REPUBLIC OF KENYA

COUNTY GOVERNMENT OF NYANDARUA

OL'KALOU MUNICIPALITY

URBAN CLIMATE RISK PROFILE

2026

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URBAN CLIMATE RISK PROFILE
FOR
Ol'KALOU MUNICIPALITY

2025

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Foreword

This Urban Climate Risk Profile provides a vital framework for understanding, assessing, and responding to the growing climate-related risks that affect our municipality. This document serves as an evidence-based guide to inform planning, investment, and policy decisions towards building a climate-resilient and sustainable urban future for Ol'Kalou Municipality.

This Profile comes at a time when the impacts of climate change—ranging from erratic rainfall and flooding to prolonged droughts and shifting agricultural patterns—pose increasing challenges to urban growth and service delivery. With rapid urbanization and expanding infrastructure needs, there is a clear and urgent need to integrate climate resilience into all levels of municipal planning and management.

Anchored in Kenya's national climate change frameworks, the Sustainable Development Goals, and the County Integrated Development Plan (CIDP) 2023-2028, this Climate Risk Profile complements ongoing planning efforts such as the Ol'Kalou Municipality Integrated Strategic Urban Development Plan (ISUDP) 2023-2032, Integrated Development Plan (IDeP) 2026-2031 and sectoral development plans and strategies. It provides a critical knowledge base that identifies climate vulnerabilities, maps potential hazards, and highlights adaptation and mitigation opportunities tailored to Ol'kalou's unique context.

The preparation of this document has been guided by the principles of public participation, inclusivity, and sustainability. It reflects the voices and priorities of local stakeholders, communities, and institutions, and demonstrates our collective resolve to strengthen resilience against climate shocks while advancing our socio-economic development aspirations.

This Urban Climate Risk Profile identifies priority interventions to reduce vulnerability across key sectors within the Municipality; water, agriculture, housing, infrastructure, health, and ecosystems while promoting low-carbon urban growth and sustainable livelihoods. Implementing these interventions will require collaboration between the County Government, the National Government, development partners, civil societies, and the private sector.

The County Government of Nyandarua is committed to leading this process by mainstreaming climate action into urban planning, governance and project cycles to ensure the municipality evolves into a safe, livable, and climate-smart municipality. Together, we can transform climate risks into opportunities for innovation, green investment, and long-term prosperity.

I wish to express my sincere appreciation to all partners who supported the development of this Urban Climate Risk Profile, including the World Bank, the Kenya Urban Support Programme, the Technical Working Group and all the stakeholders who contributed their insights and expertise.

My administration remains steadfast in our commitment to fostering climate resilience and sustainability in the Ol'Kalou Municipality. I invite all stakeholders to join us in implementing the recommendations of this Profile, as we work towards a climate-resilient, inclusive, and thriving future for our municipality.

Priscillah Mwirigi
Chairperson – Ol'kalou Municipal Board

Preface

This Urban Climate Risk Profile for Ol'Kalou Municipality has been developed in recognition of the urgent need to understand, plan for, and respond to the growing impacts of climate change at the local level. Climate-related risks continue to intensify, manifesting in increasingly frequent droughts, erratic rainfall, floods, and changing temperature patterns. Ol'Kalou, like many other municipalities across Kenya, finds itself at a critical juncture where proactive planning is essential to safeguard lives, livelihoods, and development gains.

The primary objective of this report is to provide a concise yet comprehensive overview of the key climate risks facing the Municipality, grounded in both scientific evidence and community-level insights. It identifies vulnerable sectors, populations, and systems, and offers initial recommendations for building local resilience through adaptation and risk mitigation strategies. This assessment is intended to support informed decision-making among municipal leaders, planners, and stakeholders, and to serve as a foundational resource for integrating climate risk considerations into urban development, infrastructure planning, natural resource management, and social service delivery.

This work is aligned with national and county climate policy frameworks, including Kenya's National Climate Change Action Plan and the Nyandarua County Climate Change Action Plan. It also supports the broader goals of sustainable urban development, environmental stewardship, and socio-economic resilience as envisioned in Kenya's Vision 2030 and the Sustainable Development Goals (SDGs).

We acknowledge the valuable contributions of Technical Working Group, Stakeholders, and development partners who participated in the assessment process. Their input has enriched the findings and ensured that the report reflects the lived realities and priorities of Ol'Kalou Municipality residents.

We hope this report will catalyze further actions, investments, and collaborations to build a climate-resilient future for Ol'Kalou Municipality.

Eric Igogo

Ol'kalou Municipality manager

ACKNOWLEDGEMENT

The preparation of the Urban Climate Risk Profile for Ol'Kalou Municipality represents a major step toward strengthening our municipality's resilience to climate change and ensuring sustainable, inclusive urban growth. This document provides a solid foundation for understanding climate-related vulnerabilities, assessing potential hazards, and guiding effective adaptation and mitigation strategies that safeguard the wellbeing of our residents and the sustainability of our urban systems.

On behalf of the Ol'Kalou Municipal Board and Secretariat, I wish to express my sincere appreciation to all institutions and stakeholders who contributed to the development of this Profile. Special gratitude goes to the World Bank, the State Department for Housing and Urban Development, and the Kenya Urban Support Programme County Program Coordinating Team for their technical and financial support, which made this initiative possible. Their collaboration continues to strengthen our capacity to address the growing impacts of climate change within our municipality.

We equally acknowledge the leadership and support of the County Government of Nyandarua under the stewardship of His Excellency the Governor Dr. Moses Kiarie Badilisha, whose vision for a resilient and modern Ol'Kalou has been central to this process. Appreciation is also extended to the County Department of Lands, Physical Planning and Urban Development, Municipal Board Members, technical officers and other partners for their invaluable contributions throughout the preparation of this document.

Our gratitude also goes to community members, civil society organizations, residents' associations, and private sector representatives for their active participation and insights. Your engagement ensured that this Profile reflects the true priorities and aspirations of the people of Ol'Kalou Municipality.

The implementation of this Urban Climate Risk Profile will require continued collaboration and commitment from all stakeholders. As a municipality, we remain dedicated to mainstreaming climate resilience into all our planning and service delivery processes, ensuring that Ol'Kalou Municipality becomes a climate-smart, livable, and prosperous urban center for present and future generations.

Josephine Muiru,
Housing and Urban Development

Executive Summary

Kenya's rapid urbanization, projected to reach 50% by 2050, has transformed towns like Ol'Kalou into growing economic hubs but also heightened their vulnerability to climate hazards such as floods, droughts, and extreme heat. As these risks intensify, integrating climate risk considerations into Ol'Kalou's spatial planning, investment decisions, and service delivery is essential to protect lives, infrastructure, and ecosystems. Proactive climate-informed urban management will enhance preparedness, support adaptation, and build long-term resilience for sustainable development.

The objectives of this Climate risk profile is;-

1. To determine community needs and align them to the requirements of the constitution and other relevant climate policies
2. To inform decision-making process of both the County and the Municipality in identifying and climate proofing projects
3. Through the established mechanisms for citizen participation, define and identify climate risks, hazards and climate actions
4. To undertake climate risk assessment and impacts on the current socio-cultural, economic and environmental parameters to inform priority interventions.
5. To ensure protection and promotion of the interests and rights of minorities and vulnerable groups and communities

List of key hazards identified during the Assessment,

During the stakeholder engagement held, four key hazards were identified in Ol'Kalou Municipality and mapped as follows;

Table 1:Key Hazards in Ol'Kalou Municipality

Hazard	Karau	Kaimbaga	Rurii	Kanjuiri (Tumaini)	Wanjohi (Ndemi)
Floods	✓	✓	✓	✓	✓
Drought	✓	✓	✓	✓	✓
Extreme temperatures	✓	✓	✓	✓	✓
Hailstones	✓	✓	✓	X	✓

After the Climate risk assessment, the Risk results summary for each of the key hazard are as presented below**;**

Table 2. Summary of Floods risks for Ol'KalouMunicipality

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

Table 3. Summary of Drought risks for Ol'Kalou Municipality

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

Table 4: Summary of Extreme temperatures risks for Ol'Kalou Municipality

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

Table 5. Summary of Hailstones risks for Ol'Kalou Municipality

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

Key takeaways on what can be done to mitigate the higher risks.

To mitigate the increasing risks from floods, droughts, hailstones, and extreme cold, Ol'Kalou should prioritize climate-resilient urban planning and infrastructure. This includes improving drainage systems, promoting rainwater harvesting, protecting green spaces, and enforcing zoning regulations to prevent settlement in high-risk areas. Strengthening early warning systems, supporting climate-smart agriculture, and enhancing community awareness will also reduce vulnerability and build adaptive capacity against future climate shocks.

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ABBREVIATIONS AND ACRONYMS

CIDP	County Integrated Development Plan
CMIP	Coupled Model Intercomparison Project
GoK	Government of Kenya
IDEP	Integrated Development Plan
ISUDP	Integrated Strategic Urban Development Plan
KISIP	Kenya Informal Settlement Program
KMD	Kenya Meteorological Department
KNBS	Kenya National Bureau of Statistics
KUSP	Kenya Urban Support Program
NEMA	National Environment Management Authority
NCCAP	National Climate Change Action Plan
NCG	Nyandarua County Government
NCCAP	Nyandarua County Climate Action Plan
NGO	Non-Governmental Organisation
OLWASCO	Ol'Kalou Water and Sanitation Company
PLWD	Persons Living with Disability
RCP	Representative Concentration Pathway
SDG	Sustainable Development Goals
SACCO	Savings and Credit Cooperative
SE	Stakeholder Engagement
SSP	Shared Socioeconomic Pathways
UACA	Urban Areas and Cities Act, 2011
UCRA	Urban Climate Risk Assessment
UCRP	Urban Climate Risk Profile
VMGs	Vulnerable and Marginalized Groups
WBG	World Bank Group

CHAPTER ONE

1. Context

Kenya is urbanizing rapidly, with 31% of the population living in urban areas as of 2019, a figure projected to rise to about 50% by 2050 (KNBS, 2019). This growth is particularly pronounced in small and medium-sized towns such as Ol'Kalou, which are emerging as key centers of economic activity and population expansion.

While urbanization drives economic development and improves living standards, it also heightens exposure to climate-related hazards including flooding, drought, and extreme heat. These hazards are increasing in frequency and intensity, posing significant risks to people, infrastructure, and ecosystems.

To safeguard lives, livelihoods, and critical assets, urban decision-makers in Ol'Kalou Municipality must integrate climate risk understanding into spatial planning, investment priorities and service delivery. Doing so will not only enhance preparedness for climate shocks but also support adaptation and strengthen long-term urban resilience.

1.1. Objective

This Urban Climate Risk Profile aims;

1. To comply with National, County and Municipal legal frameworks to address current and future climate risks.
2. To integrate climate resilience into the planning, design and implementation of the Municipal Development process in the next five years.
3. To plan and deliver climate resilient infrastructure that withstands current and future climate impacts and minimizes climate risks.

The specific objectives are:

1. To determine community needs and align them to the requirements of the constitution and other relevant climate policies
2. To inform decision-making process of both the County and the Municipality in identifying and climate proofing projects
3. Through the established mechanisms for citizen participation, define and identify climate risks, hazards and climate actions
4. To undertake climate risk assessment and impacts on the current socio-cultural, economic and environmental parameters to inform priority interventions.
5. To ensure protection and promotion of the interests and rights of minorities and vulnerable groups and communities

1.2. Urban Context

This section provides an overview of the municipality's strategic location and regional linkages, the legal status, its extent in size, climate and geology. It provides a synopsis on the municipality's drainage, climate, terrain and geographic features. In addition, it explores the demographic, socio-economic characteristics and settlement patterns of the Municipality

1.2.1. Geographic area

Ol'Kalou Municipality is located within Ol'Kalou sub-county, one of the five (5) sub-counties in Nyandarua County. It is located 15km west of Aberdare range and approximately 40km to East of Nakuru City and about 160km from Nairobi, the capital city. As such, it is the seat of the county headquarters, the county government and other national government agencies. Other key installations and landmarks include JM Kariuki County Referral Hospital, Lake Ol Bolossat Regionally, the town is located approximately 160km from Nairobi County. Natural structuring elements such as River Malewa define the municipality's eastern boundaries whereas River Mukuyu defines the southern boundary. Lake Ol Bolossat outlines its north-eastern tip, Ol'Kalou (ISUDP, 2023-2033).

The municipality covers an area of 364.7 km2 which include three whole wards of Rurii, Kaimbaga and Karau; and Tumaini and Ndemi centres in Kanjuiri Ridge and Wanjohi wards respectively. In terms of population, the municipality has 67,500 people.

Table 6: Administrative Wards within Ol'Kalou Municipality

Sub-county	Constituency	Wards
Ol'Kalou	Ol'Kalou	Karau
		Kaimbaga
		Rurii
		Kanjuiri
		Wanjohi

Local context: In terms of regional connectivity Nyandarua County is relatively well connected by a number of roads to major cities and towns in Kenya, hence enjoying a regional advantage for investments. Some of the major roads are Gilgil-Ol'Kalou Nyahururu road (A4), Nyahururu-Ndaragwa-Nyeri road (B21) and Dundori Ol'Kalou-Njabini road (B20). These are the major roads which traverse the County.

