensaries and Health Centres
	Public spaces	Y	Y	Kapenguria Recreation Park,Chelanga Garden ,Police Round About
	Faith-based Buildings	Y	Y	AIC,Catholic ,Full gospel,Mosque,Deliverance ,PAG,KAG ,Lutheran and several in entire Municipality
	Cultural and heritage assets	N	Y	Kapenguria Museum,Mtelo Hall,Sengekwo Women Group
Emergency Services	Fire stations	Y	Y	Kapenguria fire Station
	Police stations	Y	Y	Kapenguria ,Makutano police Station, Murkwijit Post,Siyoi Post, Keringet Police Post.
	Telecommunications networks	Y	Y	Kapkoris,ACK Makutano,Bendera Catholic, Police, Mosque,
	Early warning systems	Y	Y	KMD and NDMA

Category	Subcategory	Included in the RCRA (Y/N)	Available in GIS format (Y/N)	Description
	Disaster management centers and Shelters	Y	Y	Emergency Operation Centre
	Evacuation Routes	N	N	N
Populations				
Urban Residents	Population	Y	Y	Entire Municipality
	Households	Y	Y	All households living in the Municipality
Informal Settlement Residents	Population living in informal settlements	Y	N	Mathare, Aramaket, Kisima
	Households lacking land tenure	N	Y	Around Makutano Town
	Households / residents lacking access to basic Services	Y	N	Mathare, Aramaket,Eastleigh,Kisima,SokoMoko and Sakas
Vulnerable and	Low-income households	Y	N	Mathare,Aramaket,Isli,Kisima,SokoMoko Sakas,Emboasis,Lokornoi ,Chemwochoi,Cheptuya ,Karas,Naramam,Kort ome,Kopoch

Category	Subcategory	Included in the RCRA (Y/N)	Available in GIS format (Y/N)	Description
Marginalized Groups	Women-headed households	Y	N	Entire Municipality
	Children and youth	Y	N	Entire Municipality
	Elderly persons	Y	N	Entire Municipality
	People with disabilities (PWD)	Y	N	Entire Municipality
	Homeless populations	Y	N	Mathare,Aramaket
	Unemployed or precariously employed Workers	Y	N	Mathare,Aramaket,Isli,Kisima,SokoMoko Sakas,Emboasis,Lokornoi ,Chemwochoi,Cheptuya ,Karas,Naramam,Kort ome,Kopoch
	Seasonal workers / migrant laborers	Y	N	Within Makatano,Congolese,Burundians, Ugandans
	Nomadic groups in peri-urban Areas	N/A	N/A	N/A
	Urban refugees and migrants	Y	N	Within Makutano

Category	Subcategory	Included in the RCRA (Y/N)	Available in GIS format (Y/N)	Description
	Minority ethnic groups in urban Areas	Y	Y	Talau,Makutano,Siyoi,Kaibos
Natural Assets				
Urban Green Infrastructure	Urban parks and Gardens	Y	Y	Chelanga, Kapenguria Recreation Park
	Green corridors	N	N	N/A
	Street landscaping	Y	N	Opposite Huduma Centre
	Urban forests and forest Reserves	Y	Y	Prisons,Kapenguria forest,KFS,Kamatira
Urban Blue Infrastructure	Natural wetlands	Y	Y	Keringet
	Rivers	Y	Y	Kotoruk,Chewoyet,Siyoi,
	Riparian zones	Y	Y	Koturuk ,Chewoyet,Siyoi
	Lakes, ponds and reservoirs	Y	N	Kitale posho Fish Pond(private) and others distributed within the Municipality
	Coastal ecosystems	N/A	N/A	N/A
	Urban agriculture	Y	N	Around Makutano town

Category	Subcategory	Included in the RCRA (Y/N)	Available in GIS format (Y/N)	Description
Peri-urban and Agricultural Systems	Peri-urban agriculture	Y	N	Outside Makutano town
	Agroforestry Systems	Y	Y	Aramaket Tree Nursery,Farmers have tree nurseries distributed within the Municipality,KFS,Prisons.
	Forests and forest reserves	Y	Y	Kapolot
	Protected areas and national parks	N	N	N
	Savannahs and rangelands	N	N	N

2.5.2 Exposure, Vulnerability and Impacts of Climate Hazards on Urban Elements

This section presents an assessment of the exposure and vulnerability of urban systems, populations and natural assets to key climate-related hazards affecting the Kapenguria Municipality. Exposure is understood as the presence of people, infrastructure, services, economic activities and ecosystems in locations that could be adversely affected by climate hazards, while vulnerability reflects the degree to which these elements are susceptible to harm, considering their sensitivity and capacity to anticipate, cope with and recover from hazard impacts.

The assessment adopts a multi-hazard approach, examining pluvial flooding, drought, landslides, extreme heat and gully erosion, all of which pose increasing risks due to climate variability, urban expansion and land-use change. For each hazard, exposure and vulnerability are analyzed across three main categories: infrastructure and services, populations and natural assets. This approach enables a comprehensive understanding of both direct and indirect impacts on urban functionality, livelihoods and environmental systems.

Table 16 that follow summarize hazard-specific exposure and vulnerability using qualitative descriptions and indicative levels (low, medium, high and very high). Vulnerability levels are derived from an integrated consideration of sensitivity, such as structural condition, socio-economic characteristics and environmental degradation and adaptive capacity, including preparedness, institutional arrangements and availability of resources. The resulting impact levels indicate the likely severity of consequences should a hazard occur.

Together, these tables provide a structured basis for identifying priority risk areas and systems, informing targeted risk reduction measures, investment planning and resilience-building interventions in subsequent sections of the report.

The interpretation of exposure and vulnerability levels was done as per Table 16 below:

Table 16: Exposure and Vulnerability Levels

Level	Exposure Level Interpretation	Vulnerability Level Interpretation
High	A large number and high-value urban elements (e.g., critical infrastructure, dense neighborhoods, major economic assets) are located within the hazard footprint.	The urban element is vulnerable to the climate hazard due to high natural sensitivity, considering physical and non-physical characteristics and limited adaptive capacity.
Medium	A moderate number or a mix of low- and medium-value urban elements are located within the hazard footprint.	The urban element is somewhat vulnerable to climate hazards due to moderate sensitivity and adaptive capacity.
Low	Few or no critical urban elements lie within the hazard footprint or area of impact.	The urban element is minimally vulnerable to climate hazard due to limited sensitivity and/or a high degree of adaptive capacity.

Table 17: Exposure, Vulnerability and Impacts of Drought - Prolonged dry spell on Urban Elements

HAZARD 1- DROUGHT					
Category	**Exposure (Description)**	**Exposure Level**	**Vulnerability (Description)**	**Vulnerability Level**	**Impact Level**
Infrastructure & Services					
Storm water Drainage	Low relevance; mostly dry channels affected indirectly by reduced water flow Closed drains are situated along, Toror – Jacaranda roads in Makutano township. Open line drain situated along Lotodo street, Kamuino, Lityei, Cereal – Sakas roads	Low	Sensitivity: Reduced flow may cause sediment accumulation Poorly maintained drains Poorly designed drains Poorly constructed drains Adaptive Capacity: Routine maintenance Redesign of drains	Low	Low
Water & Wastewater Management	Water supply systems, reservoirs and treatment plants. Most water and sewer trunk pipes/lines are located along road reserves, with some exposed due to washing. Sewer treatment works in Kaplelachkoror is located in a vast open area prone to high solar exposure Water tanks in Karas are located in the open, exposed to the dry season	Very High	Sensitivity: Reduced water availability for households and industries. Water and waste water infrastructure are designed and constructed with low-quality materials. Adaptive Capacity: Pipes laid are covered deep in the soil to increase cooling Rationing plans to be practiced	High	High

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Solid Waste Management	Water-dependent waste disposal (e.g., street cleaning, landfill leachate management). The dumpsite is located in an undesignated area next to Kapenguria Referral Hospital Waste receptacles are positioned strategically within urban areas of Makutano and Kapenguria in the open. Waste vehicles are parked within the Department of Lands offices and out in the open, exposing them to heat risks	Medium	**Sensitivity:** Reduced water limits cleaning, may increase fire risk. The dumpsite is in an undesignated area and poorly maintained, with no proper fence or gate Risk of spontaneous combustion/fire in dry waste piles. **Adaptive Capacity:** Relocation/designation of proper sanitary landfill Fencing, gating and daily covering of waste. Promotion of recycling/ segregation and regular collection schedules. Construction of parking site for solid waste trucks Community education on waste reduction	Medium	Medium

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Transport and Mobility	Roads and bridges. A large number of urban roads and streets are exposed to high temperatures during dry spells. The Makutano Matatu Stage is not covered with a roof Pedestrian walkways along key streets, e.g., Main Street, Lityei Rd, Kamuino Rd, are exposed. Increased dust on unpaved sections affects visibility and respiratory health.	Low	**Sensitivity:** Heat can damage asphalt; minimal direct impact from drought. Lack of shading increases heat stress for users. Dust exacerbates vehicle wear and tear Many roads are unpaved or low-quality asphalt, prone to cracking/ deterioration in heat/dryness. **Adaptive Capacity:** Regular maintenance mitigates effects Paving roads with heat-resistant materials. Tree planting along roads/ walkways for shade. Construction of covered bus parks and shaded pedestrian paths. Regular grading / maintenance of unpaved sections.	Low	Low

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Energy	Power plants, especially hydroelectric. Power lines in Emboasis experience short circuits, causing disruptions.	High	**Sensitivity**: Reduced water affects hydro generation. Some alternative power sources with limited capacity. **Adaptive Capacity:** Alternative sources of energy.	High	High
Economic Infrastructure	Industries and markets dependent on water	High	**Sensitivity**: Reduced water affects production and supply chains. **Adaptive Capacity**: Backup water sources for efficiency measures.	High	High
Social Infrastructure	Learning Institutions like Chemwochoi, Lokornoi, Cheptuya and Emboasi	Medium	**Sensitivity**: Water scarcity affects hygiene, sanitation and health. Extreme temperatures affect learning, especially in the afternoon. **Adaptive Capacity**: Emergency water supply plans. Nature-based designs.	Medium	Medium

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Emergency Services	Firefighting (Kapenguria fire station), police stations and health services	High	**Sensitivity**: Limited water for firefighting and hospitals. Limited mobile water units **Adaptive Capacity**: Water storage/ emergency water reservoirs. Establish more Mobile water units	High	High
Populations					
Urban Residents	Residents are reliant on municipal water	Very High	**Sensitivity**: Disruption of normal activities. Increased outbreak of drought-related diseases. **Adaptive Capacity**: Rationing systems in place	High	High
Informal Settlement Residents	Densely populated informal settlements e.g Aramaket, Eastleigh and Mathare.	Very High	**Sensitivity**: Highly exposed, limited access to water. Poor structures. **Adaptive Capacity**: Water rationing.	Very High	Very High