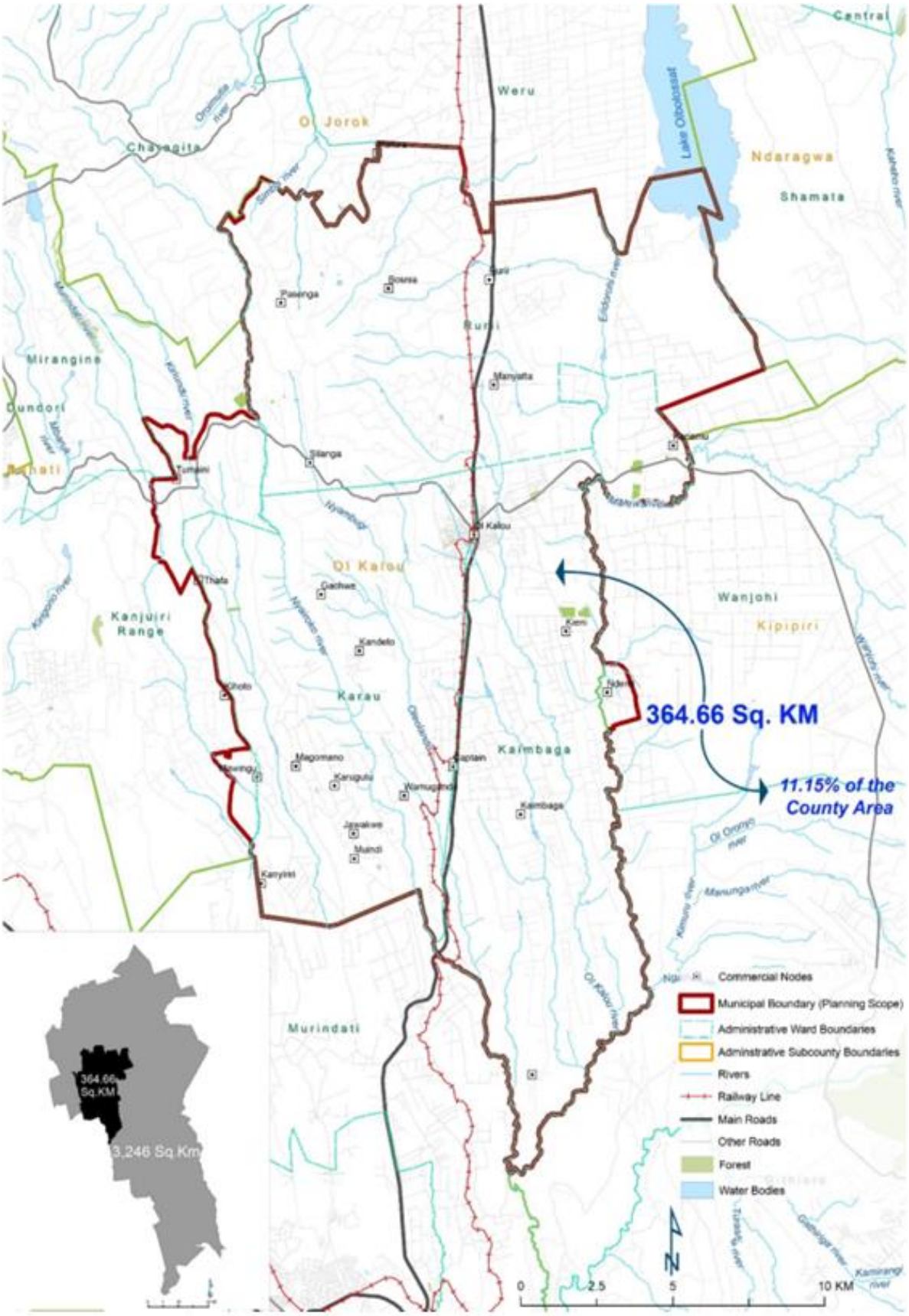


Figure 1: Location of Ol'Kalou Municipality

1.2.2. Governance Structure

The Municipality is the headquarters of Nyandarua County and also hosts several national government ministries and state agencies who have offices in the town. The County Government arms of executive and the assembly have offices within the municipality.

The municipality has a functional board of 9 members appointed as per Section 14 of the Urban Areas and Cities Act, 2011 (amended in 2019). The members are appointed by the Governor and approved by the County Assembly with powers and mandate to execute the following functions;

1. Provide for efficient and accountable management of the affairs of the Municipality.
2. Provide for a governance mechanism that will enable the inhabitants of the Municipality to:
    - Participate in determining the social services and regulatory framework which will best satisfy their needs and expectations.
    - Verify whether public resources and authority are utilized or exercised, as the case may be, to their satisfaction.
    - Enjoy efficiency in service delivery
3. Vigorously pursue the developmental opportunities which are available in the Municipality and to institute such measures as are necessary for achieving public order and the provisions of civic amenities, so as to enhance the quality of life of the inhabitants of the municipality.
4. Provide a high standard of social services in a cost-effective manner to the inhabitants of the municipality.
5. Promote social cohesiveness and a sense of civic duty and responsibility among the inhabitants and stakeholders in the Municipality in order to facilitate collective action and commitment towards achieving the goal of a harmonious and stable community.
6. Providing for services, laws and other matters for the municipality's benefit.
7. Fostering the economic, social and environmental well-being of its community.

Municipal Management

The office of municipal manager is charged with the responsibility of implementing the decisions and functions of the board of the municipality and is answerable to the board of the municipality. The municipal manager shall be fully responsible for the proper conduct of the executive, administrative and affairs of the municipality and shall thereby have the responsibilities of;

a) Supervision and coordination of departments and agencies of the municipality,
b) Guide the implementation of the municipal charter, regulations and other applicable laws,
c) Exercise such other powers as may be prescribed by the charter, regulations and applicable laws.
d) Other duties include inter-alia
    1. Ensuring execution of the decisions of the board,
    2. Secretary to the municipal board and keep all records of the board.

3. Prepare the annual estimate of revenue and expenditure for approval by the board,
4. Ensuring working relations and partnerships between the board, private sector, civil society and the community

Units in the Municipality

1. Finance, Economic planning and administration
2. Land, Physical Planning and infrastructure
3. Environment
4. Public health
5. Community development and social services
6. Legal, audit and research services

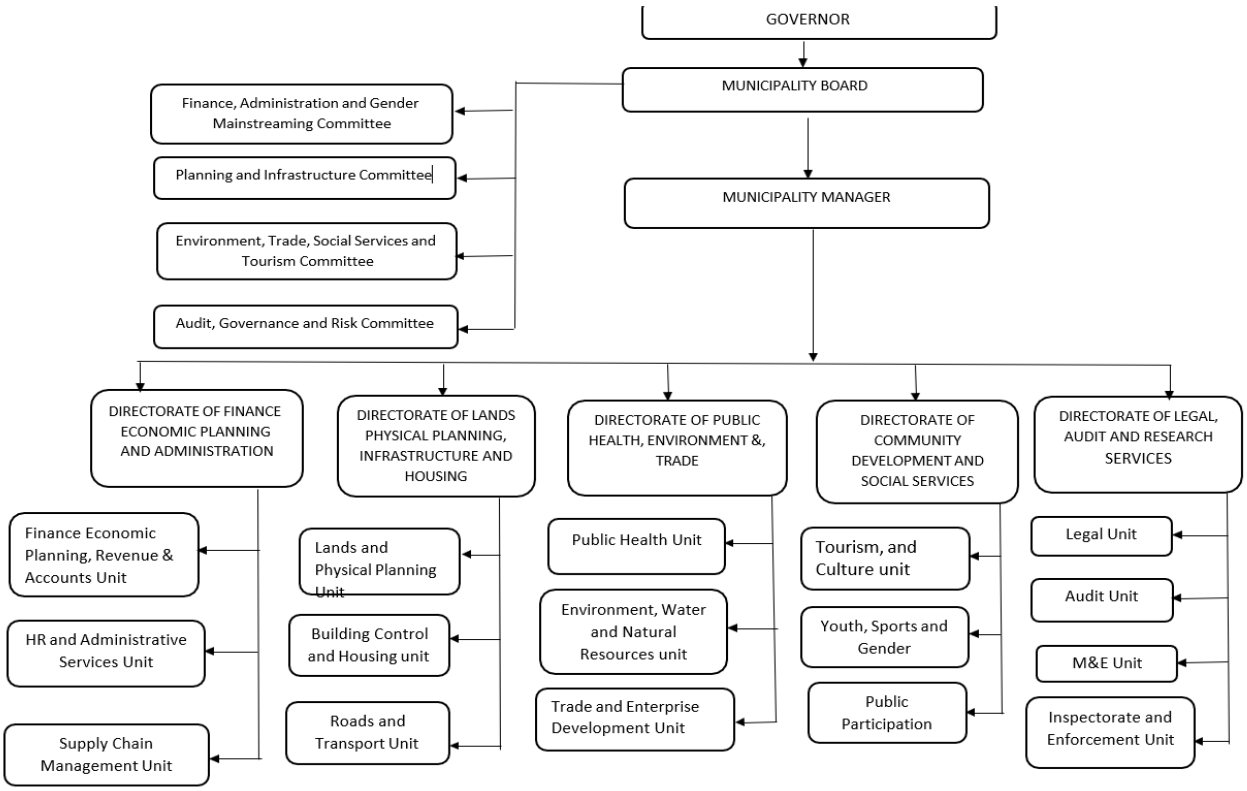


Fig 2: Ol'Kalou Municipality Organogram

1.2.3. Socio-economic Context

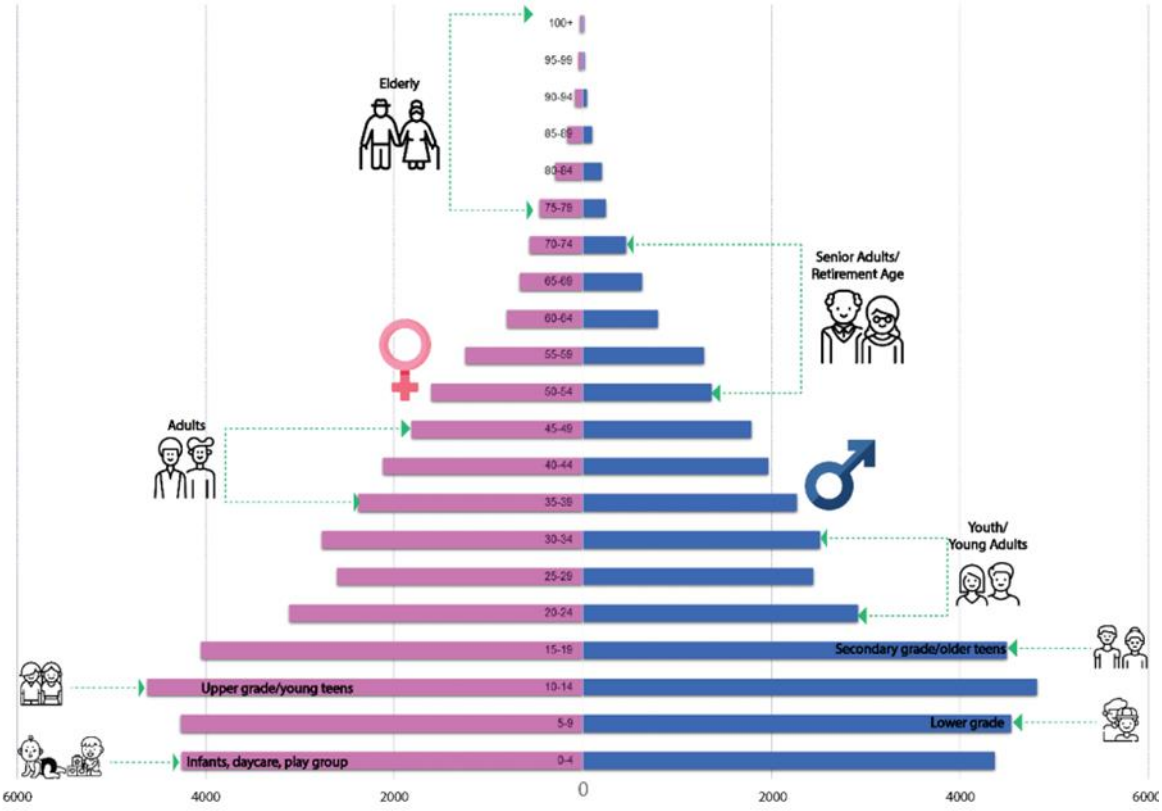
Population Distribution in Ol'Kalou Municipality

Ol'Kalou Municipality is the most populated urban area in the County. Consequently, there is eminent demand for services compared to other urban areas in the County. For this reason, there is a need for proper planning and enhancement of service delivery especially in solid waste management, provision

of water and sewer services. According to the County records the population of Ol'Kalou Municipality was estimated at 67,500 in 2020 with 49% (33,075) males and 51% (34,425) females

Population Distribution by Age

According to the 2019 Kenya Population and Housing Census, 47% of the population is below the age of 19 years with the highest population being between the ages of 10-14. This indicates a youthful population. Figure 3 below captures distribution of the age in the county



Source: Urban Lines Consultants Ltd, 2022

Figure 3: Population Structure

Population Density

Population density is a measure of the number of people per unit of area. Below is the population density of the Ol'Kalou Municipality as of 2019 and the projected density of years 2025 and 2030.