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Vulnerable and Marginalized Groups	Elderly, children, and people living with disabilities.	High	**Sensitivity**: Health risks from heat and water scarcity **Adaptive Capacity**: Depends on community or family support	High	High
Natural Assets					
Urban Green Infrastructure	Parks, street trees and green spaces (Makutano recreational park, Chelang'a garden and Jacaranda.)	High	**Sensitivity**: Vegetation suffers, loss of shade hence reduced cooling **Adaptive Capacity**: Drought-resistant vegetation.	High	High
Urban Blue Infrastructure	Rivers, canals, ponds	Very High	Sensitivity: Drying affects urban microclimate, water supply and ecosystem services. Adaptive Capacity: some wetlands exist that create micro-climate	High	High

Peri-urban and Agricultural Systems	Croplands and peri- urban farms in Siyoi, Keringet, Kishaunet and Kapchila	Very High	**Sensitivity**: Crop failure, livestock stress **Adaptive Capacity**: Traditional drought mitigation measures such as mulching.	Very High	Very High

Table 18: Pluvial Floods

Hazard 2. Exposure, Vulnerability and Impacts of Flash Floods on Urban Elements **HAZARD 2- PLUVIAL /FLASH FLOODS**					
Category	**Exposure (Description)**	**Exposure Level**	**Vulnerability (Description)**	**Vulnerability Level**	**Impact Level**
Infrastructure & Services					
Storm water Drainage	Existing drainage channels are often blocked by sediment and waste, and flood-prone catchments. Closed drains are situated along Kacheliba, Toror –Jacaranda roads in Makutano township. Open line drain situated along Lotodo street, Kamuino, Lityei, Cereal – Sakas roads Many drains run through low- lying areas such as Bondeni or converge in flood-prone zones; often clogged with silt/solid waste	High	Sensitivity: Old or undersized drains fail during heavy rainfall. Poorly maintained drains lead to frequent clogging Poorly designed drains underscore insufficient capacity Poorly constructed drains easily get damaged or eroded Drain blockage leads to overflow Regular maintenance is limited; few upgraded drainage systems. Adaptive Capacity: Redesigning and upsizing of drains Regular desilting and waste removal programs. Integration of retention basins and permeable surfaces.	High	High

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Water & Waste water Management	Treatment plants and pipelines in low-lying areas. Most water and sewer trunk pipes/lines are located along road reserves, often in low-lying or erosion-prone areas. Sewer treatment works in Kaplelachkoror can easily be washed and overflow during heavy rainfall. Water tanks in Karas are located in the open and are elevated, increasing vulnerability. Intake points along rivers Karas, Kotoruk and Siyoi are prone to flooding, affecting supply to urban residents.	Medium	**Sensitivity**: Potential contamination and service disruption. Water and wastewater infrastructure are designed and constructed with high-quality materials. Pipes exposed to erosion/scouring or inundation. High risk of sewage overflow and contamination of water sources. Treatment works vulnerable to flooding damage. **Adaptive Capacity**: Elevation or relocation of critical infrastructure. Backflow prevention valves and spill containment. Alternative borehole sources and treatment upgrades. Early warning-linked shutdown protocols.	Medium	Medium

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Solid Waste Management	Dumpsites near flood-prone areas; informal waste disposal along streets. Dumpsite is located next to Kapenguria Referral Hospital in a potentially storm – water pathway and can be washed. Waste receptacles are positioned strategically within urban areas of Makutano and Kapenguria and are often near drains. Waste vehicles are parked out in the open, exposing them to the effects of floods. Loose waste easily mobilized by floodwaters, causing blockages and haphazard dumping	High	**Sensitivity**: Waste can block drains; overflow contaminates streets. The dumpsite allows waste washed into waterways during heavy rains. Clogging of drains by scattered waste increases sensitivity. Increased vector-borne and waterborne disease risk from contaminated floodwater and stagnant water. **Adaptive Capacity**: Relocation of the dumpsite to a properly designated and developed site. Secure receptacles and covered storage reduce waste spillages. Enhanced collection frequency during rainy seasons. Community clean-up and segregation programs.	High	High

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Transport and Mobility	Roads, footpaths and bridges in low-lying or poorly drained zones. A large number of urban roads and streets in low-lying or valley areas prone to inundation. Makutano Matatu Stage in flat/open area with poor drainage easily get flooded. Pedestrian walkways along key streets near drains or seasonal streams are prone to washing. Unpaved municipal roads are highly susceptible to erosion and washouts.	High	**Sensitivity**: Roads prone to waterlogging; disruption of public transport. Limited/lack of elevated crossings or culverts increases the risks of flooding. Limited alternate routes; poor flood signage. **Adaptive Capacity**: Elevation of critical road sections to prevent flooding and washing. Improved culverts and bridges reduce risk of flooding. Construction of covered bus parks. Regular grading/maintenance of unpaved sections.	High	High

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Energy	Electrical substations and power lines in flood-prone areas. Overhead power lines crossing rivers/valleys or low-lying zones. Transformers and poles in areas with poor drainage. Firewood, which is a major source of fuel get washed and trees fall during flooding. Street-lights may get washed away and destroyed by floods	Medium	**Sensitivity**: Risk of short-circuiting and outages. Flooding causes short-circuits, pole collapse, or substation inundation. Erosion undermines pole foundations. Outages disrupt pumping, emergency services, online activities and communications. **Adaptive Capacity:** Elevation of substations and critical equipment. Underground cabling in high-risk zones. Backup generators and rapid restoration protocols.	Medium	Medium

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Economic Infrastructure	Markets, shops and commercial buildings in lowlands. Markets, shops and small industries in low-lying commercial zones (e.g., Kishaunet Center). Warehouses and stores near roads/drain prone to flooding. Trade that is dependent on roads is frequently cut off during flooding. Informal businesses are prone to flood risks due to their location e.g. on road reserves	High	**Sensitivity**: Businesses suffer water damage, stock loss. Stock damage from inundation. Business interruption and access loss. Increased costs for cleanup and restocking. Limited insurance coverage; slow recovery. **Adaptive Capacity**: Elevated storage platforms. Flood insurance and business continuity plans. Diversified supply chains. Raised market structures	High	High

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Social Infrastructure	Learning institutions, hospitals such as Kapenguria referral hospital and community centers in flood-prone zones.	Medium	**Sensitivity**: Service interruption, damage to facilities. Inundation disrupts services and damages buildings. Contaminated water increases disease outbreaks. Access roads cut off. Facilities get washed and destroyed. Some emergency plans, but limited capacity for extended closure. **Adaptive Capacity**: Raised plinths and flood barriers. On-site water treatment and reserves. Evacuation plans and temporary facilities. Community early warning integration.	Medium	Medium

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Emergency Services	Fire stations, police stations, ambulance routes	Medium	**Sensitivity**: Flooded roads slow response. Few alternative routes; vehicles may be affected. **Adaptive Capacity**: Pre-positioned supplies and coordinated early warning. Community-based response teams are equipped with skills to respond.	Medium	Medium

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Populations					
Urban Residents	People living in flood-prone neighborhoods. Areas like Tilak, lower Siyoi, Chesra, Chepunpun	High	**Sensitivity**: Risk to health and property loss due to limited early warning. Some awareness, but limited evacuation options **Adaptive Capacity**: Create evacuation routes	High	High
Informal Settlement Residents	Densely populated informal settlements in low-lying areas like Mathare and Aramket.	Very High	**Sensitivity**: Highly exposed; weak housing structures **Adaptive Capacity**. Evacuation Upgrade of the informal housing structures	Very High	Very High
Vulnerable and Marginalized Groups	Elderly, children, people with disabilities	High	**Sensitivity**: Unable to evacuate or cope with flooding **Adaptive Capacity**: Dependent on family/community support.	High	High

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Natural Assets					
Urban Green Infrastructure	Parks (Makutano Recreational Park), green spaces and trees in flood pathways	Medium	**Sensitivity**: Can help absorb water, but may be damaged Poor maintenance reduces function **Adaptive Capacity**: Some flood retention features and design.	Medium	Medium
Urban Blue Infrastructure	Rivers(Kotoruk), ponds within urban area	High	**Sensitivity**: Susceptible to overflowing due to poor embankments. Some flood control structures exist but are poorly maintained **Adaptive Capacity**: Flood control structures. Observing the riparian land minimum requirements.	High	High
Peri-urban and Agricultural Systems	Farmlands near urban edges eg Tartar, Kakrut and Murkwijit.	Medium	**Sensitivity**: Soil erosion, crop loss. Water pollution (pesticides and fertilizers) **Adaptive Capacity**: Traditional flood management practices (terraces and gabions)	Medium	Medium

Table 19: Exposure, Vulnerability and Impacts of Extreme Heat on Urban Elements

HAZARD 3-EXTREME HEAT					
Category	**Exposure (Description)**	**Exposure Level**	**Vulnerability (Description)**	**Vulnerability Level**	**Impact Level**
Infrastructure & Services					
Storm water Drainage	Mostly exposed through drying, cracking and sediment build-up during prolonged heat. (Makutano town)	Low	**Sensitivity**: Poorly maintained drains Poorly designed drains Poorly constructed drains **Adaptive Capacity**: Routine maintenance possible. Redesign of drains	Low	Low
Water & Wastewater Management	Water supply systems, reservoirs, and pumping stations are exposed to increased demand	Very High	**Sensitivity**: Higher water demand; reduced supply availability Limited water storage **Adaptive Capacity**: Rationing, Water storage, emergency supply measures Heat-proof pipes	High	High

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Solid Waste Management	Collection points, dumpsites, are exposed to high temperatures	High	**Sensitivity**: Increased bad smell, fire risk, health hazards **Adaptive Capacity**: cooling measures at collection points Regular collection and disposal Waste to energy programs	High	High
Transport and Mobility	Roads, air strips, and sidewalks are exposed to prolonged heat	High	**Sensitivity**: Asphalt softening, road deformation, reduced walkability **Adaptive Capacity**: Heat- resistant materials Reactive maintenance	Medium	Medium
Energy	Power generation, transmission lines and substations	Very High	**Sensitivity**: Peak electricity demand overheating equipment **Adaptive Capacity**: Load Shedding	High	High

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Economic Infrastructure	Markets, industrial areas and informal trading spaces	High	**Sensitivity**: Reduced productivity Spoilage of goods **Adaptive Capacity**: cooling facilities Insurance	High	High
Social Infrastructure	Learning Institutions, hospitals and care facilities	High	**Sensitivity**: Heat stress for users; cooling demand increases **Adaptive Capacity**: Fans/ Air Condition Trees shade Green rooftops and enough ventilation.	High	High
Emergency Services	Fire, ambulance, disaster response units	High	**Sensitivity**: Increased emergency calls; staff heat stress **Adaptive Capacity**: Cooling equipment and rest facilities	High	High

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Populations					
Urban Residents	Residents in densely built-up areas with limited green space	Very High	**Sensitivity**: Heat stress, dehydration, reduced productivity **Adaptive Capacity**: Access to cooling and water storage	High	High
Informal Settlement Residents	Residents in overcrowded, poorly ventilated housing	Very High	**Sensitivity**: Extreme indoor temperatures; poor housing materials **Adaptive Capacity**: Cooling options i.e fans/Air Conditioning Improved housing structures	Very High	Very High
Vulnerable and Marginalized Groups	Elderly, children, pregnant women, outdoor workers	Very High	**Sensitivity**: High risk of heat-related illness and mortality **Adaptive Capacity**: Dependence on caregivers and services	Very High	Very High