Table 7: Population Density of Ol'Kalou Municipality (2019–2030)

Area Sq Km	2019		2025 Projections		2030 projections	
	Population	**Density Persons per sq km**	**Population**	**Density Persons per sq km**	**Population**	**Density Persons per sq km**
333.5	67,500	202	82,124	246	99,916	300

Population Projections

Taking into account the estimates by the World Bank based on the United Nations Population Division's World Urbanization Prospects, as of 2018 the annual urban population growth rate in Kenya was calculated at 4.0%. The projection population for Ol'Kalou below 2020 to 2030 is as below in

Table 8: Population Projections for Ol'Kalou Municipality (2020–2030)

Municipality	Population 2020	Projected Population 2025	Projected population 2030
Ol'Kalou	67,500	82,124	99,916

As indicated above, Ol'Kalou population will continue to grow thus necessitating concerted efforts in planning and investment in social and physical infrastructure to support the growing population. The Technical team calculated the population projections in Table 9 based on KNBS,(2019) data.

Table 9: Age-Based Population Distribution and Projections for Ol'Kalou Municipality

Age Group	Population	Projected Population	
Total	67,500 (2020)	2,276 (2025)	100,601 (2030)
0-4	7,763	9,445	11,491
5-9	7,898	9,609	11,690
10-14	8,438	10,266	12,490
15-19	7,695	9,363	11,390
20-24	5,400	6,569	8,502
25-29	4,523	5,502	6,694
30-34	4,725	5,748	6,993
35-39	4,185	5,091	6,193
40-44	3,645	4,434	5,394
45-49	3,308	4,024	4,895
50-54	2,666	3,243	3,945
55-59	2,295	2,792	3,396
60-64	1,418	1,725	2,098
65-69	1,148	1,396	1,698

70-74	945	1,149	1,397
75-79	608	739	899
80-84	473	575	699
85-89	270	328	399
90-94	135	164	199
95-99	61	74	90
100+	34	41	49

The population growth of the youths and the working age group creates a need for creation of employment opportunities to reduce the levels of unemployment in the county and in the country all together.

1.2.4. Economic Context

The main economic activities within Ol'Kalou Municipality include Agriculture, retail and wholesale, financial institutions, quarrying, educational establishments. Agricultural land covers the biggest proportion of the municipality land mass with agricultural activities mainly done on Karau, Kaimbaga and Rurii wards.

Ol'Kalou Municipality is endowed with part of the only highland lake in Kenya, lake Ol Bolossat rich in biodiversity supporting local ecotourism and a critical ecosystem for downstream economies and livelihoods. The Lake continues to face impacts of unsustainable anthropogenic activities and climate hazards which affect its functionality.

1.2.5. Land-use Context

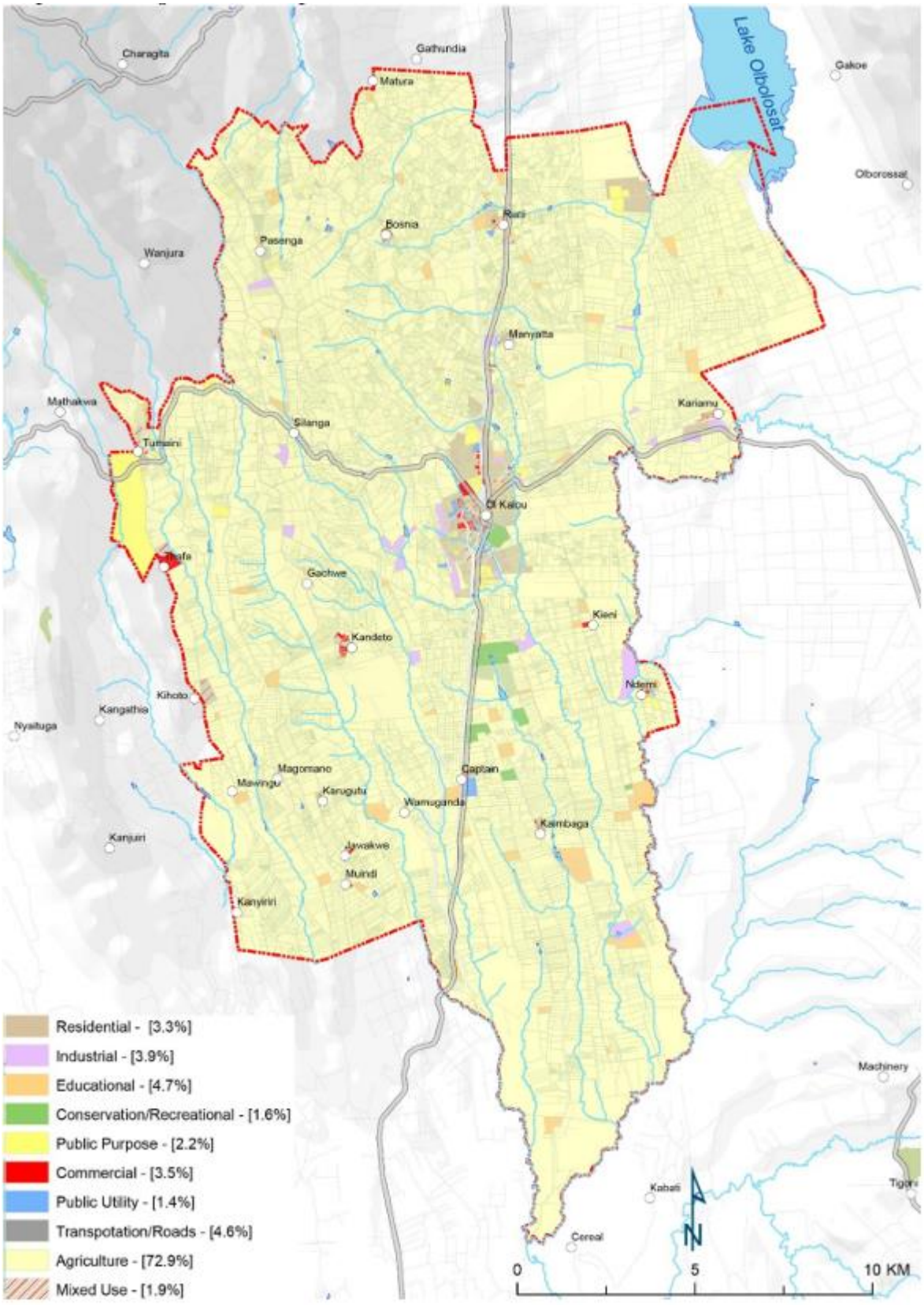
Agriculture is the dominant land use in the municipality at 72.9%. Residential areas occupy about 3.3% with estates such as Huruma, Site & service scheme, Bahati which are susceptible to climate hazards. Mixed-use land use (1.9%) is presented across the municipality mainly presented by commercial–cum residential use within most of the commercial nodes. Public utility has the least share of land use (1.4%). Public spaces are mainly

The land under conservation is about 1.6% with Ol'Kalou Arboretum and Presidential Planted Park being the key areas. The majority of the residents practice agroforestry with an estimated tree cover of 6.0%. These green open spaces are critical carbon sinks that regulate urban heat island within the Municipality.

Table 10: Existing Land Use Distribution in Ol'Kalou Municipality

Land use	**Existing land use coverage**
Residential	3.3%
Industrial	3.9%
Educational	4.7%
Conservation/Recreational	1.6%
Public purpose	2.2%
Commercial	3.5%
Public utility	1.4%
Transportation	4.6%
Agriculture	72.9%
Mixed-use	1.9%

Source: Ol'Kalou Municipality ISUDP, (2023-2033)



Data sources: Field Survey - 2022, Cadastral Outlay – Survey of Kenya, Lands Dep. - CGN

Figure 3: Ol'kalou Municipality Land use Map

1.3. Key Stakeholders & Inclusiveness

In order to develop the content of the Ol'Kalou Municipality Urban Climate Risk Profile, the Municipality appointed a multi-sectoral technical working group comprising of representatives from the Board, Municipal Manager, KMD, Climate Change, Office of the County Attorney, Finance, Environment, Natural resources, Infrastructure and Public works, Public Administration, physical planning and urban development.

The TWG conducted a thorough stakeholder analysis to map key stakeholders for engagement during the Urban Climate Risk Assessment, Scenario Mapping and Data Collection exercise.

The identified stakeholders were as follows:

- Ward Committee Members (9 members from each of the 4 wards)
- Local administrators (Chief)
- Community Health Promoters
- Faith Based Organization Rep
- Business Community Reps (Male & Female)
- Sub-County Education Officer
- Cooperatives Rep
- Tree Nurseries Rep
- Senior elders above 75years (Male & Female)
- Farmers Reps (Male & Female)
- Traders Reps (Male & Female)
- Informal Waste Handlers
- Sub-County Administrator
- Water Officer
- Sub-County Agricultural Officer (Crop and Livestock)
- Sub-County Social Development Officer
- Director Public Participation

Table 11: Stakeholder Mapping for Ol'Kalou Municipality Urban Climate Risk Profile

High	**High Influence – Low Interest** • Local chief (NGAO) • Community Health Promoters • Faith based Organization Reps • Cooperatives Rep • Sub-County Administrator	**High Influence – High Interest** • Ward Committee members • Farmers • Water Officer • Director Public Participation
	Low Influence – Low Interest • Business Community Reps • Sub-County Education Officer • Senior elders above 75years (Male & Female) • Traders Reps (Male & Female) • Informal Waste Handlers	**Low Influence – High Interest** • Tree Nurseries Rep • Sub-County Agricultural Officer (Crop and Livestock) • Sub-County Social Development Officer
Low		**High**

Plate1: Stakeholder Engagement Forum

Validation Exercise

The Validation Workshop for Ol'Kalou Municipality was held on 13th November 2025 aimed at confirming the accuracy, completeness and contextual relevance of the draft Urban Climate Risk Assessment (UCRA) for Ol'Kalou Municipality.

2. Validation Process

- Presentation of climate hazards and municipal vulnerabilities.
- Review of exposure, sensitivity, and adaptive capacity indicators.
- Group discussions verifying data and hazard maps.
- Stakeholder inputs on local experiences and priority risk zones.
- Consensus on feasible adaptation options.

Plate 2: Urban Climate Risk Profile Validation Forum

3. Key Validation Outcomes

• Accuracy of mapped flood-prone areas confirmed.

• Recommendations to update population and infrastructure data.

• Flooding and drainage congestion prioritized as key risks.

• Adaptation actions endorsed: drainage upgrades, greening, waste management, early warning.

4. Stakeholder Recommendations

• Strengthen collaboration between municipal and county units.

• Capture more socio-economic vulnerabilities.

• Integrate assessment into MIDP and planning cycles.

• Provide indicative costs for interventions.

CHAPTER TWO

2. Hazard Assessment

Climate hazard assessment constitutes a critical component of climate risk analysis and adaptation planning. It is a systematic, evidence-based process aimed at identifying, characterizing, and quantifying the potential occurrence and magnitude of climate-induced hazards and their spatial and temporal distribution. The assessment provides the analytical foundation for understanding how climatic variables and extreme events interact with physical, ecological, and socio-economic systems to produce adverse outcomes.

The outcomes of climate hazard assessment forms the basis for comprehensive vulnerability and exposure assessments, enabling the estimation of overall climate risk. When integrated into policy formulation, development planning, and disaster risk management, such assessments enhance the capacity of institutions and communities to anticipate, mitigate, and adapt to climate-induced threats.

In summary, climate hazard assessment provides a robust framework for evaluating the dynamic interactions between climate processes and socio-environmental systems. It is an indispensable tool in designing targeted climate adaptation, resilience-building, and risk-informed development strategies at local, national, and regional scale

Table 12: Key Climate Hazards

Hazard	Karau	Kaimbaga	Rurii	Kanjuiri (Tumaini)	Wanjohi (Ndemi)
Floods	✓	✓	✓	✓	✓
Drought	✓	✓	✓	✓	✓
Extreme temperatures	✓	✓	✓	✓	✓
Hailstones	✓	✓	✓	X	✓

Plate 3: Climate Hazards in Olkalou Municipality

Table 13: Climate Hazard Screening for Ol'Kalou Municipality

Hazard	Hazard Likely (Y/N)	Significant Impact (Y/N)	High Priority (Y/N)	Key Hazard (Y/N)
Heat Stress				
Average surface temperature increase	N	N	N	N
Average ocean temperature increase	N	N	N	N
Extreme heat	Y	Y	N	N
Marine heatwaves	N	N	N	N
Cold Stress				
Average surface temperature during winter	N	N	N	N
Extreme cold (e.g., cold spells, frost)	Y	Y	Y	Y
Snowfall and ice storms	N	N	N	N
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	N
Sea level rise	N	N	N	N
Coastal flooding, including storm surges	N	N	N	N
Waterlogging	Y	Y	Y	N
Water Stress				
Drought (meteorological, hydrological)	Y	Y	Y	Y
Groundwater salinization	Y	N	N	N
Saline intrusion	N	N	N	N
Wildfire				
Wildfires & bushfires	Y	N	N	N
Storms				
Extreme wind	Y	N	N	N
Tropical cyclones	N	N	N	N
Sand and dust storms	N	N	N	N
Hailstorms	Y	Y	Y	Y
Mass Movement				
Landslides	N	N	N	N
Coastal erosion	N	N	N	N
Gully erosion	Y	Y	N	N
Marine Conditions				
Ocean acidification	N	N	N	N
Geophysical*				
Subsidence	N	N	N	N
Earthquakes	N	N	N	N
Volcanos	N	N	N	N

** These hazards, if present, can be highly impactful and are therefore included in the screening step, as they may significantly influence the urban planning informed by this urban climate risk profile.*

2.1. Climate Indicators and Hazard Thresholds

Table 14 : Selected Climate Indicators and Hazard Thresholds for OlKalou Municipality

Key Hazard	Climate indicator	Data source	Threshold		
			Low	Medium	High
Floods	Excessive Rainfall	MET/ SE			✓
Drought	Depressed Rainfall	MET/ SE			✓
Extreme temperatures	Frost/Heatwave	MET/ SE			✓
Hailstones	Frequency and intensity of occurrence	MET/ SE		✓	

*MET- Meteorology * SE- Stakeholder Engagement

2.2. Current Hazard Levels and Climate Projections

In the figures below, is an analysis of hazards levels and climate projects informed by multiple data sources from the Kenya Meteorology Department, (2024)**.**

Temperature patterns:

The historical data on temperature also shows positive increase for both the maximum and minimum temperatures in the three municipalities. The rate of increase on the minimum temperature is more compared to the rate of increase on the maximum temperature under the two scenarios RCP4.5 and RCP8.5 emission. The annual fluctuations of temperature show the existence of extreme temperatures during the period. The temperature ranges from a minimum of 6-14 degrees Celsius to a maximum of between 20-25 degrees Celsius

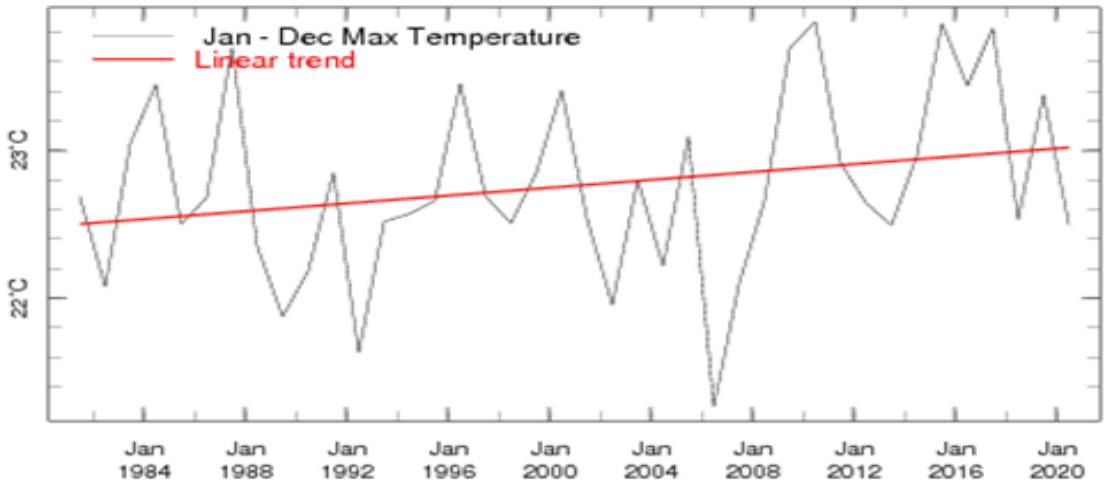


Figure 4: Annual Maximum temperatures from 1984-2022

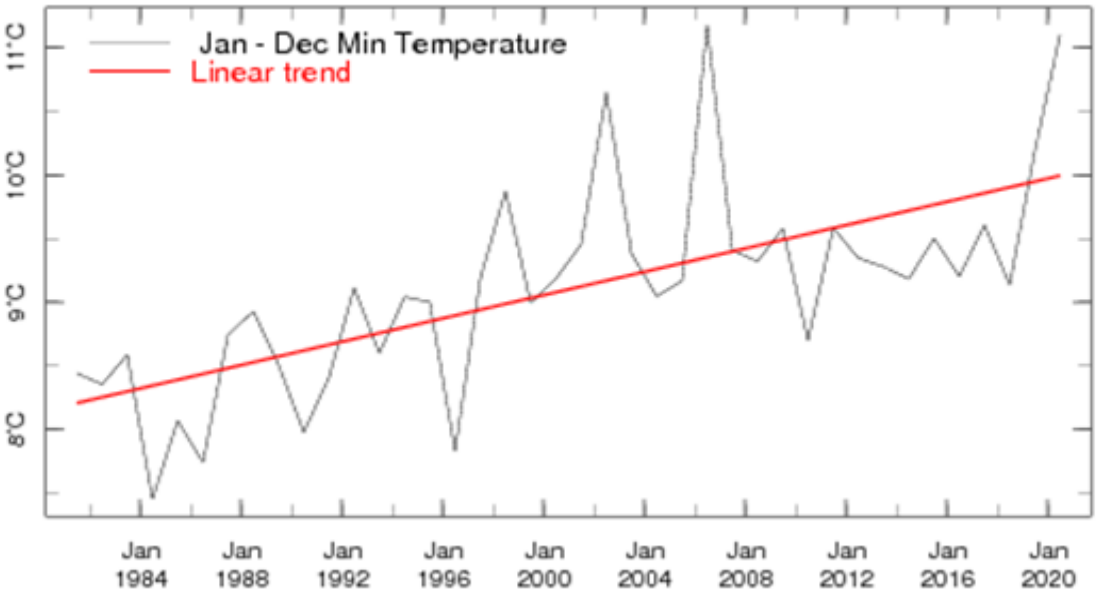


Figure 5: Annual minimum temperatures ranging from 1984 to 2022

Rainfall patterns

The historical data from the three municipalities indicates a positive increase of both the annual rainfall and the seasonal rainfall (MAM, JJA, and OND). The annual rainfall ranges from about 200 mm up to a maximum of about 1700 mm and an annual mean of about 1000 mm. The fluctuations depict years of extreme rainfall both positive and negative. This shows persistence of floods and drought for the municipality.