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Natural Assets					
Urban Green Infrastructure	Urban trees, parks, green corridors	High	**Sensitivity**: Vegetation stress and die-off **Adaptive Capacity**: Irrigation and maintenance	Medium	Medium
Urban Blue Infrastructure	Rivers, ponds, wetlands	High	**Sensitivity**: Evaporation, reduced water quality **Adaptive Capacity**: Protection of streams and wetlands. Natural cooling functions (i.e. absorbing heat, enabling evaporation, breeze)	Medium	Medium
Peri-urban and Agricultural Systems	Farms, livestock areas near urban edges	Very High	**Sensitivity**: Crop failure, livestock heat stress **Adaptive Capacity**: Irrigation and climate-smart Practices	High	High

Table 20: Exposure, Vulnerability and Impacts of Landslides on Urban Elements

HAZARD 4- LANDSLIDES					
Category	**Exposure (Description)**	**Exposure Level**	**Vulnerability (Description)**	**Vulnerability Level**	**Impact Level**
Infrastructure & Services					
Storm water Drainage	Drainage channels on slopes or near cut slopes	Medium	**Sensitivity**: Poor drainage can trigger slope failure **Adaptive Capacity**: Slope stabilization Reactive maintenance	Medium	Medium
Water & Wastewater Management	Pipelines and treatment plants on or near slopes	Medium	**Sensitivity**: Damage to pipelines from soil movement **Adaptive Capacity**: Land use planning	Medium	Medium
Solid Waste Management	Dumpsites on or near slopes	High	**Sensitivity**: Waste runoff can trigger slides **Adaptive Capacity**: Regulation and maintenance	High	High
Transport and Mobility	Roads, footpaths, air strip	High	**Sensitivity**: Roads blocked are destroyed Likelihood of accidents **Adaptive Capacity**: Alternate routes established	High	High

HAZARD 4- LANDSLIDES					
Category	**Exposure (Description)**	**Exposure Level**	**Vulnerability (Description)**	**Vulnerability Level**	**Impact Level**
Energy	Electrical poles, substations on slopes	Medium	**Sensitivity**: Poles may collapse; line interruptions **Adaptive Capacity**: Alternative sources of energy.	Medium	Medium
Economic Infrastructure	Businesses and commercial buildings on hillsides	Medium	**Sensitivity**: Structural damage; inventory loss **Adaptive Capacity**: Slope mitigation and insurance coverage	Medium	Medium
Social Infrastructure	Schools, hospitals near slopes	Medium	**Sensitivity**: Damage risk to buildings, disruption of services **Adaptive Capacity**: Emergency Plans Evacuation paths	Medium	Medium
Emergency Services	Fire stations, police posts, hospitals	Medium	**Sensitivity**: Access hindered; vehicles at risk **Adaptive Capacity**: Emergency Response plans	Medium	Medium

HAZARD 4- LANDSLIDES					
Category	**Exposure (Description)**	**Exposure Level**	**Vulnerability (Description)**	**Vulnerability Level**	**Impact Level**
Populations					
Urban Residents	Residents living on hillsides or unstable slopes	High	**Sensitivity**: Houses prone to collapse; Injuries and displacement likely **Adaptive Capacity**: Knowledge of Evacuation	High	High
Informal Settlement Residents	Slum settlements on steep slopes	Very High	**Sensitivity**: Weak housing, overcrowding, highly exposed **Adaptive Capacity**: Evacuation	Very High	Very High
Vulnerable and Marginalized Groups	Elderly, PWDs, children	High	**Sensitivity**: Less able to evacuate quickly **Adaptive Capacity**: Depend on family/community support	High	High

HAZARD 4- LANDSLIDES					
Category	**Exposure (Description)**	**Exposure Level**	**Vulnerability (Description)**	**Vulnerability Level**	**Impact Level**
Natural Assets					
Urban Green Infrastructure	Urban parks, Trees and vegetation on slopes	Medium	**Sensitivity**: Vegetation may reduce landslide risk if maintained; removal increases hazard **Adaptive Capacity**: Slope stabilization programs	Medium	Medium
Urban Blue Infrastructure	Streams and drainage along slopes	High	**Sensitivity**: Erosion and saturation increase landslide risk **Adaptive Capacity**: Regular embankment maintenance	High	High
Peri-urban and Agricultural Systems	Farms on hillsides or steep terrain in areas like Chemwochoi, Kopoch, Kaprom and Komol	Medium	**Sensitivity**: Soil loss, crop damage, blocked access **Adaptive Capacity**: Traditional terracing or stabilization methods	Medium	Medium

Table 21: Exposure, Vulnerability and Impacts of Gully Erosion on Urban Elements

HAZARD 5: GULLY EROSION					
Category	**Exposure (Description)**	**Exposure Level**	**Vulnerability (Description)**	**Vulnerability Level**	**Impact Level**
Infrastructure & Services					
Storm water Drainage	Open drains, roadside channels and unlined culverts are exposed to concentrated runoff	Very High	**Sensitivity**: High erosion of unlined channels; structural collapse **Adaptive Capacity**: Regular maintenance	Very High	Very High
Water & Wastewater Management	Water pipelines and sewer lines crossing erosion-prone areas	High	**Sensitivity**: Pipe exposure, rupture and service disruption **Adaptive Capacity**: Protection and repairs	High	High
Solid Waste Management	Waste dumping along drainage lines and gullies	High	**Sensitivity**: Waste accelerates erosion and blocks flow **Adaptive Capacity**: Enforcement and cleanup activities	High	High

HAZARD 5: GULLY EROSION					
Category	**Exposure (Description)**	**Exposure Level**	**Vulnerability (Description)**	**Vulnerability Level**	**Impact Level**
Transport and Mobility	Roads, footpaths, bridges near drainage channels	Very High	**Sensitivity**: Road undermining, collapse of shoulders and culverts **Adaptive Capacity**: Reactive repairs, Erosion-control structures	Very High	Very High
Energy	Power poles and underground cables near gullies	Medium	**Sensitivity**: Pole instability; cable exposure **Adaptive Capacity**: Relocation alternatives	Medium	Medium
Economic Infrastructure	Markets, workshops, storage facilities near eroded corridors	High	**Sensitivity**: Structural damage, loss of access **Adaptive Capacity**: Insurance and relocation options	High	High
Social Infrastructure	Learning Institutions, health centers near drainage lines	Medium	**Sensitivity**: Safety risks and access disruption **Adaptive Capacity**: Protective works and designs	Medium	Medium

HAZARD 5: GULLY EROSION					
Category	**Exposure (Description)**	**Exposure Level**	**Vulnerability (Description)**	**Vulnerability Level**	**Impact Level**
Emergency Services	Fire brigade, police, ambulance access routes	Medium	**Sensitivity**: Gullies block access and response time **Adaptive Capacity**: Alternative routes	Medium	Medium
Populations					
Urban Residents	Residents living near drainage corridors or unstable land	High	**Sensitivity**: Risk of property loss and injury **Adaptive Capacity**: Protection works Emergency funds	High	High
Informal Settlement Residents	Settlements located along drainage paths and floodways	Very High	**Sensitivity**: Housing collapse; displacement common **Adaptive Capacity**: Tenure security or mitigation options	Very High	Very High
Vulnerable and Marginalized Groups	Elderly, children, persons with disabilities	High	**Sensitivity**: High injury risk; evacuation challenges **Adaptive Capacity**: Dependence on others	High	High

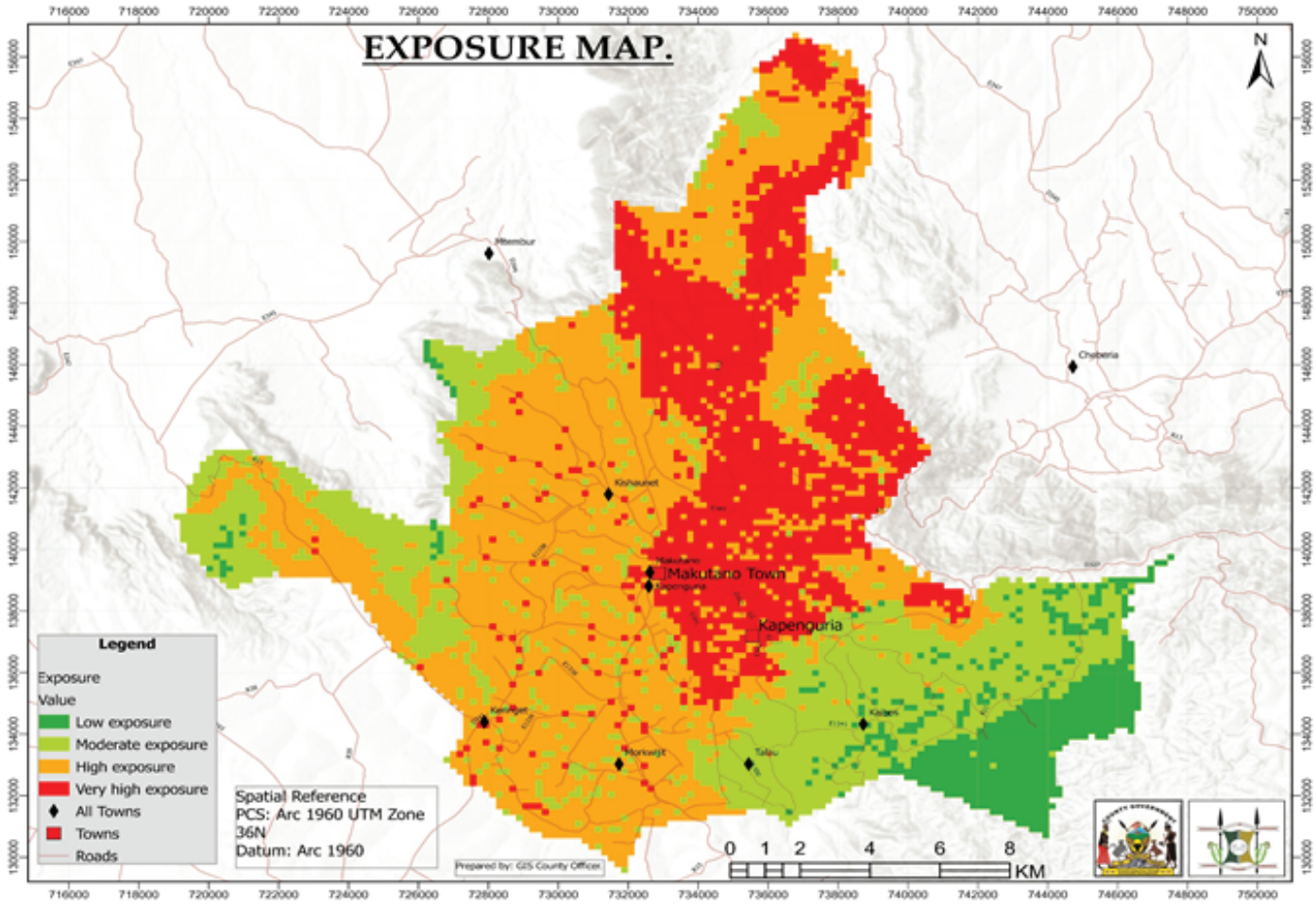
Natural Assets					
Category	**Exposure (Description)**	**Exposure Level**	**Vulnerability (Description)**	**Vulnerability Level**	**Impact Level**
Urban Green Infrastructure	Vegetated areas along slopes and drainage lines	Medium	**Sensitivity**: Vegetation loss accelerates erosion **Adaptive Capacity**: Revegetation and slope protection	Medium	Medium
Urban Blue Infrastructure	Rivers, streams, urban channels	Very High	**Sensitivity**: Channel deepening and bank collapse **Adaptive Capacity**: Engineered stabilization works	High	High
Peri-urban and Agricultural Systems	Farms, grazing land near urban edges	High	**Sensitivity**: Loss of fertile soil; Land fragmentation **Adaptive Capacity**: Traditional controls	High	High