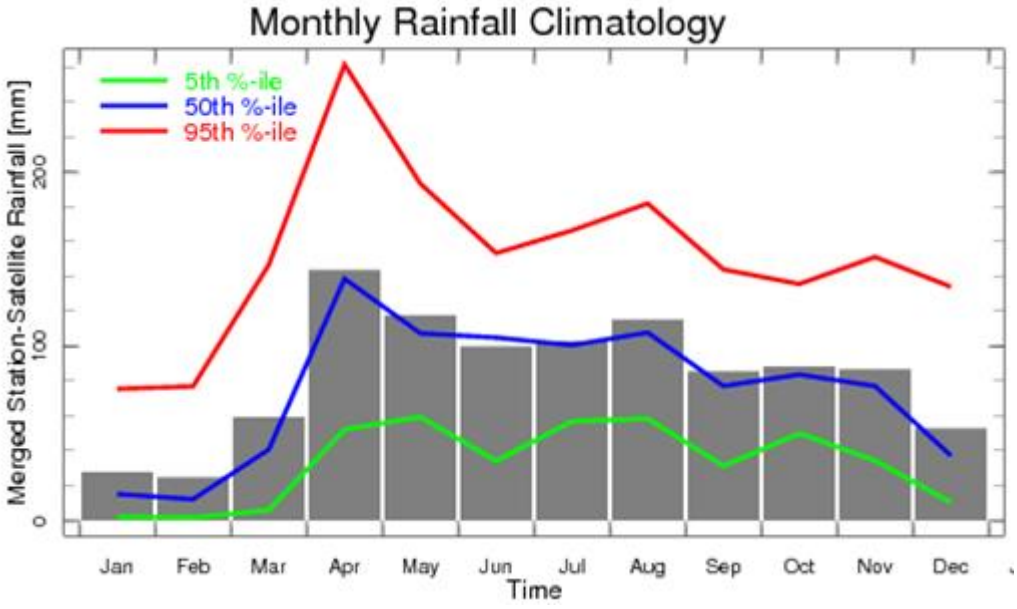


Figure 6: Monthly rainfall Climatology

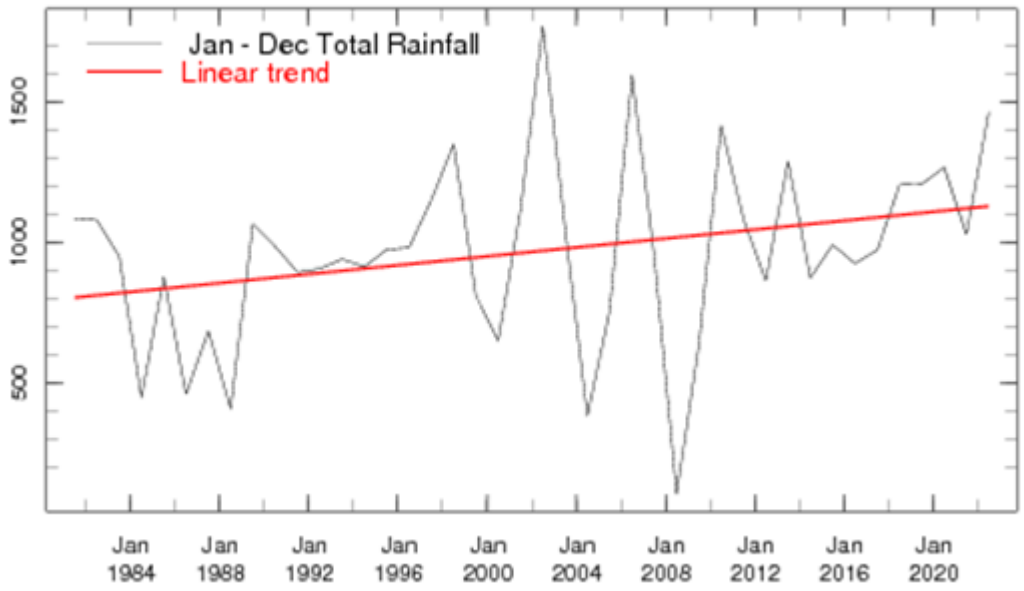


Figure 7: January to December annual rainfall pattern ranging from 1984 to 2022

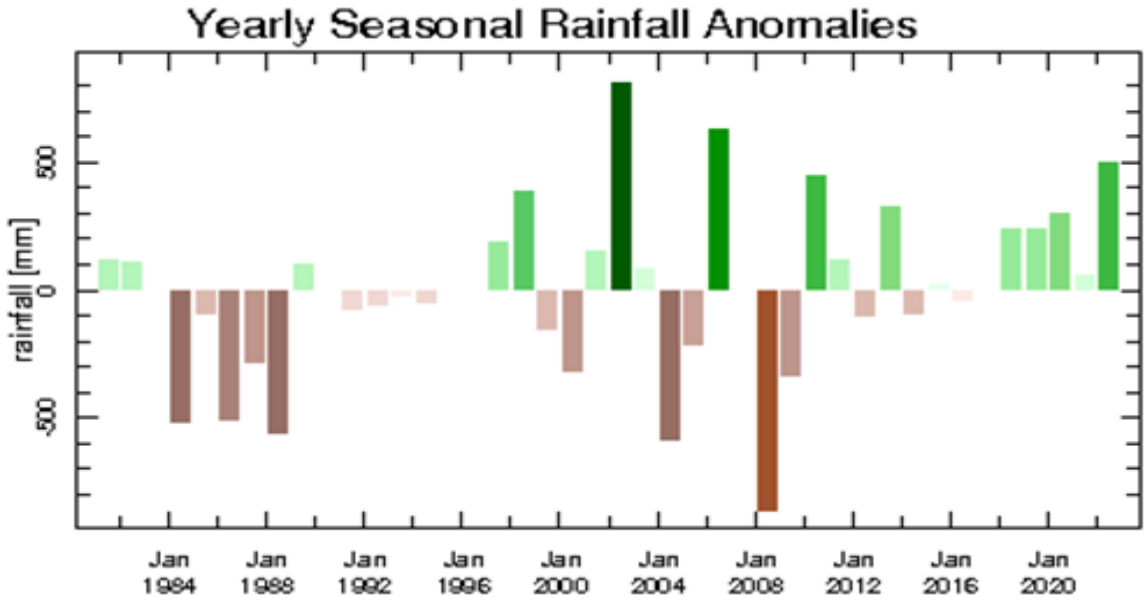


Figure 8: Yearly Seasonal Rainfall Anomalies

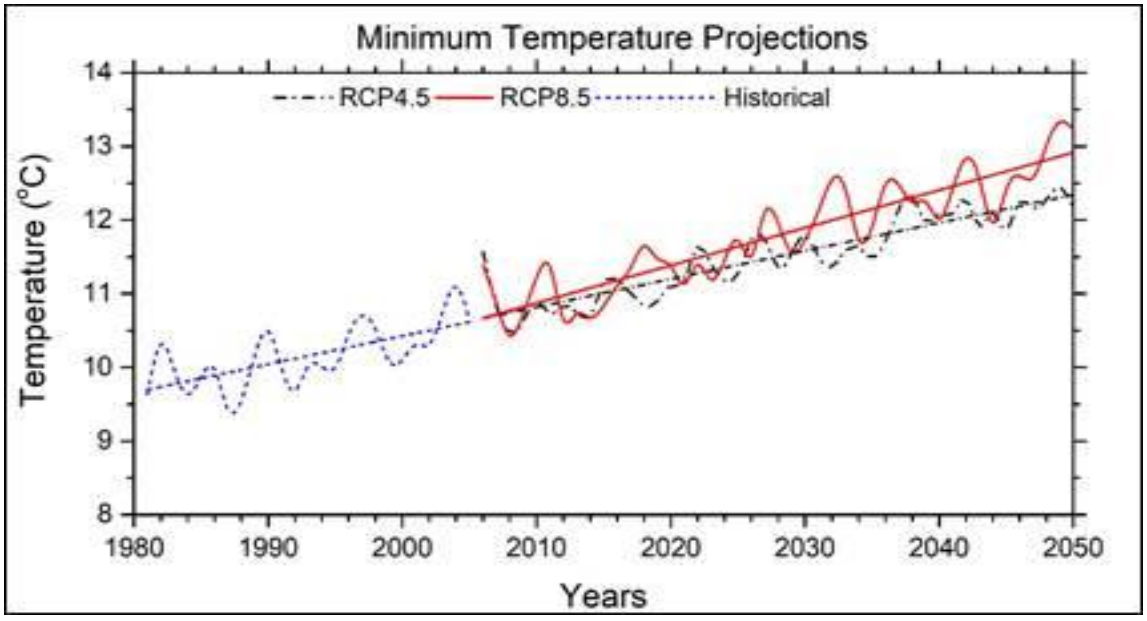


Figure 9: Minimum Temperature Projection

Observed minimum temperature from 1980 to 2006 and future minimum temperature projection from 2006 to 2050 obtained from CMIP5 model under the RCP4.5 and RCP8.5 scenarios.

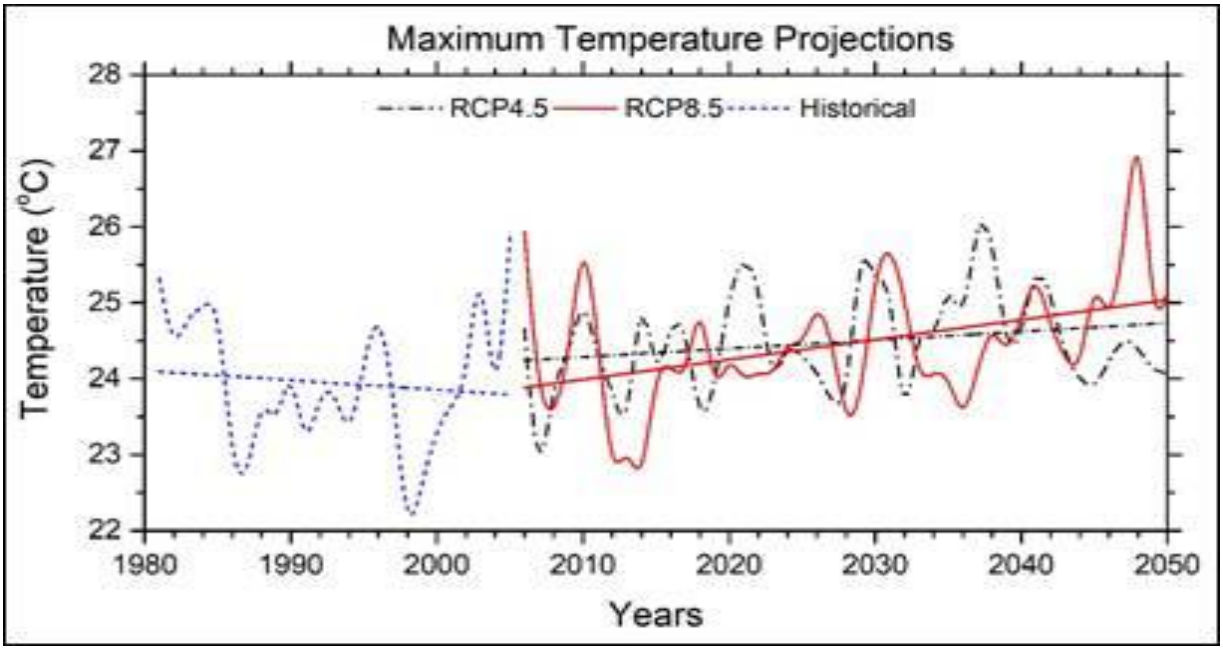


Figure 10 : Maximum Temperature Projection

Observed maximum temperature from 1980 to 2006 and future maximum temperature projection from 2006 to 2050 obtained from CMIP5 model under the RCP4.5 and RCP8.5 scenarios.

Temperature Projection summary

At the national level, under the worst case RCP8.5 scenario:

- Average temperatures nationally are expected to continue rising by 1.7% by the 2050s and by 3.5% at the end of the 21st century.
- The number of hot days and hot nights will increase, with hot days projected to occur on 19%- 45% of days by mid-century. Hot nights are expected to increase even more rapidly, projected to occur on 45%-75% of nights by 2050.

Cold days and nights are expected to become increasingly rare.

Table 15: Current and Future Climate Hazard Levels for Ol'Kalou Municipality

	Hazard Level				
Hazard	**Current (Baseline)**	**2050 SSP2-4.5**	**2050 SSP5-8.5**	**2100 SSP2-4.5**	**2100 SSP5-8.5**
Floods	High	High	Very High	Very High	Very High
Drought	High	High	Very High	Very High	Very High
Extreme temperatures	High	High	Very High	Very High	Very High
Hailstones	Medium	Medium	High	High	Very high

For this Urban Climate Risk Profile, hazard levels should be interpreted in accordance with the table below.

Table 16: Interpretation of Climate Hazard Levels

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

2.3. Current and Future Hazard Impact Areas

Floods

Spatial Extent: Low-lying areas, riverbanks, drainage corridors and built-up sections of **Tumaini, Ndemi, Karau and parts of Rurii**.
Frequency: Occasional but recurrent during heavy rainfall seasons.
Severity: Moderate to high, causing localized flooding, soil erosion, damage to roads, drainage systems and settlements.
Overlap: Often overlaps with extreme rainfall events and poor drainage, and may follow prolonged dry spells.

Drought / Prolonged Dry Spells

Spatial Extent: Municipality-wide, affecting **Rurii, Kaimbaga, Karau, Tumaini and Ndemi** areas.
Frequency: Increasing, with more frequent and prolonged dry periods.
Severity: High, due to water scarcity, crop failure, pasture stress and reduced household water availability.
Overlap: Overlaps with extreme temperatures and increases vulnerability to food and water insecurity.

Hailstorms

Spatial Extent: Localized but impactful, mainly affecting agricultural zones in **Rurii, Kaimbaga and Karau**.
Frequency: Occasional and unpredictable.
Severity: Moderate to high, causing sudden and severe damage to crops and farm infrastructure.
Overlap: Often occurs alongside intense rainfall and strong winds, compounding crop losses.

Extreme Temperatures

Spatial Extent: Across the entire municipality, affecting both urban and agricultural areas.
Frequency: Seasonal, with increasing variability in both hot and cold extremes.
Severity: Moderate, with impacts on crop performance, livestock productivity and human health.
Overlap: Overlaps with drought (heat stress) and floods (cold stress following heavy rains).

Table 17: Summary of current climate trends

Hazard	Spatial Extent	Frequency	Severity	Overlap
Floods	Low-lying areas, riverbanks, drainage corridors and built-up sections in Tumaini, Ndemi, Karau and parts of Rurii	Occasional, during heavy rainfall seasons	Moderate–High (infrastructure damage, erosion, flooding of settlements)	Overlaps with intense rainfall and poor drainage; may follow dry spells
Drought / Dry Spells	Municipality-wide across Rurii, Kaimbaga, Karau, Tumaini and Ndemi	Increasing and prolonged	High (water scarcity, crop failure, pasture stress)	Overlaps with extreme temperatures and food insecurity
Hailstorms	Localized agricultural zones in Rurii, Kaimbaga and Karau	Occasional and unpredictable	Moderate–High (sudden crop damage)	Occurs with intense rainfall and strong winds
Extreme Temperatures	Entire municipality (urban and agricultural areas)	Seasonal with increasing variability	Moderate (crop stress, livestock and human health impacts)	Overlaps with drought (heat stress) and floods (cold stress)

Projected Future Climate Scenarios Across the Wards of Ol'Kalou Municipality

Across Nyandarua County, including **Rurii, Kaimbaga, Karau wards and Tumaini & Ndemi areas**, future projections indicate the following broad trends:

Increased Moisture Stress (Drought Intensity & Duration): Projections show longer and more frequent dry periods across the municipality, intensifying soil moisture deficits, reducing water availability for households, crops, and livestock, and increasing vulnerability to food insecurity.

More Intense Precipitation and Flood Risk: While heavy rainfall events may not become significantly more frequent, when they occur they are likely to be more intense, increasing the risk of localized flooding, soil erosion, and damage to infrastructure, particularly in low-lying and poorly drained areas.

Temperature Extremes: Rising temperatures are expected to increase heat stress on crops, livestock, and human health. Seasonal variability may also lead to occasional cold stress events, particularly following intense rainfall or during unusual weather patterns, further affecting agriculture and livelihoods.

Hailstorm Risk: Hailstorms are projected to remain localized but may become more severe and unpredictable, particularly in exposed agricultural zones. These events can cause sudden and substantial damage to crops, property, and infrastructure, compounding the impacts of other hazards such as intense rainfall and strong winds.

CHAPTER THREE

3. Exposure & Vulnerability Assessment

Ol'Kalou Municipality, like many growing urban centers, is increasingly exposed to the impacts of climate change, including irregular rainfall, flooding, prolonged dry spells, and rising temperatures. These changes threaten urban infrastructure, water resources, livelihoods, and overall municipal development. Understanding exposure and vulnerability within the municipality is therefore critical for building long-term climate resilience.

This assessment identifies the degree to which people, infrastructure, and economic activities in Ol'Kalou are exposed to climate-related hazards, and how social, economic, and environmental factors influence their vulnerability. The findings help identify priority areas and populations that are most at risk, guiding evidence-based adaptation interventions.

The assessment aligns with the objectives of the CIDP, (2023-2028), Ol'Kalou Municipality IDeP, (2026-2031) and the Ol'Kalou, ISUDP, (2023-2033) both of which emphasize sustainable urban growth, improved service delivery, and climate-resilient infrastructure. By integrating climate risk considerations into these planning frameworks, the municipality strengthens its capacity to anticipate, prepare for, and respond effectively to climate impacts-supporting the realization of a safe, inclusive, and sustainable urban environment.