Summary of Key Findings

Urban systems and populations in Kapenguria Municipality are exposed to a range of climate hazards whose impacts vary spatially and sectorally but collectively pose significant risks to service continuity, livelihoods and human well-being. From the analysis above, the following could be deduced:

1. Pluvial flooding presents widespread exposure across low-lying and poorly drained areas, affecting major transport networks, stormwater infrastructure, informal settlements and economic nodes such as the Kapenguria-Lodwar trunk road. Vulnerability is high where drainage systems are undersized or obstructed, solid waste management is weak and adaptive capacity is constrained by limited maintenance, early warning and emergency response mechanisms. Informal settlement residents and critical infrastructure located along natural drainage corridors exhibit the highest vulnerability and impact levels.
2. Drought exposure is primarily concentrated in water-dependent systems and populations. Water supply, wastewater services, energy generation, emergency services and peri-urban agriculture experience very high exposure due to prolonged rainfall deficits and increasing demand. Vulnerability is driven by high sensitivity to water scarcity and limited adaptive capacity, including inadequate storage, weak demand management and reliance on single water sources. Informal settlements and vulnerable population groups are disproportionately affected due to limited access to affordable water, reduced coping mechanisms and heightened health risks.
3. Landslide risk is spatially localized but severe in hilly and steep-slope areas where settlements, transport infrastructure and utilities are sited on unstable terrain. Exposure is highest along road corridors, informal hillside developments and waste disposal sites located on slopes. Vulnerability stems from poor slope drainage, vegetation removal, weak construction standards and limited slope stabilization measures. Informal settlements on steep slopes face very high vulnerability due to fragile housing, high population density and limited evacuation capacity, resulting in potentially catastrophic impacts.
4. Extreme heat affects nearly all urban systems but with particularly high exposure in dense, built-up areas characterized by impervious surfaces and limited green cover. Populations, energy systems, water services, health facilities and economic activities exhibit very high exposure to heat stress. Vulnerability is amplified by poor housing quality, lack of passive cooling, rising energy demand and limited access to cooling and water. Informal settlement residents, outdoor workers and vulnerable groups such as the elderly and children experience the highest vulnerability and impact due to prolonged exposure and minimal adaptive capacity.
5. Gully erosion represents a highly destructive localized hazard, especially along uncontrolled stormwater pathways, road corridors and settlement edges. Exposure is highest where concentrated runoff intersects with unlined drainage systems, weak road infrastructure and informal development. Vulnerability is driven by highsensitivity of infrastructure to erosion, inadequate erosion control measures, poor land-use regulation and limited institutional capacity for preventive interventions. Transport networks, stormwater systems and informal settlements exhibit very high vulnerability, often resulting in permanent land loss, infrastructure collapse and displacement.

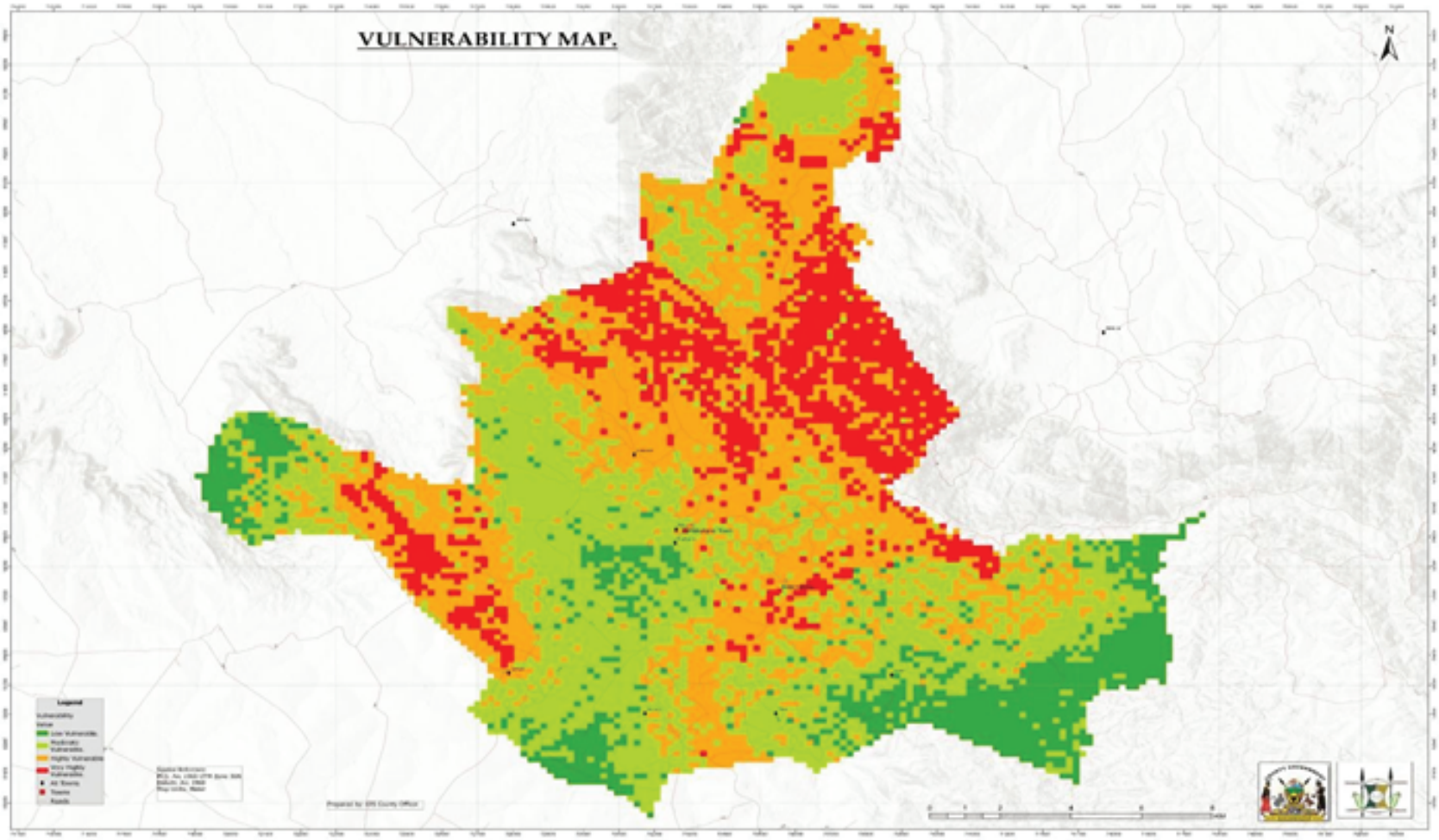
Across all hazards, informal settlements, vulnerable populations and aging or poorly maintained infrastructure consistently emerge as the most exposed and vulnerable. Limited adaptive capacity—manifested through weak planning enforcement, insufficient investment in resilient infrastructure and constrained social protection mechanisms significantly amplifies risk. The assessment underscores the need for integrated, multi-hazard risk reduction strategies that combine structural interventions, ecosystem-based solutions, improved service delivery and targeted social protection to reduce exposure and vulnerability in urban area



This exposure map illustrates the spatial distribution of people, infrastructure, and key urban assets exposed to climate-related hazards. It highlights areas where populations, housing, critical services, and economic activities overlap with hazard-prone zones, indicating locations where climate impacts could result in significant social, economic, and infrastructure losses. Areas with high population coupled with topographical challenges have the highest exposure rate. Areas with relatively high-capital infrastructure such as roads and water pipes also have high exposure rate compared to areas with natural assets such as forests.

Source: field observation and mapping.

Figure 32: Exposure Map



This map illustrates the spatial distribution of vulnerability to climate hazards, reflecting socio- economic conditions, infrastructure quality, and environmental sensitivity that influence the ability of communities and systems to anticipate, cope with, and recover from climate impacts. Beyond spatial exposure, vulnerability is determined by socio-economic conditions, demographic characteristics, infrastructure quality, institutional capacity, access to basic services, environmental conditions, and the adaptive capacity of communities and systems.
Source: field observation and mapping.

Figure 33: Vulnerability Map

CHAPTER 3 CLIMATE RISK ASSESSMENT

This section assesses both current and future climate risks on key urban elements, focusing on infrastructure and services, populations and natural assets. It integrates hazard exposure with vulnerability considerations, including sensitivity and adaptive capacity, to identify systems and groups most at risk under present conditions and projected climate scenarios. The analysis provides the foundation for prioritizing adaptation measures, guiding resilient urban planning and informing climate- responsive investment decisions in subsequent sections of the assessment.

Table 22: Risk matrix

		Hazard Level		
		Low	Medium	High
Impact Level	Catastrophic	High	Very High	Very High
	Major	Medium	High	Very High
	Moderate	Low	Medium	High
	Minow	Low	Low	Medium
	Insignificant	Very Low	Low	Low

For this Urban Climate Risk Profile, risk levels should be interpreted based on the table below.

Table 23: Interpretation of risk levels

Level	Interpretation
Very High	Very high risks are unacceptable. Risk should be avoided, reduced or transferred. Immediate planning and implementation of risk reduction measures is required. Allocate resources and coordinate interventions to prevent or minimize impact.
High	High risks should be actively addressed. Develop and implement mitigation actions promptly. Monitor environmental indicators and ensure readiness of emergency or adaptation measures.
Medium	Medium risks should be managed. Plan and implement mitigation activities to reduce them to acceptable levels. Regularly review climate data and risk levels.
Low	Low risks are acceptable under current conditions. Minimal control or monitoring is needed, provided they remain stable and do not escalate.
Very Low	Very low risks are negligible in terms of likelihood and consequences. No immediate action is required beyond routine monitoring and periodic review.

3.1 Current and Future Climate Risks on Urban Elements

1. DROUGHT

Table 24:Summary of Drought Risks for Kapenguria Municipality

	Hazard Level	Risk Levels				
Categories	**Impact**	**Current**	**2050 SSP2-4.5**	**2050 SSP5-8.5**	**2100 SSP2-4.5**	**2100 SSP5-8.5**
Infrastructure & Services						
Storm water Drainage	Insignificant	Low	Low	Low	Low	Low
Water & wastewater Management	High	high	medium	high	medium	High
Solid Waste Management	Insignificant	Low	low	Low	low	Low
Transport and Mobility	Medium	Medium	Medium	High	Medium	High
Energy	Medium	Low	Low	Medium	Medium	High
Economic Infrastructure	Medium	Medium	Low	Medium	Low	High
Social Infrastructure	Medium	Medium	Low	Medium	Medium	High
Emergency Services	Medium	Medium	medium	High	Medium	High
Populations						
Urban Residents	High	High	medium	High	medium	High
Informal settlement Residents	High	High	High	high	high	High
Vulnerable and Marginalized Groups	High	High	High	high	high	High

	Hazard Level	Risk Levels				
Categories	Impact	Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
Natural Assets						
Urban Green Infrastructure	High	medium	Low	Medium	Medium	High
Urban Blue Infrastructure	High	medium	low	High	Medium	High
Peri-urban and Agricultural Systems	High	High	Medium	High	Medium	High

2. PLUVIAL FLOODS

Table 25: Summary of Pluvial risks for Kapenguria Municipality

			Risk Levels			
Categories	Impact	Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
Infrastructure & Services						
Stormwater Drainage	Catastrophic	High	High	High	High	High
Water & Wastewater management	Moderate	High	High	High	High	High
Solid Waste Management	Insignificant	Low	Low	Low	Low	Low
Transport and Mobility	Moderate	High	High	High	High	High
Energy	Insignificant	Low	Low	Low	Low	Low
Economic Infrastructure	Insignificant	Low	Low	Low	Low	Low
Social Infrastructure	Insignificant	Low	Low	Low	Low	Low
Emergency Services	Insignificant	Low	Low	Low	Low	Low

Categories	Impact	Current	Risk Levels			
			2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
Populations						
Urban Residents	Major	Very high	Very High	Very high	Very high	Very high
Informal Settlement Residents	Catastrophic	Very high	Very high	Very high	Very high	Very high
Vulnerable and Marginalized Groups	Moderate	High	High	High	High	High
Natural Assets						
Urban Green Infrastructure	Insignificant	Low	Low	Low	Low	Low
Urban Blue Infrastructure	Minor	Medium	Medium	Medium	Medium	Medium
Peri-urban and Agricultural Systems	Minor	Medium	Medium	Medium	Medium	Medium

3. EXTREME HEAT

Table 26: Summary of Extreme heat risks for Kapenguria Municipality

Categories	Impact	Current	Risk Levels			
			2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
Infrastructure & Services						
Storm water Drainage	Insignificant	Low	Low	Low	Low	Low
Water & Wastewater Management	Moderate	Medium	High	High	High	High
Solid Waste Management	Insignificant	Low	Low	Low	Low	Low
Transport and Mobility	High	medium	Low	High	Low	High

		Risk Levels				
Categories	**Impact**	**Current**	**2050 SSP2-4.5**	**2050 SSP5-8.5**	**2100 SSP2-4.5**	**2100 SSP5-8.5**
Energy	High	Low	Low	Medium	Low	High
Economic Infrastructure	Medium	Low	Low	Low	Low	Low
Social Infrastructure	Medium	Low	Low	Medium	Low	Medium
Emergency Services	High	medium	Low	Medium	medium	High
Populations						
Urban Residents	Medium	Low	Low	High	Medium	High
Informal Settlement Residents	High	Medium	Medium	High	Medium	High
Vulnerable and Marginalized Groups	High	Medium	Medium	High	Medium	High
Natural Assets						
Urban Green Infrastructure	High	Low	Medium	High	Medium	High
Urban Blue Infrastructure	High	Low	Medium	High	Medium	High
Peri-urban and Agricultural Systems	High	Medium	Medium	High	Medium	High

4. LANDSLIDES

Table 27:Summary of Landslide Risks for Kapenguria Municipality

Categories	Impact	Risk Levels				
		Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
Infrastructure & Services						
Storm water Drainage	High	Low	Low	Medium	Medium	High
Water & Wastewater Management	Medium	Low	Low	Medium	Medium	High
Solid Waste Management	Medium	Low	Low	Medium	Medium	Medium
Transport and Mobility	High	Medium	Medium	High	Medium	High
Energy	High	Medium	Medium	High	Medium	High
Economic Infrastructure	High	Medium	Medium	High	Medium	High
Social Infrastructure	High	medium	Medium	High	Medium	High
Emergency Services	High	Low	Low	High	Low	Medium
Populations						
Urban Residents	High	Medium	Low	Medium	Medium	High
Informal Settlement Residents	High	Medium	Low	High	Medium	High
Vulnerable and Marginalized Groups	High	Medium	Medium	High	Medium	High
Natural Assets						
Urban Green Infrastructure	High	High	Medium	High	Medium	High
Urban Blue Infrastructure	High	High	Medium	High	Medium	High
Peri-urban and Agricultural Systems	High	High	Medium	High	Medium	High

5. GULLY EROSION

Table 28:Summary of Landslide Risks for Kapenguria Municipality.

		Risk Levels				
Categories	**Impact**	**Current**	**2050 SSP2-4.5**	**2050 SSP5-8.5**	**2100 SSP2-4.5**	**2100 SSP5-8.5**
Infrastructure & Services						
Storm water Drainage	High	Low	Low	Medium	Low	High
Water & Wastewater Management	Medium	Low	Low	medium	Low	High
Solid Waste Management	Medium	Low	Low	Medium	Low	High
Transport and Mobility	High	Low	Low	Medium	Low	High
Energy	High	Low	Low	Medium	Low	High
Economic Infrastructure	High	Low	Low	Medium	Low	High
Social Infrastructure	High	Low	Low	Medium	Low	High
Emergency Services	High	Low	Low	Medium	Low	High
Populations						
Urban Residents	Low	Low	Low	Medium	Low	Medium
Informal Settlement Residents	Medium	Low	Low	medium	Low	Medium
Vulnerable and Marginalized Groups	Medium	Low	Low	medium	Low	Medium
Natural Assets						
Urban Green Infrastructure	Medium	Low	Low	Medium	Low	Medium
Urban Blue Infrastructure	Medium	Low	Low	Medium	Low	Medium
Peri-urban and Agricultural Systems	Medium	Low	Low	Medium	Low	Medium

3.2 Climate Risk Hotspots

Climate risk hotspots refer to specific geographic areas where the interaction of climatic hazards, high exposure of people and assets and underlying vulnerability results in disproportionately high climate risk. Identifying these hotspots helped prioritize adaptation interventions, inform land-use planning and guide investment towards areas where climate impacts are likely to be most severe. Climate risk hotspots were identified through the overlay of hazard intensity and frequency (such as flooding, drought, extreme heat, landslides and erosion), exposure of critical urban elements (including population, housing, infrastructure and economic assets) and vulnerability factors such as poverty levels, informal settlements, environmental degradation and limited access to basic services.

The analysis reveals that climate risk hotspots are predominantly concentrated in low- lying floodplains, river corridors, steep or unstable slopes, densely populated informal settlements and areas with inadequate drainage and degraded ecosystems. These locations experience recurrent climate shocks and have limited adaptive capacity, increasing the likelihood of significant human, economic and environmental losses. Their concentration is driven by a combination of physical factors (such as topography and proximity to water bodies), rapid and unplanned urbanization, encroachment into hazard-prone areas, inadequate infrastructure and socio-economic vulnerabilities, including poverty and limited access to early warning and emergency response systems.