3.1. Urban Elements

Table 18: Urban Elements Inventory for Ol'Kalou Municipality

Category	Subcategory	Included in the RCRA (Y/N)	Available in GIS format (Y/N)	Description
Infrastructure & Services				
Stormwater Drainage	Stormwater drainage conveyance network	Y	N	Storm water drains mainly in Ol'Kalou town and main market centers on the road reserve
	Stormwater storage	Y	N	Most of the storm water flows into streams, water ways and reservoirs
Water & Wastewater Management	Pumping stations	Y	Y	One in Ol'Kalou town.
	Groundwater abstraction	Y	Y	The main sources of water for the municipality include boreholes, water pans and dams
	Water treatment facilities	Y	Y	Ol'Kalou Treatment Works serving Ol'Kalou town
	Water supply networks	Y	Y	Water supply in the municipality is managed by OLWASCO
	Sewer networks	Y	Y	Sewer networks within Ol'Kalou Town
	Wastewater treatment facilities	Y	Y	Ol'Kalou Waste Water Treatment at Ol'Kalou town

Category	Subcategory	Included in the RCRA (Y/N)	Available in GIS format (Y/N)	Description
Solid Waste Management	Transfer facilities	N	N	The Municipality is in the process of establishing the facilities
	Landfills and dump sites	Y	Y	A dumpsite in Ol'Kalou town which also serves the entire County
	Recycling centers	Y	N	Informal recycling centers
	Collection fleet	Y	N	One truck is shared between the municipality and three other sub-counties.
Transport and Mobility	Road networks	Y	Y	The municipality has approximate 84 Kms of Bitumen roads and 131.2 Kms of murram roads
	Bridges	Y	N	There are five bridges within the municipality namely Kanduma, Thaba, Nyairoko, Manyatta and Rumathi
	Public transport networks (rail, bus, mini-bus, etc.)	Y	Y	The existing Gilgil-Ol'Kalou Railway network is under rehabilitation. Matatus, Bus and Mini bus serving the Municipality and beyond. Bodaboda transport is growing rampantly
	Transportation terminals	Y	Y	Ol'Kalou Railway Station under rehabilitation One bus terminal in Ol'Kalou town serves the entire municipality.
	Vehicle depots	N	N	N/A
	Non-motorized transport networks	Y	Y	From County Headquarters to JM Referral Hospital
	Freight and logistics hubs	N	N	N/A
Energy	Energy power plants	N	N	N/A
	Poles and power lines	Y	Y	Managed by Kenya Power Lighting Company
	Transformers and substations	Y	Y	One Sub Station and transformers Scattered within the Municipality and managed by KPLC
	Streetlighting	Y	N	Floodlights within main urban centers of the municipality Streetlights are within Tumaini, Captain and Ol'Kalou towns.
Economic Infrastructure	Markets	Y	Y	Three Main markets are operational. Informal Roadside markets across the municipality being very susceptible to climate impacts

Category	Subcategory	Included in the RCRA (Y/N)	Available in GIS format (Y/N)	Description
	Businesses and commercial hubs	Y	Y	Ongoing Ol'Kalou Commercial hub next to the affordable housing
	Industrial zones/parks and logistics parks	Y	Y	Refer to the approved County Spatial Plan
Social Infrastructure	Government buildings and service centers	Y	Y	County Headquarters, National Government offices are within Ol'Kalou Town. Other Administrative offices within the satellite centers
	Education facilities	Y	Y	Nyandarua University College main campus (operationalization in progress) 49 Primary schools, 20 Secondary Schools 46 ECDEs 3 Vocational Technical Centers 1 TVETs
	Healthcare facilities	Y	Y	1 public and 1 private hospital, 2 health centers, 14 dispensaries and 12 private and faith based health facilities
	Public spaces	Y	Y	Ol'Kalou Arboretum, Presidential Planted Park, Road and Rail Reserves and Ol'Kalou Green Park
	Sporting Facilities	Y	Y	Ol'Kalou Stadium and Playing fields.
	Faith-based buildings	Y	Y	Numerous across the Municipality
	Cultural and heritage assets	Y	Y	3 Cemetries, Lake Olbollosat
Emergency Services	Fire stations	Y	N	One Fire Station at Ol'Kalou
	Police stations	Y	Y	3 Police Station and 8 police posts
	Telecommunications networks	Y	Y	Major Networks (Saf, Airtel and Telecom) Wireless networks (Fiber)
	Early warning systems	Y	N	Meteorological forecast
	Disaster management centers and shelters	Y	Y	Red Cross, County Directorate of Disaster Management
	Evacuation routes	N	N	Main facilities have fire exit and fire assembly points
Populations				
Urban Residents	Population	Y	Y	The municipality has an expansive population structure with a high youthful population
	Households	Y	N	Average household size of 3.4
	Population living in informal settlements	Y	N	Data not up to date

Category	Subcategory	Included in the RCRA (Y/N)	Available in GIS format (Y/N)	Description
Informal Settlement Residents	Households lacking land tenure	Y	N	Some of the urban areas facing insecurity of tenure include Silanga, Captain, Tumaini and the slaughter house area
	Households / residents lacking access to basic services	Y	Y	Majority of the settlements depict informal characteristics such as inadequate physical and social infrastructure
Vulnerable and Marginalized Groups	Low-income households	N	N	Data not available
	Women-headed households	N	N	Data not available
	Children and youth	Y	N	Data not up to date
	Elderly persons	Y	N	Data not up to date
	People with disabilities (PWD)	Y	N	Data not up to date
	Homeless populations	N	N	Data not available
	Unemployed or precariously employed workers	Y	Y	The analysis are provided in the municipal spatial plan
	Seasonal workers / migrant laborers	N	N	Data not available
	Nomadic groups in peri-urban areas	N	N	Data not available
	Urban refugees and migrants	N	N	Data not available
	Minority ethnic groups in urban areas	Y	N	Data not available
Natural Assets				
Urban Green Infrastructure	Urban parks and gardens	Y	Y	Ol'Kalou Arboretum, Presidential Planted Park and Ol'Kalou Green Park.
	Green corridors	Y	Y	Road and Rail Reserves
	Street landscaping	N	N	No landscaping
	Urban forests and forest reserves	Y	Y	Ol'Kalou Arboretum, Presidential Planted Park,
Urban Blue Infrastructure	Natural wetlands	Y	Y	Lake Ol Bolossat
	Rivers	Y	N	2 rivers and several seasonal streams
	Riparian zones	Y	Y	Lake Ol Bolossat 2 rivers and several seasonal streams
	Lakes, ponds and reservoirs	Y	Y	Lake Ol Bolossat Various Dams
	Coastal ecosystems	N	N	N/A
	Urban agriculture	Y	Y	Despite the zonation agriculture practiced in the urban centers
Peri-urban and Agricultural Systems	Peri-urban agriculture	Y	Y	Mixed agriculture practiced
	Agroforestry systems	Y	N	Extensively practiced in the municipality

Category	Subcategory	Included in the RCRA (Y/N)	Available in GIS format (Y/N)	Description
	Forests and forest reserves	Y	Y	Ol'Kalou Arboretum and Presidential Park Plantations
	Protected areas and national parks	N	N	N/A
	Savannahs and rangelands	N	N	N/A

3.2. Exposure, Vulnerability, and Impacts of Climate Hazards on Urban Elements

For this Urban Climate Risk Profile, the analysis in Table 21 to Table 24 on exposure, Vulnerability and Impacts of various climate hazards on urban elements should be interpreted in accordance with information in Table 19 and Table 20 below.

Table 19: Exposure–Vulnerability Impact Matrix Interpretation

Level	Exposure Level Interpretation	Vulnerability Level Interpretation
High	Few or no critical urban elements lie within the hazard footprint or area of impact.	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 the climate hazard due to moderate sensitivity and adaptive capacity.
Low	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 minimally vulnerable to the climate hazard due to limited sensitivity and/or a high degree of adaptive capacity.

Table 20: Impact Matrix

		Vulnerability Level		
		Low	**Medium**	**High**
Exposure Level	**High**	Moderate	Major	Catastrophic
	Medium	Minor	Moderate	Major
	Low	Insignificant	Minor	Moderate

Table 21: Exposure, Vulnerability, and Impacts of Flooding on Urban Elements in Ol'Kalou Municipality

Hazard: Floods

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Infrastructure & Services					
Stormwater Drainage	• Clogging • Siltation • Destruction of scour-checks and pitch stones	Medium	**Sensitivity:** • High during flooding especially in the informal settlements **Adaptive Capacity:** • Functional Directorate dealing with surveillance and Regular maintenance of drains	High	High
Water & Wastewater Management	• Infrastructure destroyed • Pollution; Wastewater mix with domestic water • Overflowing of wastewater in sewerage networks	High	**Sensitivity:** • High during floods **Adaptive Capacity:** • Regular Surveillance and maintenance of drains • Developed a common sewerage system as opposed to individual units • Encourage uptake of biodigesters instead of septic tanks	High	High
Solid Waste Management	• Inaccessible Disposal sites • Indiscriminate disposal of waste • Contamination of water resources including streams • Residents prone to Health risks	High	**Sensitivity:** • High • Residents in the neighborhood susceptible to impacts of poor waste management **Adaptive Capacity:** • Enhance Integrated solid waste management • Limited	High	High
Transport and Mobility	• Infrastructure destruction • Accessibility is cut off	Medium	**Sensitivity:** • High • Ripple effect	Medium	Medium

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
	• Mechanical break down and extended travel time • Post-harvest losses and disruption of livelihood • Loss of human life		**Adaptive Capacity:** • Limited • Enhance construction of climate proofed infrastructure		
Energy	• Little to no effect	Low	**Sensitivity:** • Low **Adaptive Capacity:** • High since residents are dependent on alternative energy sources	Low	Low
Economic Infrastructure	• Post harvest loss • Disruption of livelihood • High cost of recovery	Medium	**Sensitivity:** • High • Backbone of livelihoods and economy in the municipality **Adaptive Capacity:** • Medium d • Multiple and diversified sources of livelihood • Directorate of Social Services and emergency fund kitty	Medium	Medium
Social Infrastructure	• Subsidence of graveyards • Inaccessible and waterlogged facilities - playing fields	Medium	**Sensitivity:** • Medium • Social infrastructure not relied upon by majority of the urban residents **Adaptive Capacity:** • High • Alternatives available	Low	Low
Emergency Services	• Delayed response • Death and loss of livelihood	Low	**Sensitivity:** • Low • Not regularly required **Adaptive Capacity:** • High • Multisectoral Municipal Flood Response team	Low	Low
Populations					

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Urban Residents	• Inaccessibility and mobility challenges • Disruption of livelihoods	Low	**Sensitivity:** • Low • Infrastructure relatively resilient **Adaptive Capacity:** • High • Improved drainage systems, road networks, and waste management infrastructure	Low	Low
Informal Settlement Residents	• Loss and disruption of livelihoods • Pollution and contamination of Water sources • Temporal displacements	High	**Sensitivity:** • High • Livelihoods not diversified **Adaptive Capacity:** • Limited • Donor and partners (KISIP II) implementing various projects to improve resilience	High	High
Minority and Vulnerable Groups	• Mobility of PWDs, school going children, elderly •	High	**Sensitivity:** • High • Low independence **Adaptive Capacity:** • Medium • Emergency rescue and services	High	Medium
Natural Assets					
Urban Green Infrastructure	• Urban Green infrastructure is not heavily exposed; it acts as a shock absorber allowing excess water to percolate to the ground. • Also acts as a carbon sink	Low	**Sensitivity:** • Low • Acts as a buffer to the impacts of flooding **Adaptive Capacity:** • High • Acts as a buffer to the impacts of flooding	Low	Low
Urban Blue Infrastructure	• Siltation of Lake Ol Bolossat • Spread of *Salvinia molesta* an invasive species	Medium	**Sensitivity:** • High • Support biodiversity **Adaptive Capacity:** • Medium • Supporting recovery of the lake	Low	Medium

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Peri-urban and Agricultural Systems	• Post-harvest loss • Crop destruction	High	**Sensitivity:** • High • Agriculture is the major livelihood source **Adaptive Capacity:** • Medium • Diversified livelihoods	High	High

Table 22: Exposure, Vulnerability, and Impacts of Drought on Urban Elements in Ol'Kalou Municipality

Hazard: Drought

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Infrastructure & Services					
Storm water Drainage	• Drying and cracking of drainage channels • Accumulation of solid waste due to reduced runoff	Low	**Sensitivity** • Low • drainage systems underutilized during drought • Reduced flow causes silt build-up **Adaptive Capacity:** • High • Regular maintenance possible during dry seasons	Low	Low
Water & Wastewater Management	• Declining water levels in storage and supply systems • Reduced recharge of boreholes and springs • Water rationing and scarcity	High	**Sensitivity:** • High • overreliance on groundwater and rain-fed sources **Adaptive Capacity:** • Medium	High	High

			• OLWASCO water projects, rainwater harvesting initiatives		
Solid Waste Management	• Scattered dry waste. • Odor and fire risks increase	Medium	**Sensitivity:** • Medium • operational challenges in waste management. **Adaptive Capacity:** • Medium • scheduled collection, awareness campaigns.	Medium	Medium
Transport and Mobility	• Dust pollution and road degradation from dryness • Increased maintenance costs	Medium	Sensitivity: • Medium • unpaved roads affected by dust. **Adaptive Capacity:** • Medium • maintenance and paving programs.	Medium	Medium
Energy	• Reduced hydropower generation nationally • Reliance on biomass and alternative energy	Medium	**Sensitivity:** • Medium • dependent on national grid **Adaptive Capacity** • High • diversification to solar and biogas	Medium	Medium
Economic Infrastructure	• Decline in productivity and income in agro-based businesses • Increased cost of goods and services	High	**Sensitivity**: • High • agriculture-dependent economy **Adaptive Capacity:** • Medium	High	High