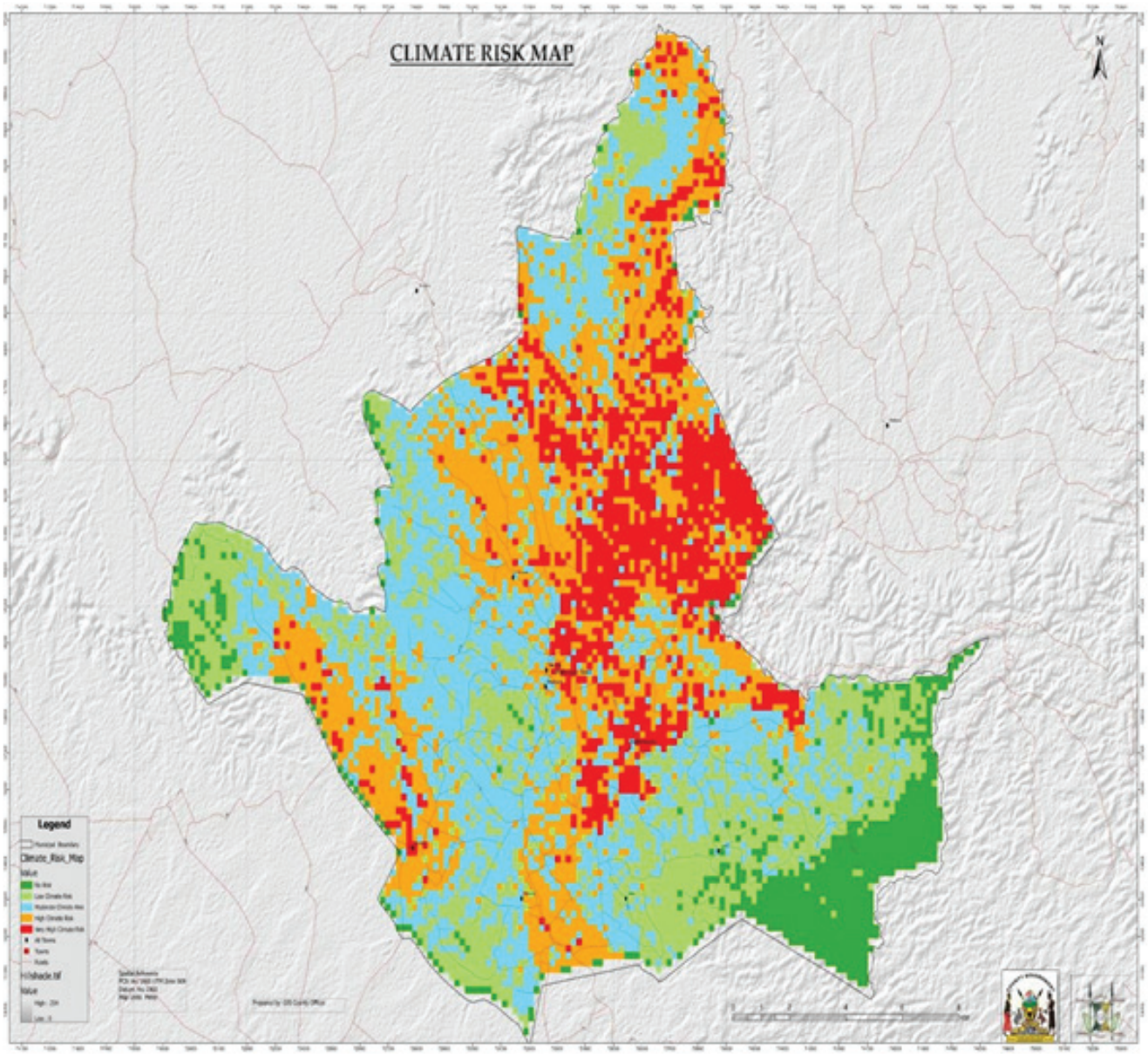


Figure 34:Climate Risk Map

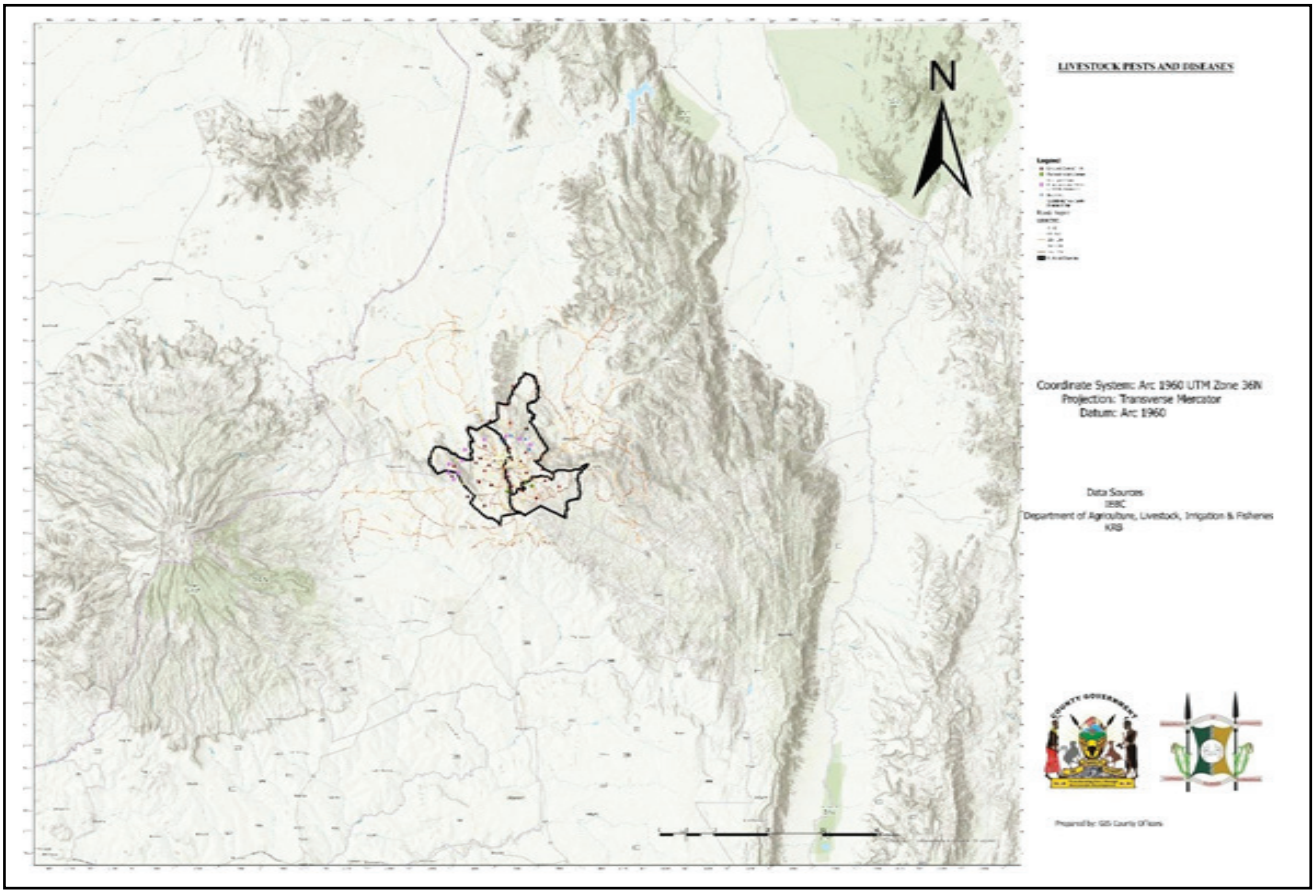


Figure 35:Livestock Pests & Diseases Map

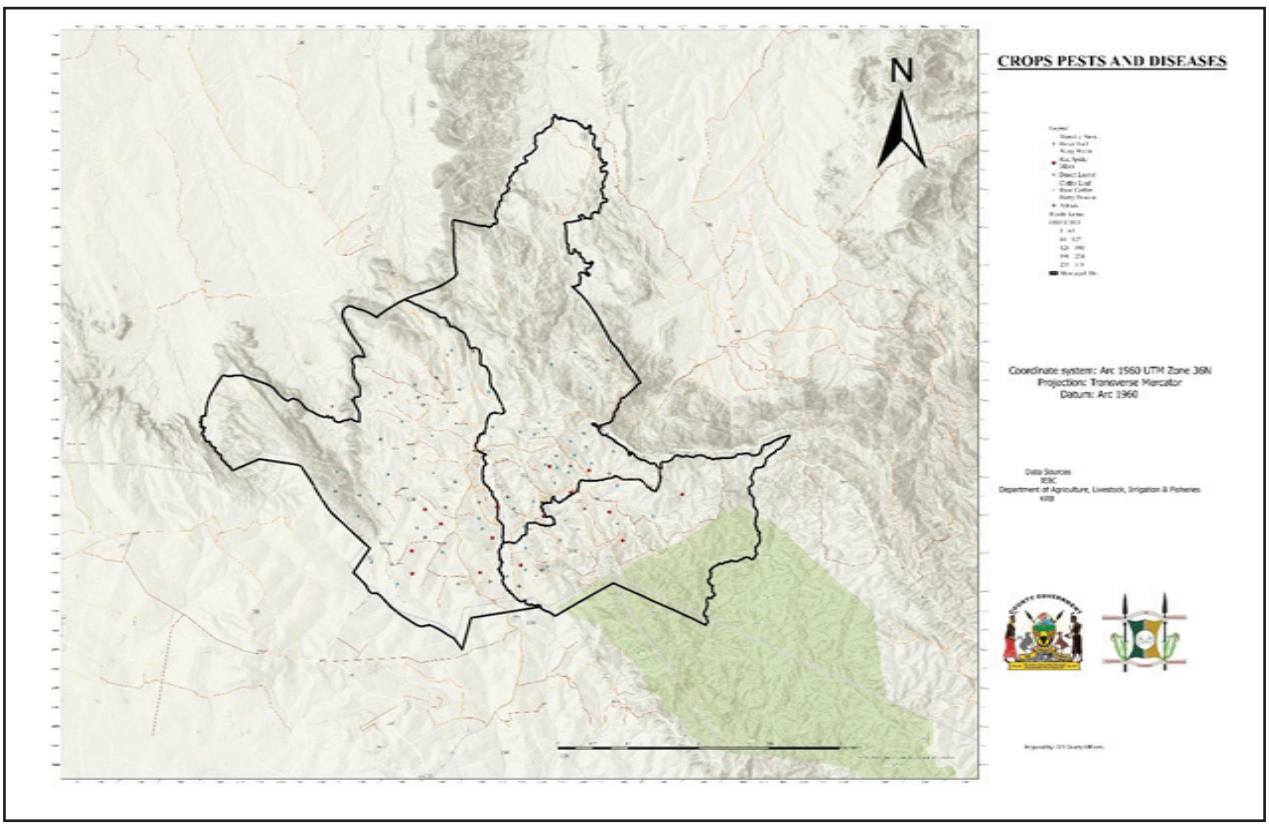


Figure 36:Crop Pests and Diseases Map

Key Findings.

The climate risk assessment indicates that Kapenguria Municipality is already experiencing significant climate-related stresses, which are projected to intensify over the mid-term (2050) and long-term (2100) due to climate change and ongoing urban development. The interaction between increasing climate hazards, unplanned urban growth and existing service and infrastructure deficits is driving heightened risk across multiple urban elements.

- **Pluvial flooding** emerges as one of the most pervasive current and future hazards, with widespread exposure of stormwater drainage systems, transport networks, economic infrastructure and informal settlements. Inadequate and undersized drainage infrastructure, coupled with solid waste accumulation and development along natural drainage corridors, significantly increases vulnerability and results in frequent service disruptions, property damage and localized displacement.
- **Drought and water scarcity** represent a critical and growing risk, particularly for water and wastewater management systems, energy supply, peri-urban agricultural systems and urban populations. High sensitivity to reduced water availability, combined with limited storage capacity and increasing demand, results in elevated vulnerability for households, businesses and essential services. Informal settlement residents and vulnerable groups are disproportionately affected due to limited access to reliable and affordable water sources.
- **Extreme heat** is identified as a cross-cutting hazard affecting nearly all urban elements. Dense built-up areas with limited green cover experience high exposure, while poor housing quality, limited access to cooling and increasing energy demand exacerbate vulnerability. Populations such as informal settlement residents, outdoor workers, the elderly and children face the highest risks of heat stress and associated health impacts.
- **Landslide risk,** while spatially localized, poses severe threats in hilly and steep-slope areas. Transport infrastructure, settlements and utilities located on or near unstable slopes are highly exposed. Vulnerability is driven by poor slope drainage, vegetation clearance, weak construction practices and limited slope stabilization measures, with informal hillside settlements facing the greatest potential for loss of life and property.
- **Gully erosion** is a highly destructive hazard closely linked to intense rainfall events and poor stormwater management. Roads, drainage systems and settlements located along concentrated runoff pathways exhibit very high exposure and vulnerability. The hazard results in permanent land loss, infrastructure failure, restricted access and increased risk to nearby populations, particularly in informal and peri-urban areas.

Across all assessed hazards, informal settlements, vulnerable and marginalized groups and aging or poorly maintained infrastructure consistently exhibit the highest levels of exposure and vulnerability. Limited adaptive capacity—manifested through weak land-use enforcement, insufficient infrastructure investment and constrained institutional and household resources—amplifies climate risks and contributes to recurring losses.

Overall, the assessment highlights the urgent need for integrated, multi-hazard risk reduction and adaptation measures. Priority actions include upgrading and maintaining drainage infrastructure, improving water security, expanding urban green and blue infrastructure, strengthening land-use planning and development control and targeting support to the most vulnerable populations. These findings provide a critical evidence base for prioritizing resilience-building interventions and informing climate- responsive urban planning and investment decisions.

The table below presents a screening of key climate hazards affecting urban elements under current conditions and projected mid- and long-term climate futures. The identification of hazards reflects observed climate trends, projected changes in temperature and precipitation and their interaction with existing urban development patterns.

Table 29: Current and future hazard Levels

Category	Key hazards		
	Current	Mid-term (2050)	Long-term (2100)
Infrastructure & Services			
Stormwater Drainage	Pluvial flooding; Gully erosion	Pluvial flooding; Gully erosion; Landslides	Pluvial flooding; Gully erosion; Landslides
Water & Wastewater Management	Pluvial flooding; Drought; Extreme heat	Pluvial flooding; Drought; Extreme Heat	Pluvial flooding; Drought; Extreme heat
Solid Waste Management	Pluvial flooding; Extreme heat	Pluvial flooding; Extreme heat	Pluvial flooding; Extreme heat
Transport and Mobility	Pluvial flooding; Gully erosion; Landslides	Pluvial flooding; Gully erosion; Landslides; Extreme Heat	Pluvial flooding; Gully erosion; Landslides; Extreme heat
Energy	Extreme heat; Drought	Extreme heat; Drought	Extreme heat; Drought
Economic Infrastructure	Pluvial flooding; Extreme heat	Pluvial flooding; Extreme heat; Drought	Pluvial flooding; Extreme heat; Drought
Social Infrastructure	Pluvial flooding; Extreme heat	Pluvial flooding; Extreme heat	Pluvial flooding; Extreme heat
Emergency Services	Pluvial flooding; Extreme heat	Pluvial flooding; Extreme heat	Pluvial flooding; Extreme heat
Populations			
Urban Residents	Pluvial flooding; Extreme heat	Pluvial flooding; Extreme heat; Drought	Pluvial flooding; Extreme heat; Drought
Informal Settlement Residents	Pluvial flooding; Gully erosion; Extreme heat	Pluvial flooding; Gully erosion; Extreme heat; Drought	Pluvial flooding; Gully erosion; Extreme heat; Drought
Vulnerable and Marginalized Groups	Extreme heat; Pluvial flooding	Extreme heat; Pluvial flooding; Drought	Extreme heat; Pluvial flooding; Drought
Natural Assets			
Urban Green Infrastructure	Drought; Extreme heat	Drought; Extreme Heat	Drought; Extreme heat
Urban Blue Infrastructure	Pluvial flooding; Drought	Pluvial flooding; Drought	Pluvial flooding; Drought
Peri-urban and Agricultural Systems	Drought; Extreme heat	Drought; Extreme heat	Drought; Extreme heat

3.3 Climate Adaptation and Resilience Solutions

This chapter explores strategies and interventions aimed at reducing the impacts of climate hazards and enhancing the ability of communities, infrastructure and ecosystems to withstand and recover from climate-related shocks. It highlights both structural and non-structural approaches, including nature-based solutions, policy measures and community-led initiatives, emphasizing integrated actions that build long-term resilience and adaptive capacity.

Table 30:Climate resilience framework for Kapenguria Municipality

Category	Immediate (0–2 years)	Mid-term (3–10 years)	Long-term (10+ years)
Infrastructure & Services			
Stormwater Drainage	Desilt and unblock existing drains Enforce waste removal from drainage corridors Upgrade and expand drainage capacity in priority areas like Bendera, Panama, Mawingo Road, behind Lomut Hardware, behind Kapematt Supermarket to Cereal Board road, St. Mary's School to Cereal river road, Makutano stadium to Cereal river road and Karas-Siyoi road	Introduce nature-based drainage (bioswales, infiltration trenches)	Redesign Municipal stormwater systems for future rainfall extremes Integrate drainage planning into land-use planning
Water & Wastewater Management	Repair leaks and damaged pipes for the clean water and sewer lines Implement water rationing and demand management Create Emergency Response Fund Strict Compliance to Water Resource Authority Regulations	Increase water storage through the provision of high-capacity water tanks and diversify sources high-capacity water tanks and diversify sources Upgrade wastewater treatment capacity Encourage rainwater harvesting	Develop climate-resilient, integrated water resource systems Promote circular water reuse and recycling
Solid Waste Management	Intensify waste collection in flood-prone areas Remove illegal dumping along waterways	Expand waste transfer and establish recycling facilities Improve enforcement of waste regulations	Transition to integrated solid waste management systems Promote circular economy and waste-to-energy solutions

Category	Immediate (0–2 years)	Mid-term (3–10 years)	Long-term (10+ years)
Transport and Mobility	Repair flood-damaged roads and culverts Improve drainage along transport corridors	Construct Climate-proof roads and bridges Introduce alternative and non-motorized routes	Redesign transport networks for climate resilience Shift toward low-carbon, climate-resilient mobility systems
Energy	Protect substations and power lines from flooding and heat Implement load-management during heat waves Inspection of power lines and maintenance Provide alternative sources of energy, like solar, for street lighting	Upgrade energy infrastructure for heat tolerance Expand renewable energy programmes, such as the use of biogas in institutions like schools	Transition to resilient, low-carbon energy systems, such as electric cars and motorcycles. Integrate energy planning with climate risk scenarios
Economic Infrastructure	Protect markets and business areas from flooding	Relocate or retrofit high-risk economic facilities Improve access to insurance and finance	Develop climate-resilient economic zones Diversify urban livelihoods and value chains
Social Infrastructure	Retrofit schools and health facilities in high-risk areas Ensure backup water and power supply	Upgrade facilities to climate-resilient standards Integrate cooling and flood protection measures	Site future facilities outside hazard-prone areas Adopt climate-responsive design standards
Emergency Services	Strengthen early warning and emergency response Improve access routes to high-risk areas Create Emergency Response Fund	Expand emergency facilities and shelters Enhance inter-agency coordination	Institutionalize disaster risk management systems Develop evacuation routes Integrate climate risk into urban safety planning

Category	Immediate (0–2 years)	Mid-term (3–10 years)	Long-term (10+ years)
Populations			
Urban Residents	Public awareness on extreme heat, flooding and water conservation Improve access to timely and accurate early warning information	Promote household-level resilience measures Strengthen social protection systems	Support planned urban growth in safe areas Mainstream climate risk into housing policy
Informal Settlement Residents	Improve drainage, waste collection and access paths Provide emergency assistance and basic services	Upgrade informal settlements using resilient designs Secure land tenure where Feasible	Relocate settlements from high-risk areas. Integrate informal areas into formal urban planning
Vulnerable and Marginalized Groups	Targeted extreme heat and flood response support Improve access to water, health and shelter	Expand inclusive social protection and livelihood programs Improve access to resilient housing	Institutionalize equity-focused climate adaptation programmes Reduce structural vulnerabilities through long-term development

Category	Immediate (0–2 years)	Mid-term (3–10 years)	Long-term (10+ years)
Natural Assets			
Urban Green Infrastructure	Protect existing green spaces and trees Promote tree planting in heat-stressed areas	Expand urban parks, green corridors and street trees Restore degraded green areas	Integrate green infrastructure into citywide planning Maintain ecological connectivity across the urban landscape
Urban Blue Infrastructure	Undertake public awareness of existing riparian buffer regulations Clear and protect rivers and riparian buffers Prevent encroachment and pollution Enforce riparian buffer regulations	Restore wetlands and riverbanks Establish flood retention along rivers	Integrate blue infrastructure into flood management systems Long-term protection of urban water ecosystems
Peri-urban and Agricultural Systems	Promote soil conservation and water harvesting Support climate-smart farming practices	Expand agroforestry and drought-resilient crops and livestock breeds Improve irrigation efficiency	Transition to resilient peri-urban food systems Protect agricultural land through land-use planning

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CIDP

Annexes

Annex I: Historical Hazard Event

1. DROUGHT

Hazard Event/Type	**DROUGHT**
Date or period	**1999, 2001**
Location	**Emboasis - Chemwochoi, Cheptuya, Lokornoi**
Intensity	**High**
Social Impacts	• Disruption of daily life, high vulnerability • Increased household water scarcity, health risks, and social vulnerability • Limited access to safe water, increased health risks (outbreak of diseases), and social stress • Food insecurity, malnutrition risk, school absenteeism • Water scarcity, reduced household water availability
Physical Impacts	• Drying of boreholes and streams • Strain on water infrastructure • Depletion of water sources, drying of shallow wells
Economic Impacts	• Reduced agricultural productivity, and higher food prices • Crop failure, livestock losses, increased expenditure on water and food • Lower crop yields, livestock productivity decline, cost of water trucking • Reduced agricultural and livestock income, higher food prices • Economic losses in agriculture and livestock, • increased household expenditure
Ecological Impacts	• Loss of pasture, soil degradation, stress on flora and fauna • Vegetation drying, reduced groundwater recharge, stress on local ecosystems • Reduced green cover, soil erosion • Loss of soil moisture, vegetation stress, and reduced biodiversity in the dry season • Reduced pasture for livestock

2. FLASH FLOODS

Hazard Event/Type	**FLASH FLOODS**
Date or period	**1999, 2001**
Location	**EMBOASIS - Chemwochoi, Cheptuya, Lokornoi**
Intensity	**High**
Social Impacts	• Disruption of daily life, high vulnerability of low- income households • Limited access to safe water, increased health risks and social stress • Stress in the health facilities
Physical Impacts	Damage to houses, roads and electricity poles
Economic Impacts	Damage to crops and livestock leading loss of economic livelihood and disruption of trade activities
Ecological Impacts	Loss of soil and vegetation increasing land degradation

3. EXTREME COLD

Hazard Event/Type	EXTREME COLD
Date or period	July-August 2025, 1999, 1977 in Mnagei ward
Location	All 1977- Mnagei ward
Intensity	Medium
Social Impacts	• Increased respiratory illnesses, school absenteeism, vulnerability of children and the elderly • Health risks (coughs, flu), increased vulnerability of the elderly and infants • Increased school absenteeism and illness among low-income households • Health risks for vulnerable groups, disruption of daily routines • Heightened health risks, increased demand for social support, disrupted schooling
Physical Impacts	• Reduced indoor comfort, increased pressure on housing structures, and inadequate heating • Damage /burst water pipes in some areas under gravity • Roof leaks and structural stress in temporary housing
Economic Impacts	• Higher healthcare costs, reduced productivity, cost of heating fuel • Increased expenditure on healthcare, temporary work disruptions
Ecological Impacts	• Loss of livestock productivity, increased heating expenses • Stress on livestock due to cold, reduced crop growth in peri-urban farms • Frost damage to crops, stress on vegetation cover • Minimal; some vegetation stress, higher soil moisture retention in frost periods • Limited ecological impact; slight impact on local flora • Frost damage to crops and grasslands, stress on urban greenery

4. EXTREME HEAT

Hazard Event/Type	**EXTREMW HEAT**
Date or period	**2025 - 2026 February 20th -27th**
Location	**Makutano town, Kishaunet, Cheptuya Emboasis and Chepkechir**
Intensity	**Medium**
Social Impacts	Overcrowded recreation parks
Physical Impacts	No
Economic Impacts	Low productivity due to people overstaying in houses and recreation parks
Ecological Impacts	Wilting of tree leaves and vegetation cover.