			• cooperatives and social safety nets		
Social Infrastructure	• Reduced functionality of social amenities due to dryness • Decline in aesthetics and comfort	Medium	**Sensitivity**: • Low • facilities remain usable **Adaptive Capacity:** • High • irrigation or rehabilitation possible	Low	Low
Emergency Services	• Increased demand for water trucking and firefighting • Resource strain on response teams	Medium	**Sensitivity**: • Medium • moderate increase in demand. **Adaptive Capacity:** • High • county emergency units operational	Medium	Medium
Populations					
Urban Residents	• Reduced water availability for domestic use • Increased cost of living and health risks	Medium	**Sensitivity**: • Medium • dependent on OLWASCO municipal water. **Adaptive Capacity:** • Medium • storage facilities and drilling of boreholes	Medium	Medium
Informal Settlement Residents	• Acute water scarcity • Poor sanitation and hygiene • Increased disease burden	High	**Sensitivity**: • High • limited storage and poor access **Adaptive Capacity:** • Low • donor and NGO reliance (KISIP II)	High	High

Vulnerable and Marginalized Groups	• Dehydration, mobility challenges for PWDs, elderly • Health risks	High	**Sensitivity**: ● High ● low adaptive ability **Adaptive Capacity:** ● Medium ● targeted social support .	High	High
Natural Assets					
Urban Green Infrastructure	• Vegetation loss and drying of urban parks • Reduced shading and ecosystem services	High	**Sensitivity**: ● High ● dependent on rainfall. **Adaptive Capacity:** ● Medium ● municipal reforestation	High	High
Urban Blue Infrastructure	• Reduction of Lake Ol Bolossat levels • Loss of aquatic biodiversity • Spread of invasive species	High	**Sensitivity**: ● High ● fragile ecosystem **Adaptive Capacity:** ● Medium ● lake restoration and catchment protection	High	High
Peri-urban and Agricultural Systems	• Crop failure, livestock loss, food insecurity • Decline in farm income	High	**Sensitivity**: ● High ● reliant on rainfall agriculture **Adaptive Capacity:** ● Medium ● irrigation, crop diversification	High	High

Table 23: Exposure, Vulnerability, and Impacts of Extreme Temperatures on Urban Elements in Ol'Kalou Municipality

Hazard: Extreme temperatures

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Infrastructure & Services					
Stormwater Drainage	• Material damage • Structural stress due to pressure fluctuation. • Thermal pollution	Low	**Sensitivity:** • Medium • Infrastructure relatively resilient **Adaptive Capacity:** • High • Improved drainage systems, road networks, and waste management infrastructure	Medium	Low
Water & Wastewater Management	• Reduced or increased microbial activities • Effect on settling • Increased pathogenic risks • Corrosion and blockages • Increased pathogenic risks • Air pollution	Medium	**Sensitivity:** • Medium • Sewer treatment facility in Ol'Kalou **Adaptive Capacity** • High • Regular maintenance of the sewer system by OLWASCO.	Medium	Medium
Solid Waste Management	• Increased fire hazard • Increased decomposition resulting to increased GHGs • Worsened air quality • Operational challenges	High	**Sensitivity:** • High • Residents in the neighborhood susceptible to poor waste management **Adaptive Capacity:** • Medium • Enhanced integrated solid waste management	High	Medium
Transport and Mobility	• Infrastructural damage • Operational disruption • Health hazard to travellers	Low	**Sensitivity:** • Low • Limited effect on transport and mobility **Adaptive Capacity:** • High • Adaptive to diversified mode of transport	Medium	medium

Energy	• Deforestation • Low temperatures affect solar powered systems.	High	**Sensitivity:** • High • With slight change in temperature the residents are dependent on alternative sources of energy **Adaptive Capacity:** • medium • Diversified energy sources	Medium	Medium
Economic Infrastructure	• Damage of infrastructure • Operational slowdown • Economic losses	Low	**Sensitivity:** • low • Limited effect of economic temperature to changing extreme temperatures **Adaptive Capacity:** • High • Infrastructure relatively resilient	medium	medium
Social Infrastructure	• Damage of infrastructure • Increased energy demand for cool and heating	Medium	**Sensitivity:** • Medium • Social infrastructure not relied upon by majority of the urban residents **Adaptive Capacity:** • High • Alternative available	Medium	Medium
Emergency Services	• Unexpected incidences •	Low	**Sensitivity:** • Medium • Emergency services due to extreme temperatures are not frequent. **Adaptive Capacity:** • Surveillance and early warning • Deployment of emergency resources • Multi stakeholder coordination	Low	Low
Populations					
Urban Residents	• Health hazards • Increased mortality risks • Impacts on infrastructure • Mental health	High	**Sensitivity:** • High • Infrastructure cushions residents from changes	Medium	Low

			Adaptive Capacity: ● High ● Climate resilient Infrastructure		
Informal Settlement Residents	● Increased heat and cold stress ● Worsened air quality ● Health problems ● Increased risks from electrical faults ● Fire hazards ● Mental health	High	**Sensitivity:** ● High ● Poor housing condition **Adaptive Capacity:** ● Limited ● Poor resource households and livelihoods not reliable	High	High
Vulnerable and Marginalized Groups	● Increased illness and mortality ● Disproportionate impact ● Mental health ● Reduced productivity ● Maladaptation	High	**Sensitivity:** ● High ● Affected by extreme cold and high temperatures affecting their mobility **Adaptive Capacity:** ● Limited ● Mobility and resilience affected due to their independence	High	High
Natural Assets					
Urban Green Infrastructure	● Reduced cooling effect ● Damage to vegetation through leaf falls and reduced growth ● Increased stress	Medium	**Sensitivity:** ● Low ● Little to no effect on urban infrastructure **Adaptive Capacity:** ● Medium ● Few green spaces in the Municipality	Low	Low
Urban Blue Infrastructure	● Drying up of lake Ol Bolossat ● Water scarcity ● Drying up of water sources		**Sensitivity:** ● Medium ● Drying of Lake Ol Bolossat affecting biodiversity dependent on lake including some endangered species **Adaptive Capacity:** ● Catchment rehabilitation ● Resources allocation for climate action ● Engagement of multiple stakeholders	High	High

Peri-urban and Agricultural Systems	• Reduced crop production • Increased stress for both crops and farmworkers	Medium	**Sensitivity:** • High • Crop productivity affected by extreme cold and or high temperatures **Adaptive Capacity:** • High • Crop and livelihood diversification	Medium	Medium

Table 24:Exposure, Vulnerability, and Impacts of Hailstorms on Urban Elements in Ol'Kalou Municipality

Hazard: Hailstones

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Infrastructure & Services					
Stormwater Drainage	• Increased run off • Blockage of drains • Flooding	Moderate	**Sensitivity:** • High • Limited capacity for drains which have not been designed for massive hail stones **Adaptive Capacity:** • Low • Current capacity is insufficient for intense or repeated hailstorm	Moderate	Moderate
Water & Wast e water Management	• Damage to open sewer inlets,pipelines and manholes • Freezing/hail accumulation that can affect flows	Moderate	**Sensitivity:** • High • If system has no capacity for extra load it could be disrupted • Hail blocking inlets **Adaptive Capacity:** • Moderate • Adaptation may be low as hail events occur less frequently and not as well anticipated	Moderate	Moderate

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Solid Waste Management	• Increased surface run off which carry solid waste along open routes are blocked or slowed down during heavy hails • Open dumpsite/collection points are physically displaced by hailstones	Moderate	**Sensitivity:** • High • Hailwater mixes with solid waste which increases leachate generation that can contaminate water resources **Adaptive Capacity:** • Medium • Existence of an Integrated Solid Waste Management Policy • Inadequate equipments (limited number of trucks)	Moderate	High
Transport and Mobility	• Slippery conditions of surfaces hindering mobility	Low	**Sensitivity:** • Low • Unpaved roads can become muddy thus impassible **Adaptive Capacity:** • High • Limited hail-early warning systems existence to road users	Low	Low
Energy	• Low effect	Low	**Sensitivity:** • Low **Adaptive Capacity** • High as there exists alternative sources of energy	Low	Low
Economic Infrastructure	• Main roads and open spaces exposed to hail damage and disruptions • Damage of open markets	Low	**Sensitivity:** • Low • Incidences of hail impacts not evident **Adaptive Capacity:** • High • Not a regular occurence	Low	Low
Social Infrastructure	• Damage of exposed roofs • Hail accumulation result to impassible paths and roads to students,patients and service users	Medium	**Sensitivity:** • Medium • Occasional occurrences that can affect county offices,churches and community centres	Low	Low

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
			Adaptive Capacity: ● High ● Low frequency		
Emergency Services	● Low exposure effect	Low	**Sensitivity:** ● Low ● No incidence **Adaptive Capacity:** ● High ● Rare occurence	Low	Low
Populations					
Urban Residents	● Damage of structures(buildings,shops) ● Power outage	Low	**Sensitivity:** ● Low ● Infrastructure resilience **Adaptive Capacity:** ● High ● Infrastructure resilience	Low	Low
Informal Settlement Residents	● Destruction of infrastructure	High	**Sensitivity:** ● High ● Poor roofing angles cause hail and heavy rains to accumulate increasing structural stress **Adaptive Capacity:** ● Low ● KISIP (Donor funded project) and other partners have implemented projects to improve resilience	High	High
Minority and Vulnerable Groups	● Mobility of school going children,PWDs and the Elderly	High	**Sensitivity:** ● High ● Inability to protect assets **Adaptive Capacity:** ● Low ● Less likely to receive weather alerts	High	Medium
Natural Assets					

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Urban Green Infrastructure	• Damage of tree canopies,breakage of foliage	Low	**Sensitivity:** • Moderate • Freezing of vegetation **Adaptive Capacity:** • High • Green infrastructure provide ecosystem services (shade,cooling,water retention)	Low	Low
Urban Blue Infrastructure	• Damage of storm water drains,channels and culverts	Moderate	**Sensitivity:** • High • Hail accumulation can temporarily cause blockage,dislodging covers and drainage inlets **Adaptive Capacity:** • High • Routine maintenance	Low	Moderate
Peri-urban and Agricultural Systems	• Damage of crops,soil and agricultural infrastructure	High	**Sensitivity:** • High • Reduction of foliage quality **Adaptive Capacity:** • Low • When damage occurs replanting and re-establishing may be constrained by seasons,cost and labor	High	High

CHAPTER FOUR

4. Climate Risk Assessment

The Ol'Kalou Municipality Climate Risk Assessment examines the current and projected climate-related hazards affecting the area, including floods, droughts, hailstorms, and extreme cold. This assessment aims to identify the municipality's key vulnerabilities and the potential impacts of these hazards on livelihoods, infrastructure, and essential services. The findings provide a foundation for informed decision-making, guiding the development of effective adaptation and resilience strategies to safeguard the community and support sustainable urban growth.

For this Urban Climate Risk Profile, the assessment Tables 27 to Table 30 summarizes overall risk for each urban element by combining the assessed hazard level and the estimated impact level. This analysis should be interpreted with information in Table 25 and Table 26 below.

Table 25: Climate 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 26: Interpretation of Climate 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.

4.1. Current and Future Climate Risks on Urban Elements

Table 27: Summary of Flood Risk Levels for Urban Elements in Ol'Kalou Municipality

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

Table 28: Summary of Drought Risk Levels for Urban Elements in Ol'Kalou Municipality

	Time Horizon & Climate Scenario	Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
	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						
Stormwater Drainage	Low	Low	Low	Medium	Medium	High
Water & Wastewater Management	High	High	High	Very High	Very High	Very High
Solid Waste Management	Medium	Medium	High	High	High	Very High
Transport and Mobility	Medium	Medium	High	High	High	Very High
Energy	Medium	Medium	High	High	High	Very High
Economic Infrastructure	High	High	Very High	Very High	Very High	Very High
Social Infrastructure	Low	Low	Low	Medium	Medium	High
Emergency Services	Medium	Medium	High	High	High	Very High
Populations						
Urban Residents	Medium	Medium	Medium	Medium	Medium	Medium
Informal Settlement Residents	High	Very High	Very High	Very High	Very High	Very High
Vulnerable and Marginalized Groups	High	High	Very High	Very High	Very High	Very High
Natural Assets						
Urban Green Infrastructure	High	High	Very High	Very High	Very High	Very High
Urban Blue Infrastructure	High	High	Very High	Very High	Very High	Very High
Peri-urban and Agricultural Systems	High	High	Very High	Very High	Very High	Very High

Table 29: Summary of Extreme Temperature Risk Levels for Urban Elements in Ol'Kalou Municipality

	Time Horizon & Climate Scenario	Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
	Hazard Level					
Categories	**Impact**	**Risk Levels**				
		Current	**2050 SSP2-4.5**	**2050 SSP5-8.5**	**2100 SSP2-4.5**	**2100 SSP5-8.5**
Infrastructure & Services						
Stormwater Drainage	Low	Low	Medium	Medium	High	High
Water & Wastewater Management	Medium	Medium	Medium	High	High	Very High
Solid Waste Management	Medium	Medium	Medium	High	High	Very High
Transport and Mobility	Medium	Medium	Medium	High	High	Very High
Energy	Medium	Medium	Medium	High	High	Very High

Economic Infrastructure	Medium	Medium	Medium	High	High	Very High
Social Infrastructure	Medium	Medium	Medium	High	High	Very High
Emergency Services	Low	Low	Low	Medium	High	High
Populations						
Urban Residents	Low	Medium	Medium	High	High	Very High
Informal Settlement Residents	High	High	High	High	Very High	Very High
Vulnerable and Marginalized Groups	High	High	High	High	Very High	Very High
Natural Assets						
Urban Green Infrastructure	Low	Low	Low	Medium	High	High
Urban Blue Infrastructure	High	High	High	Very High	Very High	Catastr ophic
Peri-urban and Agricultural Systems	Medium	Medium	Medium	High	High	Very High

Table 30: Summary of Hailstorm Risk Levels for Urban Elements in Ol'Kalou Municipality

	Time Horizon & Climate Scenario	Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
	Hazard Level					
Categories	**Impact**	**Risk Levels**				
		Current	**2050 SSP2-4.5**	**2050 SSP5-8.5**	**2100 SSP2-4.5**	**2100 SSP5-8.5**
Infrastructure & Services						
Stormwater Drainage	Medium	Medium	High	High	High	Very High
Water & Wastewater Management	Medium	High	High	High	Very High	Very High
Solid Waste Management	High	High	Very High	Very High	Very High	Very High
Transport and Mobility	Low	Medium	Medium	High	High	High
Energy	Low	Medium	Medium	High	High	High
Economic Infrastructure	Low	Medium	Medium	High	High	High
Social Infrastructure	Low	Medium	Medium	High	High	High
Emergency Services	Low	Medium	High	High	High	High
Populations						
Urban Residents	Low	Medium	Medium	High	High	High
Informal Settlement Residents	High	High	Very High	Very High	Very High	Very High
Vulnerable and Marginalized Groups	Medium	High	High	High	Very High	Very High

Natural Assets						
Urban Green Infrastructure	Low	Medium	Medium	High	High	High
Urban Blue Infrastructure	Medium	High	High	High	Very High	Very Hig h
Peri-urban and Agricultural Systems	High	High	Very High	Very High	Very High	Very High

4.2. Climate Risk Hotspots

Ol'Kalou municipality's climate risk hotspots are driven by the interaction of rising hazard intensity (especially drought and floods), population exposure in informal settlements, and dependence on rainfed agriculture. Immediate focus should be on restoring water supply resilience and protecting vulnerable settlements, while medium-term investments should prioritize catchment restoration, drainage upgrades, and agricultural adaptation ,all informed by a geospatial hotspot mapping program and participatory planning with affected communities.

This section identifies climate risk hotspots across Ol'Kalou mun's wards (Karau, Kaimbaga, Rurii, Kanjuiri/Tumaini and Wanjohi/Ndemi) by combining the assessed hazard levels (floods, drought, extreme temperatures, hailstones,) with exposure and impact estimates. Hotspots are locations where high hazard frequency/intensity intersects high exposure (people, infrastructure, natural assets) and high vulnerability (limited adaptive capacity). The analysis draws on the risk summary tables (floods, drought, extreme temperatures and hailstones) to identify priority locations for adaptation interventions and monitoring.

Hotspots identification.

1. **Hazard first:** For each ward we identified hazards score-Low, Medium High / Very High / Catastrophic across the scenarios (current → 2050 → 2100).
2. **Exposure & impact overlay:** We then overlayed where populations (especially informal settlements), critical infrastructure (water supply, wastewater, transport), and natural assets (Ol Bolossat catchment, peri-urban farms) are concentrated.
3. **Vulnerability:** Priority given to locations with limited adaptive capacity (informal settlements, vulnerable groups, heavily rain-dependent agriculture).
4. **Scenario trend:** Locations where risk compounds under future scenarios (SSP2-4.5 and SSP5-8.5) move higher in priority.

The outcome is a ward-level hotspots narrative and a short priority ranking.

Climate risks across Ol'Kalou Municipality are distributed unevenly among the five wards-Karau, Kaimbaga, Rurii, Kanjuiri (Tumaini), and Wanjohi (Ndemi), owing to variations in elevation, topography, land use, and proximity to natural features such as Lake Ol' Bolossat.

All wards experience the key hazards of floods, drought, and extreme temperatures, though the intensity and nature of exposure differ. Hailstones affect most wards except Kanjuiri, which lies in a relatively warmer and more sheltered zone.

- **Karau Ward**, the urban and administrative hub of Ol'Kalou, experiences urban flooding during heavy rains due to reduced infiltration and blocked drains. Increasing temperatures and dry spells intensify water stress for domestic and commercial users. Its built-up nature makes it less exposed to hail, but heat stress and water scarcity are growing challenges under future climate scenarios.
- **Kaimbaga Ward** faces combined flood and drought pressures, particularly in its agricultural zones. Runoff from sloped terrain causes soil erosion and localized flooding, while recurrent dry periods reduce soil moisture and crop yields. Rising extreme temperatures further threaten agricultural productivity and ecosystem stability.
- **Rurii Ward**, located adjacent to Lake Ol' Bolossat, is the most flood-prone area in the municipality. Its low-lying terrain and poor drainage expose settlements and farmlands to recurrent floods, especially under SSP5-8.5 scenarios. Rurii also faces high drought risk during dry seasons when lake levels fall, affecting both water supply and livelihoods dependent on irrigation and fishing.
- **Kanjuiri (Tumaini) Ward** experiences drought and temperature extremes as the dominant hazards. Its semi-rural setting and limited irrigation infrastructure heighten vulnerability to water shortages and agricultural losses. However, hailstone occurrence is minimal here compared to other wards, likely due to its elevation and localized microclimatic conditions.
- **Wanjohi (Ndemi) Ward**, positioned in a higher altitude and cooler zone, is known as the coldest part of Ol'Kalou Municipality. It faces limited flood risk but high exposure to hailstones and frost, which damage crops and affect rural livelihoods. Though cooler conditions moderate drought impacts, prolonged cold seasons can hinder crop maturation and reduce productivity

In summary, Rurii and Kaimbaga are the primary multi-hazard hotspots, combining high flood, drought, and temperature risks. Karau is increasingly affected by urban flooding and heat stress, while Wanjohi is distinguished by cold-related hazards such as hail and frost. Kanjuiri, though less hail-prone, remains sensitive to drought and heat extremes. These spatial differences highlight the need for ward-specific adaptation strategies, including improved stormwater management, climate-smart agriculture, and resilience planning tailored to each ward's hazard profile.

CHAPTER FIVE

5. What's Next?

In this chapter is a summary of key findings, and recommended climate adaptation and resilience solutions for Ol'Kalou Municipality

5.1. Key Findings

During Stakeholder engagement and data collection as outlined in the Ol'Kalou Municipality RCRA, the following key hazards came out strongly;

- Floods
- Drought
- Extreme temperatures
- Hailstorms

These hazards occur frequently affecting different sections of the municipality differently. Floods affect the informal sectors, exposing them to health risks as well as disrupting their livelihoods. The larger part of the Municipality practices Agriculture which is negatively affected by both floods and drought. Crop destruction leading to crop failure as a result of flooding is a serious phenomena affecting the Municipality. Drought also exacerbates crop failure due to water shortage. Death of livestock has also been witnessed leading to the disruption of people's economic activities and livelihoods.

Critical assets like road networks are adversely affected by floods affecting the vulnerable groups within the municipality especially PLWD, School going children, resource poor households and the elderly

According to KMD, it is projected that the frequency of both flooding and droughts will increase, affecting critical infrastructure assets. In realization of the above this RCRA aims at addressing key climate interventions to mitigate the impacts associated with the two hazards.

Table 31: Summary of Climate Risks Affecting Urban Elements in Ol'Kalou Municipality

Category	List of Key Hazards		
	Current	**Mid-term (2050)**	**Long-term (2100)**
Infrastructure & Services			
Stormwater Drainage	High	Medium	Medium
Water & Wastewater Management	High	High	Medium
Solid Waste Management	High	Medium	Medium
Transport and Mobility	Medium	Low	Low
Energy	Low	Low	Low
Economic Infrastructure	High	Medium	Medium
Social Infrastructure	Medium	Low	Low
Emergency Services	Low	Low	Low
Populations			
Urban Residents	Low	Low	Low
Informal Settlement Residents	High	Medium	Medium
Vulnerable and Marginalized Groups	High	Medium	Low
Natural Assets			

Category	List of Key Hazards		
	Current	**Mid-term (2050)**	**Long-term (2100)**
Urban Green Infrastructure	Medium	Low	Low
Urban Blue Infrastructure	Low	Low	Low
Peri-urban and Agricultural Systems	Medium	Low	Low

5.2. Climate Adaptation and Resilience Solutions

Table 32: Recommended Climate Adaptation and Resilience Solutions for Ol'Kalou Municipality

Category	Recommendations		
	Immediate	**Mid-term**	**Long-term**
Infrastructure & Services			
Stormwater Drainage	Unclogging of blocked drains and continuous surveillance	Climate proofing the drains by allowing excessive water to percolate to the ground enhancing underground recharge	Construction of dams and reservoirs to store excess storm water for future use.
Water & Wastewater Management	Enhance surveillance and maintenance of water and waste water infrastructure Continuous capacity development of community members on Community water projects governance and management	Enhanced integration of real time tracking and monitoring systems. Maximizing sewerage connectivity within Ol'Kalou town	Development of a comprehensive Water and Waste Water Master Plan Development of sewer systems across other market centers within the municipality
Solid Waste Management	Purchase of Skip loader Development of relevant policies	Develop the dumping site and ensure compliance with NEMA in waste management and transportation	Develop a sustainable Landfill Enhance capacity of the residents to improve on waste handling at the source
Transport and Mobility	Improving Drainage Channels Developing climate proofed non-motorized walkways	Climate Proofing the transport infrastructure to enhance resilience and sustainability Greening and creating urban spaces to regulate urban heat island	Climate Proofing the transport infrastructure to enhance resilience and sustainability Greening and creating urban spaces to regulate urban heat island Enhancing the Sponge City Concept to allow
Energy	Advocating for alternative sources of energy	Developing alternative energy for the Municipality especially utilization of the available solar energy	Integrating Renewable energy into municipality development and developing a solar mini grid for the municipality
Economic Infrastructure	Capacity building Municipality residents to understand the power of diversifying economic ventures	Use of climate proofed materials for developing the infrastructures like markets.	Integration of economic infrastructure in the climate screening and planning
Emergency Services	Institutionalizing Emergency services within the Municipality systems, plans, projects and programs	Developing hotline numbers to enhance emergency response	Develop an emergency response strategy and emergency department within the municipality
Populations			

Category	Recommendations		
	Immediate	**Mid-term**	**Long-term**
Informal Settlement Residents	Enhancing climate proofed projects like road network and drainage channels amongst others	Continuous engagement of the informal sectors in key decision making and implementation	Working to formally formalize the informal sectors noting key climate hotspots within the settlement
Vulnerable and Minority Groups	Providing a conducive climate resilient opportunity for the engagement and participation of VMGs	Providing Climate proofed opportunities allowing the integration of VMGs within the municipality	Develop and implement a framework on VMGs
Natural Assets			
Urban Green Infrastructure	Enhancing Nature Based Solutions within the urban infrastructure	Enhancing the Sponge city approach to allow water percolation while enhancing aesthetic beauty. Enhancing and implementing the green building codes to allow sustainability	Increasing Green urban spaces Enhancing and implementing the green building codes to allow sustainability
Urban Blue Infrastructure	Developing water storage systems to enhance urban agriculture	Developing water storage systems to enhance urban agriculture	Developing water storage systems to enhance urban agriculture
Peri-urban and Agricultural Systems	Integration of Climate Smart Agriculture within the peri urban areas.	Developing water storage systems to enhance urban agriculture	Zonation of key areas within the municipality

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Annex N1: Historical Climate Hazard Events

Purpose:

This annex documents significant climate-related hazard events that have affected Ol'Kalou Municipality over the past decade. The information supports the hazard assessment in Chapter Two and validates stakeholder-reported risks.

Table N1.1: Historical Climate Hazard Events in Ol'Kalou Municipality (2015–2025)

Hazard Type	Date / Period	Location	Intensity & Description	Key Impacts
Flooding	Apr–May 2018	Rurii Ward (Lake Ol' Bolossat catchment)	Prolonged heavy rainfall causing riverine and surface flooding	Displacement of households, damage to roads and drainage, crop losses, wetland degradation
Drought	2016–2017	Municipality-wide	Extended rainfall deficit and high evapotranspiration	Water shortages, crop failure, livestock losses, reduced lake levels
Flooding	Mar–Apr 2020	Karau & Kaimbaga Wards	Short-duration intense rainfall events	Sewer overflows, road washouts, disruption of transport and markets
Cold Spells / Frost	Jul–Aug 2021	Wanjohi (Ndemi) Ward	Persistent low temperatures and frost	Crop damage, reduced agricultural productivity

Flooding & Hailstorms	Mar–Apr 2024	Rurii & Wanjohi Wards	Heavy rainfall accompanied by hail	Damage to roofs, crops, drainage blockage