5. LANDSLIDES

Hazard Event/Type	**LANDSLIDES**
Date or period	**2025-2026,1995,1960-1969**
Location	**Chemwochoi, Kopoch, Kaprom, and Chepngalit Villages between 2025 and 2026** **Kapchila in 1995** **Lokurnoi and Komol between 1960 and 1969**
Intensity	**High**
Social Impacts	Increased workload in the local health facilities, leading to a shortage of drugs and other essential medicines
Physical Impacts	Damage to houses, roads and electricity poles
Economic Impacts	Damage to crops and livestock leading loss of economic livelihood and disruption of trade activities
Ecological Impacts	Increased land degradation

6. GULLY EROSION

Hazard Event/Type	**GULLY EROSION**
Date or period	**2025-2026,1995,1960-1969**
Location	**Chemwochoi, Kopoch, Kaprom, Chepngalit Village between 2025 and 2026** **Kapchila in 1995** **Lokurnoi and Komol between 1960 and 1969**
Intensity	**Medium**
Social Impacts	Road to Emboasis dispensary was cut off, hindering access to health services
Physical Impacts	Risk of damage to Emboasis dispensary due to cracks caused by the gullies
Economic Impacts	Damaged roads hinder the smooth transportation of goods and passengers
Ecological Impacts	Land degradation

6. LIGHTNING STRIKES

Hazard Event/Type	**LIGHTNING STRIKES**
Date or period	**2025, 2007**
Location	**Kaisakat , Kapchila, Kaibos** **2007-Lityei, Tartar primary, Murkwijit, Kaplelachkoror**
Intensity	**Medium**
Social Impacts	Loss of livestock, damage to the school infrastructure, injuries, loss of lives in Kaplelach Koror and Murkwijit
Physical Impacts	Fire outbreaks, destruction of property and livestock
Economic Impacts	Loss of revenue, increased building repair costs, increase in insurance claims
Ecological Impacts	Loss of trees, wildfires

8. WINDSTORMS

Hazard Event/Type	**WINDSTORMS**
Date or period	**1983, 2024**
Location	**Psigirio, Kamuino, Chewoyet 1983 Paraywa -Kapkecha -siknin ecde 2024** **Chepunpun ECDE, Lokornoi Primary School-2024**
Intensity	**Medium**
Social Impacts	Injuries to people, disruption of services, and pollution
Physical Impacts	Destruction to the ECDE infrastructure in Siknin, Chepun Pun
Economic Impacts	High cost of repair of the infrastructures
Ecological Impacts	Destruction of the Chewoyet forest, which led to the loss of trees

Annex 2: Data Sources

Data	Data Source
Climatic Hazards Projections	World Bank Climate Knowledge Portal and SPEI database, Kenya Meteorological Department, local news outlets and field observations.
• Floods Risk Map • Landslides susceptibility Map • Heat Stress Map • Drought Map • Vulnerability Map • Exposure Map Climate Risk Map	Kenya Roads Board Independent Electoral and Boundaries Commission Open Street Map West Pokot County GIS Database USGS Earth Explorer Humanitarian data Kenya Data
Crop pests and diseases map Livestock Pests and Diseases Map	Department of Agriculture, Livestock, Irrigation & Fisheries Kenya Roads Board IEBC
Baseline information	Kapenguria Municipality Spatial plan
Baseline information	Kapengururia Municipality Integrated Development plan
Baseline information	County Integrated Development plan
Legal Frameworks	West Pokot county climate change Action plan and policy

Annex 3: Stakeholders and Public Participation

RECOMMENDATIONS FROM PUBLIC PARTICIPATIONS AND STAKEHOLDERS

- Redesign the bridges in Siyoi.
- Agroforestry to be practiced within the Municipality.
- Encourage people to plant more trees.
- Tarmac water supply roads from Sunflower to Kiwanja Ndege.
- Protect Riparian areas such as Kotoruk, Siyoi and Cereal river catchments.
- Re-design Chapangang bridge along Kamorow – Tartar road in Mnagei ward.
- Urban greening in Makutano town.
- Incorporate green rooftops in project designs.
- Install lightning arrestors where there is risk of lightning strikes.
- Provide alternative livelihoods where people rely on charcoal burning for survival like small businesses, rearing chicken and farming.
- Awareness creation on the management of forests and other sensitive ecosystems.
- Land use control and planning.
- Adherence to building standards.
- Flood-proof designs, scorches.
- On-site collections of rainwater.
- Wide and sloped drainages.
- Solid waste management policy.
- Enforce development control standards and regulations.
- Flood-proof urban infrastructures.
- Fully equipped emergency operation Centre.
- Planting of bamboo along the streams.
- Developing urban forests.
- Adoption of climate-resilient crop varieties and livestock breeds and their practices.
- Establish greenhouses.
- Enforce environmental regulations.
- Livestock disease surveillance and routine vaccination.
- Integrated pest and disease management.
- Creating awareness -Sanitation, maintaining Premises and fumigation.

Annex 4: Pictorials

1.Stakeholders Meeting - Sirwo Hotel, Kitale.

Public Participation - Mtelo hall

Public Participation - Youth Empowerment Centre, Makutano

Stakeholders meeting - Sirwo Hotel in Kitale

Annex 5: Legal Frameworks

1. NATIONAL

Legislation / Policy	Scope / Relevance	Implications for Climate Risk in Kapenguria
Constitution of Kenya, 2010	Recognizes the right to a clean and healthy environment (Article 42) and mandates sustainable development	Empowers municipal authorities to implement climate-resilient planning and disaster risk reduction Measures
Environmental Management and Coordination Act (EMCA), 1999	Provides a framework for environmental protection, environmental impact assessment and pollution control	Requires environmental assessments for urban projects, including flood and drought mitigation
Climate Change Act, 2016	Provides for climate change governance, planning and mitigation at the national and county levels	Mandates county governments to integrate climate adaptation and disaster risk reduction into development planning
Water Act, 2016	Regulates water resources management	Supports sustainable urban water supply and storm water management in drought-prone and flood-prone areas
Physical and Land Use Planning Act, 2019	Provides guidelines for land-use planning and development control	Enables climate-resilient urban planning and the avoidance of hazard-prone areas for new developments
Disaster Risk Management Act, 2015	Establishes structures and measures for disaster preparedness, mitigation, response and recovery	Requires the municipality to develop local disaster risk reduction plans and early warning systems
Occupational Safety and Health Act (OSHA), 2007	Provides guidelines on safety in workplaces and public spaces	Ensures the safety of residents and workers during extreme weather events, floods and drought response activities
Energy Act, 2019	Guides sustainable energy generation and usage	Supports the adoption of climate-friendly energy solutions in municipal facilities, hospitals and schools
Agricultural Policy of 2021	The policy covers the agricultural sector: crops, livestock and fisheries production to markets, value chains, resource management, institutional frameworks and cross-cutting issues, providing a comprehensive national framework for transforming Kenyan agriculture into a sustainable, productive, commercial and inclusive sector	The policy promotes climate- smart agricultural practices such as improved water management, sustainable land use and resilient crop and livestock systems. This ensures farmers are better able to cope with droughts, floods and erratic rainfall, reducing climate-related losses. The policy also emphasizes sustainable management of land, soil, water and ecosystems so as to reduce land degradation and soil erosion.

National Agricultural Soil Management Policy of 2020	The policy gives direction on the management of agricultural soils to support productivity, food security, environmental sustainability and long-term agricultural resilience	The policy strengthens capacity to manage climate risks through having healthier soils that retain more water and nutrients, making crops and livestock more resilient to droughts, erratic rainfall and floods, thereby supporting resilient, sustainable and climate-adaptive agriculture
Kenya Climate Smart Agriculture Strategy 2017-2026	The strategy covers agricultural transformation through climate resilience and low-carbon pathways, adaptation and mitigation actions, institutional frameworks and cross-cutting enablers to ensure sustainable and climate-responsive agriculture.	The strategy mainstreams climate risk management into Kenya's agricultural development, enabling the sector to adapt to climate change, reduce emissions and sustain productivity and livelihoods under increasing climate uncertainty.
Urban and Peri - Urban Agriculture and Livestock Policy of 2010.	The policy provides a framework for promoting, regulating and supporting sustainable urban and peri-urban agriculture, livestock and fisheries activities, specifically land use planning, food security, livelihoods, environment, public health, institutional coordination and markets.	The policy promotes local food production within and around urban areas, enabling urban areas to be less dependent on distant, climate-vulnerable rural supply chains, reducing food shortages during droughts, floods, or transport disruptions. At the same time, it provides diversified income sources for low-income households and contributes to greener cities that helps in reducing urban heat island effect, lowers flood risk and improves storm water infiltration.
Public Health Act, Cap 242	The scope is to protect and promote the health of the community by regulating health services, controlling infectious diseases and addressing environmental health hazards,	The Act promotes empowers authorities to strengthen health infrastructure to handle climate-related shocks.

2. COUNTY AND MUNICIPAL

Policy / Regulation	Scope / Relevance	Implications for Climate Risk
West Pokot County Climate Change Policy 2023-2027	Guides integration of climate adaptation measures into county development	Supports climate-resilient infrastructure, urban drainage and water supply in Kapenguria
West Pokot County Climate Change Action Plan-2023-2027	It provides a 5 year framework for climate change adaptation and mitigation in West Pokot County addressing drought, floods, extreme temperature and land degradation across key Sectors.	Guides identification, prioritization of climate risk in Kapenguria Municipality, including drought, flash floods and extreme Cold and supports implementation of targeted urban resilience and adaptation measures
County Disaster Management Plans-2023- 2027	Localized disaster risk assessment and response framework	Outlines procedures for flood, drought and extreme weather events within the municipality
Municipal Development Plans & Zoning Regulations- 2025-2035	Sets guidelines for land- use, storm water management and construction standards	Reduces exposure of urban residents to flood-prone areas and encourages sustainable drainage systems
Kapenguria Municipality Local Physical and Land Use Development Plan	Provides a spatial planning framework guiding land use zoning, development control, environmental protection and infrastructure planning within Kapenguria Municipality	Reduces climate risk by restricting development in flood-prone and environmentally sensitive areas, promoting sustainable drainage systems, protecting riparian reserves and supporting climate-resilient urban designs
Kapenguria Integrated Development Plan 2025-2020	It sets a strategic framework for prioritizing development investments, including climate change adaptation and mitigation measures, by translating risk into actionable, sustainable and resilient planning	Its implications for the climate risk profile are primarily driven through capacity building, policy training and promoting the integration of climate information into development planning
Solid Waste Management Regulations- 2025-2030	County-level regulations on waste collection, disposal and recycling	Reduces drain blockages, which exacerbate flood risk during extreme rainfall

West Pokot Agro-Ecology Policy 2025	It provides the policy framework for promoting sustainable climate smart and ecologically sound Agricultural practices across West Pokot County. The policy emphasizes soil health, Water Conservation, sustainable food systems, Sustainable Food Systems and Resilience to Climate Variability.	Supports climate risk reduction in Kapenguria Municipality by promoting water-efficient agriculture, soil Conservation and diversified food systems that reduce vulnerability to drought, Floods and extreme temperatures Particularly in Peri -Urban and Urban Farming areas
County Integrated Development Plan 2023-2027	It mandates the county to develop a Five-Year County Integrated Development Plan as the primary planning and budgeting tool for the devolved units	It sets mechanisms for implementing climate change actions and interventions at the County and Municipal levels

3. INTERNATIONAL AND REGIONAL AGREEMENTS

Agreement / Convention	Relevance to Kapenguria
Paris Agreement (2015)	Encourages Kenya to implement climate mitigation and adaptation strategies, including urban resilience
Sendai Framework for Disaster Risk Reduction (2015–2030)	Guides disaster risk reduction and early warning systems, including floods, droughts and extreme events
UN Sustainable Development Goals (SDGs 6, 11, 13)	Supports access to clean water, resilient cities and climate action

COUNTY GOVERNMENT OF WEST POKOT

KAPENGURIA MUNICIPALITY

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